LAUCKS FOUNDATION

Reprint Mailing 144

As a public service, the Laucks Foundation calls attention to published material that might contribute toward clarification of issues affecting world peace, equity among peoples and environmental responsibility.

Eulah C. Laucks, Mary Laucks and Brian Swanson
P.O. Box 5012
Santa Barbara, CA. 93150-5012

July, 1997

Beginning with this issue, we start an experiment with a new format for the re-print mailing. We plan a series of five mailings focused on human population growth, in order to allow extended space to introduce more in-depth articles. Our goal is to gather together a diverse and thought-provoking collection of viewpoints on this topic.

Why the topic of human population growth? First, we believe this topic is highly controversial, and as such, is shunned by the mass media. Second, the idea of questioning population growth (e.g., population control) runs counter to evolutionary, religious, political, and economic interests. Yet, many people think that over-population underlies the most important of today's problems: environmental degradation, resource scarcity, economic inequities, and often is the basis for conflict between nations. The Laucks Foundation reprint mailing can provide a forum for examining these controversial ideas.

This first issue contains an article by John Bongaarts, Population Policy Options in the Developing World (*Science*, vol. **263**, 11 February 1994); Garret Hardin's classic 1968 article, The Tragedy of the Commons (*Science*, vol. **162**, 13 December 1968), and two quite opposing commentaries: "The Challenge of Limits", Chapter 1 from Garrett Hardin's book, *Living Within Limits*, Oxford University Press, 1993, and an article by Steven Mosher, "Too Many People? Not by a Long Shot", published in the Wall Street Journal, February 10, 1997.

In the next four mailings we will bring together articles on the uncertainties in population prediction, the politics of population control, the dynamics of population policy between developed and developing countries, the relationship between human population growth and environmental degradation, and the ethics of populations control. At the end of these mailings we will publish a bibliography for further reading, and ask you, our readers, for comments on our experiment.

ARTICLE

Population Policy Options in the Developing World

John Bongaarts

The population of the developing world is currently expanding at the unprecedented rate of more than 800 million per decade, and despite anticipated reductions in growth during the 21st century, its size is expected to increase from 4.3 billion today to 10.2 billion in 2100. Past efforts to curb this growth have almost exclusively focused on the implementation of family planning programs to provide contraceptive information, services, and supplies. These programs have been partially successful in reducing birth rