

## Reading 14

### World Population

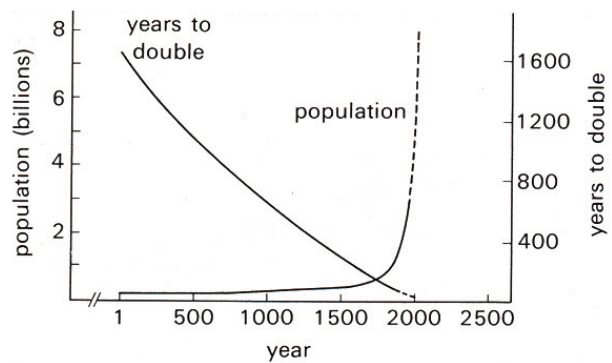
More than one million identified species of animals and plants inhabit the earth. Of these only *Homo sapiens* can willfully control and modify the environment. Because of this ability, we now dominate the earth to an extent that has not been achieved by any other species. This domination is relatively recent in human history. It has given rise to a new dimension in population growth with which we are now only beginning to cope.

The evolutionary process has endowed all species of plants and animals with a reproductive potential that, if unchecked, would overpopulate the earth within a few generations. This reproductive potential has been and still is controlled by diseases, limitation of food supply, and competition among species in the struggle for existence. No species has yet been able to free itself from the biological regulation of growth in large numbers over any significant time period. We cannot yet claim to be an exception to this rule. Our failure to achieve an optimal balance between food supply and rate of population growth reflects limitations of social organization rather than technical feasibility.

#### THE POPULATION EXPLOSION

The length of time that people have inhabited the earth is now estimated to be between 1 and 2 million years, although some estimates indicate an even earlier origin. The total human population probably had not reached 1/4 billion until approximately 2000 years ago (Fig. 1). World population did not reach 1/2 billion until the middle of the 17th century. Only 2 more centuries were required to again double the world population to slightly more than 1 billion. The time required to add an additional 1/2 billion has successively shortened. At the rate of growth now being achieved, during the 4th quarter of the 20th century less than 10 years is required to add 1/2 billion people to the world's population.

The "population explosion" of the last several decades has given rise to 2 sharply opposed viewpoints regarding its implication for human welfare. On the one hand there is a small group of alarmists, often termed "neo-Malthusians" after Thomas Robert Malthus, the famous clergyman-economist who, around 1800, first drew attention to the economic implications of rapid population growth. The neo-Malthusians have coined such phrases as "population bomb" to express their concern about the implication of a continued growth of population at the present



year	population (billions)	number of years to double
1	0.25 (?)	1,650 (?)
1650	0.50	200
1850	1.1	80
1930	2.0	45
1975	4.0	35
2010	8.0	?

**Fig. 1.** Estimated population of the world and the number of years required for it to double. [After H.F. Dorn, World Population Growth, in P.M. Hauser, The Population Dilemma, © 1963 by the American Assembly, Columbia University. Reprinted with permission of Prentice-Hall, Inc., Englewood Cliffs, N.J.]

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rate. They would pose population policy as the major issue facing humankind in the next several decades.

At the other extreme are the “technocrats,” who have faith that the possible application of science and technology to the production of crops and other raw materials will make possible a rising level of living for most of humanity for the indefinite future. Under these conditions they would expect a slowly declining birth rate to solve the population problem.

A careful sifting of the evidence seems to reveal that advancing science and technology could permit an adequate life for the world’s present population, as well as for a growing population over the next several decades. This does not imply, however, that matters of population policy are not of immediate significance. Indeed, to cast the problem in terms of whether science and technology can meet the requirements for food, fiber, and other forms of energy implied by current or anticipated population growth is highly misleading.

Current population growth rates in countries with high “medieval” birth rates and low “modern” death rates are close to 3% per year. Under these circumstances a high rate of investment in agricultural development and in educational and health facilities and services is required simply to prevent declines in individual levels of consumption and welfare. The resource demands of rapid population growth can probably be met, but only at the expense of qualitative improvements in the health, nutrition, education, and other dimensions of human welfare.

It would appear that the warnings and the concerns of both the neo-Malthusians and the technocrats are relevant to current population policy. Science and technology must be applied to the fullest extent possible if improved standards of living are to be achieved for the people who are now alive. At the same time, the rising population growth rates of the last several decades must be reversed if economic development is to be a continuing process for most regions of the earth.

The analysis needed to support this conclusion will be discussed in greater detail in the rest of this chapter. Attention will first be given to the principles of demographic changes and then to the problem of expanding crop production.

### POPULATION DYNAMICS

Inferences drawn from world population growth rates are likely to be quite unrealistic for any particular country or region in the immediate future. The world is not a single economic unit. The earth’s resources and human technological knowledge are not reservoirs available to all. Population growth rates vary widely among countries and regions. In general, technological knowledge is expanding the availability of resources most rapidly in exactly those regions or countries in which population growth rates are lowest.

In Europe, and in the USSR, North America, and Oceania, population growth rates are typically low—1% per year or less, and declining. In most countries of Africa, Asia, Central America, and South America—South Africa and Japan being exceptions—population growth rates range from 2% to slightly more than 3% per year. Most of the countries with relatively low population growth rates have experienced a transition from high to low population growth rates within relatively recent history. This transition to relatively low population growth rates, based on both low birth rates and low death rates rather than high birth rates and high death rates, is referred to as the **demographic transformation** (Box 1).

Will the rapidly growing population of Asia, Africa, and Latin America go through the same demographic transition that has occurred in Western Europe, North America, and Oceania? A purely biological theory of population would imply a negative answer to this question.

### Malthusian Population Growth

In a population system in which growth rates are determined only by biological or “natural” factors, population growth would be determined by (1) the biological capacity of women to produce children (fecundity); (2) female survival rates through reproductive ages under optimum conditions; and (3) the natural ecological conditions that affect food availability and health and reduce the actual number of children born (fertility) to below the biological maximum and reduce the average length of life (mortality) to below the natural optimum.

The best-known biological or natural theory of population growth was that attributed to Thomas Robert Malthus (1766–1834), an English clergyman-economist. Malthus concluded from the historical and scientific evidence of his time that food production had a tendency to increase at an arithmetic rate (1, 2, 3, 4,...) while human population increased at a geometric rate (1, 2, 4, 8,...) over time. He concluded that since human population growth is ultimately limited by the amount of food the world can produce, the rate of human population growth would of necessity be brought into balance with the rate of growth of food production only by the natural checks of famine and pestilence.

The Malthusian theory of population growth was not, however, a completely biological theory. Malthus noted that population growth could also be limited by such factors as delayed marriage (restraint) or prostitution (vice). He did not regard these factors as having much practical signifi-

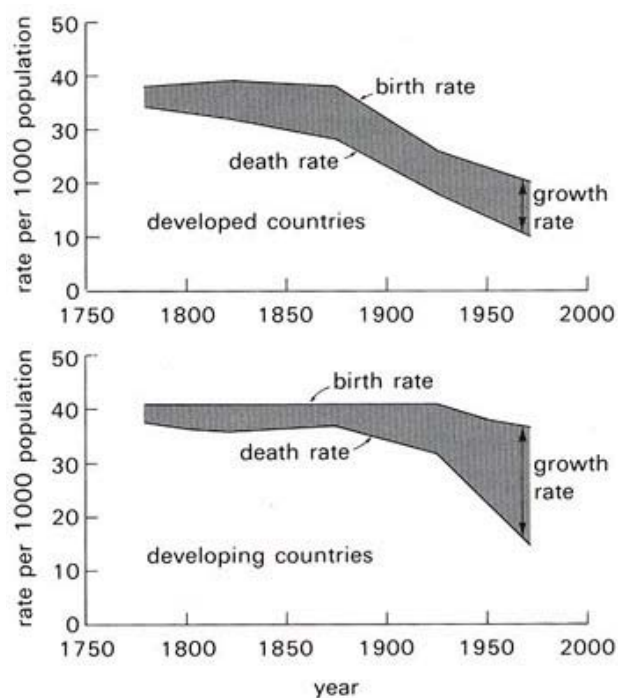
#### Box 1. Birth and Death Rates, 1770–1980

In the industrialized nations in the last century, the declining death rate was accompanied by a decline in the birth rate. From a rate of about 40 per 1000 in 1875, the birth rate in developed countries went down to about 20 per 1000 by 1970. Demographers refer to this gradual shift in both birth and death rates as the "demographic transition."

The difference between the birth rate and the death rate is a measure of how fast the population is increasing. For developed countries, this difference is about 10 per 1000 population, or about 1%. This means that, despite going through the demographic transition, developed countries continue to grow in population.

In a large number of developing countries the birth rate continues to be close to 40 per 1000, while the death rate has fallen to about 15 per 1000. This results in an increase in population of 25 per 1000 each year, or a 2.5% population growth rate.

A number of developing countries have experienced significant declines in birth rates in the 1960s and 1970s. In Cuba and Taiwan, for example, the birth rate is now approaching 20 per 1000.



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cance, nor did he visualize the potential impact of technological change, resulting from advances in the natural sciences, on our capacity to increase the production of food and fiber. Malthus visualized a pattern of population growth and decline like that shown in Fig. 2. A similar pattern was suggested in a recent study by Meadows and associates in *The Limits to Growth*.

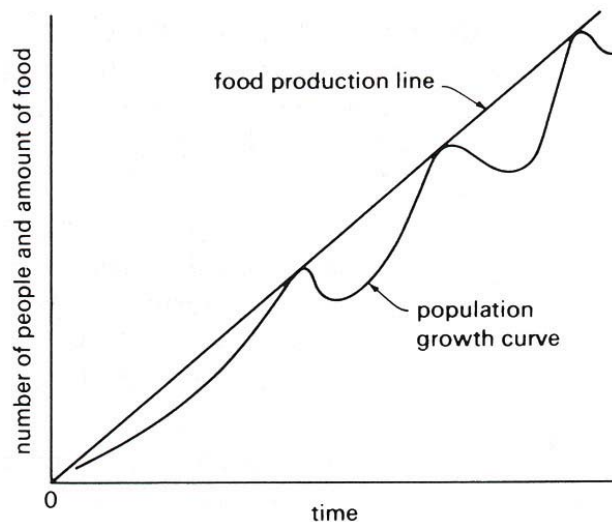
There have also been other biological or natural theories of population growth. Some have emphasized the negative effects of population density or complexity of life on the capacity to reproduce. One that gained widespread attention in the 1950s was put forth by the Brazilian biologist Josué de Castro. He suggested in *The Geography of Hunger*\* that improved diets, particularly those that are high in protein, may impair the ability to reproduce. Other biologists have suggested that undernutrition of nursing mothers delays the period of potential conception. Recent field studies in Bangladesh and Guatemala provide fairly convincing proof, however, that fecundity is not significantly affected by undernutrition.

### Sociological Explanation of Population Growth

The demographic transformation in Western Europe, which began in about 1875 when birth rates were in the middle and high 30s (per 1000 population per year), continued until the late 1930s when birth rates had declined to between 15 and 20; this decline in birth rates is generally taken as a refutation of Malthus's hypothesis. Today it is generally accepted that the rate of population growth, even in the high-growth-rate countries, is more a reflection of social and cultural customs and institutions than of natural or biological factors. Population growth is thought of as a social rather than a natural phenomenon. Explanations for differences in rates of human population growth are sought in terms of sociological or institutional influences, such as religion and law; technological influences, such as medical services and public health; economic factors, such as income and the rising economic value of women's time; and cultural factors, such as attitudes toward the role of women in society.

These factors affect the rate of population growth through their separate effects on the birth rate and on the death rate (see Box 1). During the Western demographic revolution the factors that tended to decrease death rates were more influential than the factors that tended to decrease birth rates. Better control of disease by means of improved housing, better food and water supplies, adoption of sanitary measures, advances in preventive medicine, and, more recently, development of insecticides and antibiotics have all contributed to reducing the death rate. Furthermore, rapid adoption of these advances for the purpose of reducing infant mortality or prolonging average life span has not provoked any serious moral or social conflicts.

The adoption of practices intended to reduce birth rates required much more complex



**Fig. 2.** Diagram of Malthus's theory of population growth. [After M.M. Snodgrass and L.T. Wallace, *Agriculture, Economics, and Growth*, Fig. 5-3, Meredith Publishing Company, copyright © 1964. Reprinted with permission of Appleton-Century-Crofts.]

\*Josué de Castro, *The Geography of Hunger* (Boston: Little, Brown, 1952).

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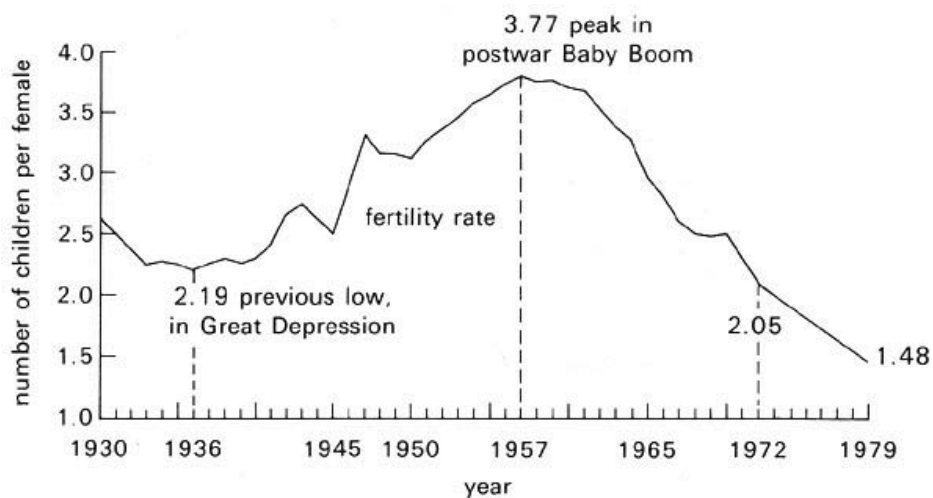
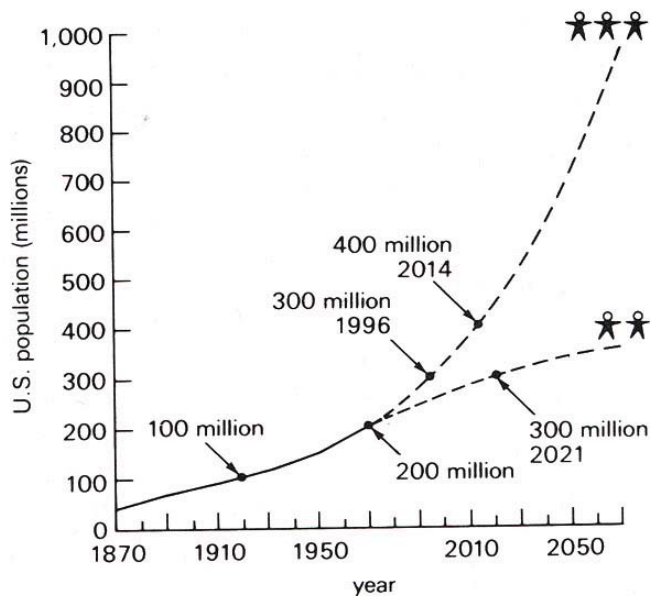
changes in personal and social motivation. Religious beliefs and social values that had developed under conditions of high mortality—for example, perpetuation of large families—were often in conflict with new values resulting from conditions in which improvement in welfare and opportunities could be gained by maintaining small families. Only after the new values were widely accepted did the control of family size through some combination of delayed marriage and contraceptive practice become extensive enough to reduce birth rates.

The lag in the decline in birth rates behind the decline in death rates has resulted in exceptionally rapid population growth during the middle years of the demographic transformation in most countries. Even the seemingly modest change from a three-child family to a two-child family can have a tremendous impact when the change occurs over several generations. In the United States an average of 3 children per family would, for example, result in a population of about 320 million in the year 2000 and almost 1 billion by 2070 (Fig. 3). An average of 2 children per family would, in contrast, result in a national population of about 270 million in 2000 and a leveling off of the population at approximately 350 million by 2070. The pattern of fluctuations in fertility rates in the United States throughout the past several decades indicates that considerable caution should be exercised in attempts to forecast the fertility behavior of American families. Recent data suggest, however, that the U.S. fertility rate is becoming one that is consistent with a stationary, or nearly stationary, population (Fig. 4).

### A neo-Mathusian Perspective

The continuum described above was once regarded as a transition through which all

**Fig. 3.** Population growth and family size in the United States. [After Commission on Population Growth and The American Future, Population and the American Future, The New American Library, 1972.]



**Fig. 4.** Fluctuation in the U.S. fertility rate, 1930–1979.

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nations would pass. All nations and people seemed to be moving through the demographic transformation, although at different rates. Developments during the 1950s and 1960s did not, however, appear to support this optimistic view. There appeared to be an increasing polarization into high-income, developed nations, in which the population increases slowly, and low-income, developing nations, in which the population increases rapidly.

This polarization was related to the extremely rapid decline in infant mortality and to an increase in average longevity. For example, the death rate among the Moslem population in Algeria declined more in the 8 years between 1946 and 1956 than the death rate in Sweden did during the period 1775 to 1875. The result is that population growth rates in the least developed countries exceeded those in the most developed countries even during their periods of most rapid population growth.

In Algeria, Mexico, Pakistan, and a number of other developing countries, for example, the population growth rate continues to exceed 3% per year. Rates of more than 3% per year are entirely outside the range of historical experience in Western countries. In the West, population growth rates have rarely exceeded 2%. The high population growth rates in some developing countries led some popular critics to propose a “life boat ethic”—implying that the wealthier countries should let the poor countries with high population growth rates drown in their own fecundity.

Since the mid-1960s, there has been a pervasive decline in both fertility and population growth rates in a number of developing countries. The decline has been most apparent in Asia and Latin America. In Colombia, for example, the birth rate declined from 46 in 1964 to 33 in 1975; and in Thailand the birth rate declined from 43 in 1960 to 36 in 1976. The population growth rate in Africa has not yet been significantly altered. By the late 1970s, however, there was less panic about the “population bomb” and more concern about effective ways of meeting world food requirements.

### POPULATION AND FOOD

In a Malthusian economy, the relation between population growth and food production is relatively simple: the rate of increase of food production limits the rate of population growth. Wars and epidemics or the discovery of new land resources might ease the food situation for a time, but population growth would ultimately be limited by the difficulty of increasing food production as cultivation extended to the less productive soils and as intensity of labor use increased. In the Malthusian system, food production is the independent variable and population growth the dependent variable.

In a world in which countries are passing through the several stages of the demographic revolution, the relation between population and food production is much more complex than in a simple Malthusian system. As a nation undergoes the transition from high birth and death rates to low birth and death rates there is a decrease in the proportion of national resources, or of personal income, spent on food. During the early stages of development 75% or more of the income of a population may be spent on food. By comparison, less than 25% of the income of consumers is typically spent on food in developed countries of today.

The demographic transformation, if successful, is accompanied by a transition from a situation in which the rate of population growth depends on the rate of growth in food production to one in which the rate of growth of food production depends on population growth. This transition is from a situation characterized by the “pressure of population on food supplies” to one characterized by the “pressure of food supplies on population.” In economies like those of Bangladesh and Nepal, population growth may still be limited by growth in food production (plus food imports).

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In the United States the growth of food production is restricted by the growth of population (plus food exports).

During the intermediate stages of the demographic transformation, the population food relation is even more complex. During the initial stages of the transformation, death rates decline more rapidly than birth rates. This alone would result in a rise in the food needs. If per capita income is also rising, this adds further to the demand for food. As incomes rise from levels of \$100 to \$200 per capita per year, much of the increase in income is spent in increasing the quantity and the quality of food consumed. The result is a rise in the demand for food that is substantially greater than the increase in population.

Before death rates begin to decline substantially, population and the demand for food may both be increasing at little more than 1.0–1.5% per year. As death rates continue to decline and birth rates remain high, the rate of population growth may rise to more than 3% per year, as in Pakistan, most of black Africa, and a number of countries in Latin America. If rapid population growth is accompanied by an increase in per capita income of 2–3% per year, the demand for food may increase by 5–6% per year.

An increase in the demand for food in this range is completely outside the experience of the developed countries. In these countries death rates declined slowly and birth rates began to decline while death rates were still relatively high. The question that remains to be answered, for countries experiencing such high rates of population growth and food demand, is whether this phase will be followed by a decline in the rate of population growth as a result of lower birth rates, along the lines of a “classical” demographic transformation, or by a decline in the rate of population growth as a result of a new “Malthusian” equilibrium.

For less developed nations, the rate of growth of domestic crop production has clearly been behind the rate of growth in demand during most of the period since World War II (Fig. 5). The projections to 1990 indicate that if these countries are to escape the Malthusian “trap” and proceed along the path of demographic transformation, either the rate of growth of food production must expand more rapidly or the rate of population growth must decline. Recently, a few countries have begun to experience changes. An agricultural “green revolution” has resulted in more rapid growth of grain production in Colombia, India, the Philippines, and a few other countries since the mid-1960s. The rate of population growth has begun to decline in an increasing number of developing countries—even some such as India and Indonesia, where the prospect for a decline in population growth rates seemed completely unrealistic in the mid-1960s. By and large, however, the institutional capacity for the dissemination of knowledge and materials, needed to speed the rate of growth of food production or reduce the rate of population growth, is still inadequate.

### POPULATION POLICY

None of the problems of population growth can be solved without sustained increases in both agricultural and industrial production. The fundamental problems that must be solved to achieve sustained increases in agricultural production are dealt with throughout this book.

It is also clear that population growth itself represents an obstacle to the achievement of sustained growth in agricultural and industrial production. High rates of population growth impose heavy demands on technical progress and capital formation simply to maintain the existing per capita rates at which food, fiber, and other forms of energy are consumed. Rapid population growth is, therefore, competitive with improvements in the quality of human existence.

There must, therefore, be a dual approach to the problems of population. One involves tech-

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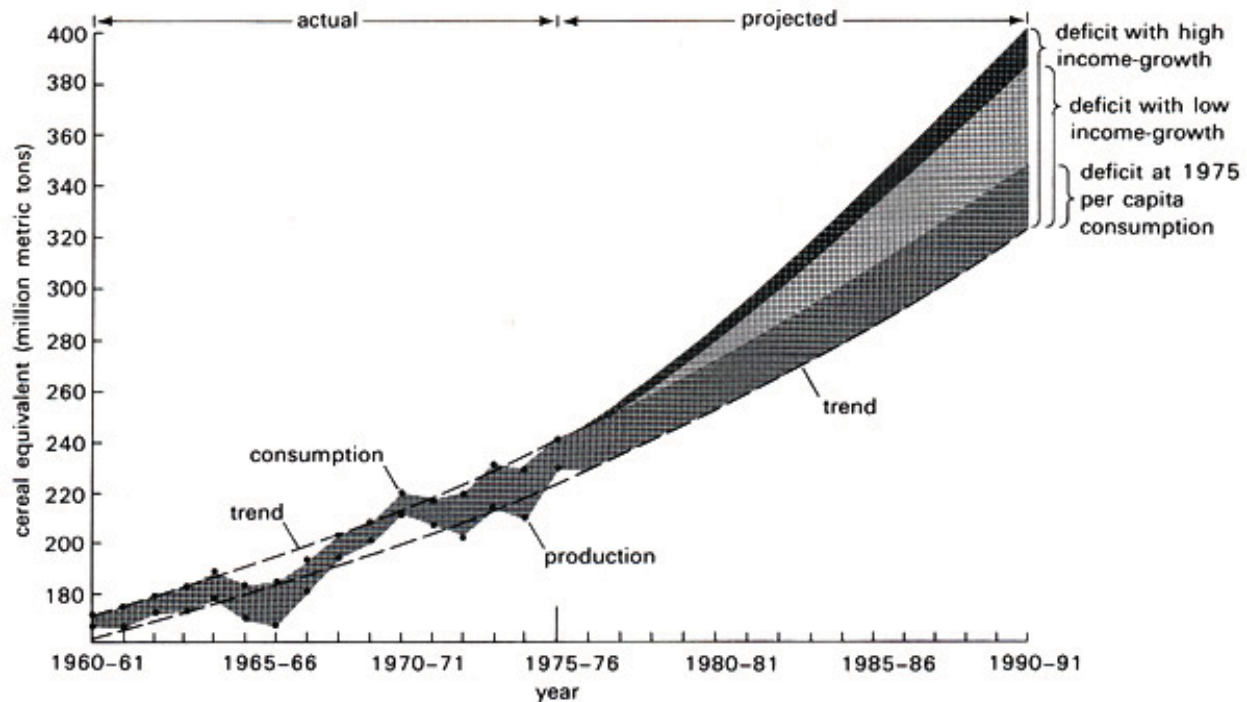
nological, social, and economic development to improve life for the people who are now alive. The other approach is demographic. There must be declines in birth rates if economic development is to become a continuing process. The problem, then, is not whether to speed up the rate of technological development or to reduce birth rates. Rather, for each country, the problem is to determine what combination of policies should be followed to achieve agricultural development and reduce population growth.

Adoption of an effective population policy is complicated by a number of social and biological factors. The social problem centers primarily on the ethical issues related to the use of contraceptive devices and the development of motivation for the control of family size. The biological problem centers on the development of low-cost, effective, socially acceptable contraceptive devices or techniques.

### Ethical Problem of Population Control

Most of the world's major religions have no generally accepted or firmly enforced objections to birth control. Individual Moslems, Hindus, Buddhists, and Confucians may be found to favor or oppose birth control, but there is no "official" theological or ethical rationalization of either position.

The Roman Catholic position does represent a more difficult theological obstacle to population control. The Catholic position does not oppose population control as such. Rather, it prescribes the means by which fertility may be regulated. Catholic doctrines on marriage and procre-



**Fig. 5.** Low-income, food-deficit developing market economies: production and consumption of major staples is shown for the period 1960–1975 and projected to 1990. The deficit is smallest if consumption remains at the 1975 per capita level, and the deficit is greatest if consumption increases rapidly because of high income-growth. [After *Food Needs of Developing Countries: Projections of Production and Consumption to 1990*, International Food Policy Research Institute, 1977.]



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ation have been significantly modified during the 20th century. Periodic abstinence as a method of regulating births has been endorsed. There has also been increased emphasis on personal and social values in marriage. Some observers anticipate further change in Catholic doctrine that will facilitate the development of policies designed to lower the birth rate in Catholic families and in predominantly Roman Catholic nations.

### Social Factors

Social inertia has, in the past, been at least as important an obstacle to the decline of birth rates as have religious and ethical values. The changes in the status of women, aspiration for social mobility, and the growth of the social and economic importance of formal education have contributed to declines in birth rates in the Catholic and non Catholic countries of Europe alike. Where motivation to control family size was strong, birth rates began to decline even before the development of modern contraceptive devices.

Among the important social, or economic, factors leading to the decrease in family size in the higher-income countries is the rising value of female labor. As employment opportunities for women have risen, paid employment has become increasingly competitive with bearing and raising children as a demand on women's time. Concurrently, the material worth of children, at least in large numbers, has lessened. Urbanization has reduced their economic value in production, and the development of social security and other institutional support for the elderly has reduced their importance as a source of security in old age.

For thousands of years people have sought reliable means of avoiding unwanted children by contraception—preventing the male sperm from fertilizing the female egg during sexual intercourse, or in other ways preventing the fetus from forming. Progress has not been as rapid in this field of medical science as in many others, partly because less effort has been devoted to methods of birth control than to improving the methods of extending life by deferring death. Furthermore, until very recently the available methods of birth control were not well adapted to meet the needs of poor, illiterate couples lacking either privacy or adequate sanitary facilities.

The principal methods of contraception include the use of jellies and foams to kill the sperm; the wearing of condoms and diaphragms to keep the sperm from reaching the egg; the ingestion of oral contraceptives by the woman to make her temporarily infertile by chemical means; and the insertion of a plastic or metal device (an IUD, or Intra-Uterine-Device) into the uterus to make the woman temporarily infertile by physical means (Fig. 6). In addition to contraception, surgical sterilization has achieved growing popularity, particularly among mature adults. The usual operation is a vasectomy for the man or a tubal ligation for the woman. Both are virtually 100% effective. Abortion is another surgical method of reducing unwanted births. It tends to be used



**Fig. 6.** In the Indian village of Deoli, a family-planning fieldworker from the Central Family Planning Institute in New Delhi discusses with village women the use of contraceptive devices. The small white object she is showing them is an IUD. [United Nations photograph.]

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most extensively where contraceptives are not easily available.

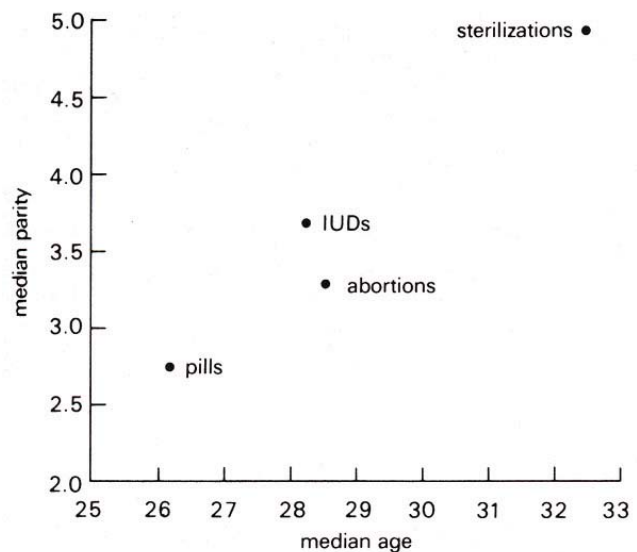
All of the methods discussed above have a place, depending on a particular country's cultural traditions and stage of medical development. Also, among individuals, variation in birth-control methods is substantial, the one employed often depending on the age of the woman and her parity status—that is, the number of children she has borne (Fig. 7). Within individual countries the transition to lower birth rates also involves a fairly complex relation among live births, induced abortion, and contraception (Box 2).

### Population Programs

There has been widespread interest in the development of population policies. Both the Republic of China (Taiwan) and the People's Republic of China have active programs to reduce birth rates. The Republic of Korea (South Korea) has a strong government backed program to spread family planning. Japan has achieved one of the world's lowest birth rates. India and Indonesia have initiated strong birth control programs. Tunisia and Egypt have both developed programs to spread family planning. Even in Latin America there is widespread concern about the "population explosion," and a few Latin American countries make contraceptive services available in government hospitals.

The fertility control efforts in Taiwan were one of the first effective efforts in a poor country. The results have been particularly interesting because they have been related to a well-planned research program designed to provide information on the efficiency and acceptability of different methods and devices.\* In Taiwan, a pre-program survey indicated that most women were having more children than they wanted and that they approved of the idea of limiting family size. Not only were they aware that limiting family size would improve the welfare of their families, but they believed the number of children should not be left to "fate" or "providence." Their attitudes were, in general, more advanced than many officials believed them to be.

Similarly, a study in the Philippines in the mid-1960s showed that rural wives would like to limit the size of their families. The study also showed, however, that the wives did not know that effective methods were available. In spite of their lack of knowledge, a very high percentage of the women studied were trying desperately, to the best of their ability, to prevent themselves from becoming pregnant by the use of the relatively ineffective practices available to them. Between



**Fig. 7.** The choice of birth-control method is greatly influenced by the age and parity status of the woman (the number of children she has borne). These data have been obtained from postpartum family-planning programs and hospitals throughout the world. [After Population Program Assistance, Agency for International Development, December 1971.]

\*Bernard Berelson and Ronald Freedman, "A Study in Fertility Control," *Scientific American*, vol. 210, no. 5, May 1964, pp. 29–37.

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1965 and 1975 the Philippines has achieved a decline in the birth rate from 44 to 36. Indonesia now seems well on the way to repeating the Taiwan and Philippine experience.

### Prospects for the Future

There is every reason to expect that birth rates in many of the newly developing countries can be reduced more rapidly than might have been predicted from the earlier experiences of Western Europe. Possibilities appear even more favorable than they did in the 1960s. Religious, ideological, and nationalistic disputes about birth control have subsided; governments are increasingly aware of the need to reduce the birth rate; much of the public is already anxious to control its childbearing; and there are new methods of contraception that are cheap, safe, and effective for the large majority of the childbearing population.

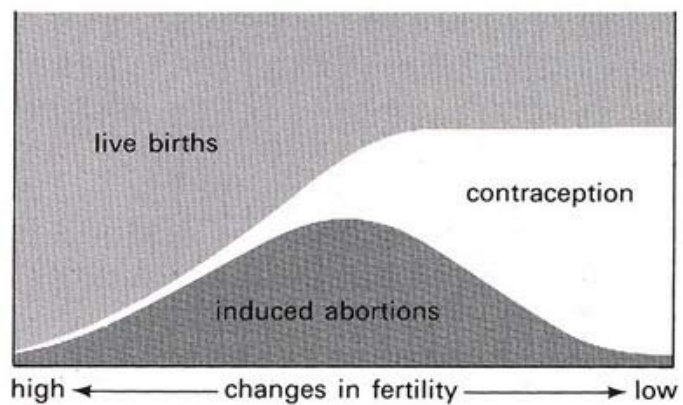
It is now possible to think that the world will—before 2000—be well on the way toward finding positive solutions to its problem of excess reproduction and population growth. This optimism is based on a number of favorable developments.

1. The optimism about future population growth should not be allowed to obscure the fact The concept of fertility control, and its individual and social benefits, has been broadly disseminated in an increasingly receptive world.
2. Many countries have removed or modified laws that restricted the availability and use of the most effective means of birth control.
3. Resources available for the development of population and family planning programs have increased rapidly.
4. Key breakthroughs in fertility control technology have occurred or now seem feasible.
5. Many countries are developing increasingly effective family planning programs.
6. Recent census and other demographic data indicate a more favorable world population

#### Box 2. The Transition to Lower Fertility: Interrelation of Births, Contraceptive Practice, and Abortion

The pattern of induced abortion during the demographic transition seems fairly constant and relatively uninfluenced by abortion law. In most instances, the transition to lower fertility rates involves an initial increase in the incidence of abortion and creates pressure for liberalization of abortion laws.

If modern contraceptives are made widely available at the same time that abortion is legalized, countries undergoing this demographic transition can avoid long term dependence on abortion as the primary method of birth prevention. However, if family planning education and service programs receive minimal public support, abortion may continue to account for an abnormally large share of births avoided long after lower birth rates have been achieved.



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figure than has been projected from earlier data.

that the increase in world population over the next several decades will be very large. In 1980, world population was slightly more than 4.5 billion people. By 2000, it will almost certainly be in the neighborhood of 6 billion.

In spite of the apparent success of family planning programs in some countries, there is still a good deal of controversy about their effectiveness. Critics argue that socioeconomic development is the primary source of fertility decline and that successful family planning programs are little more than a reflection of more basic changes in socioeconomic development. Socioeconomic development is, however, a slow process. Family planning and related health and nutrition programs are among the few instruments available to governments in poor countries to reduce fertility.

If population growth rates are to decline fast enough to allow savings and capital to be diverted from simply meeting food needs to improving the quality of life, positive government programs will be required. At least part of the resources that would otherwise be devoted to expanding national agricultural and industrial potential could be productively devoted to the extension of public education and health services directed to reducing the birth rate.

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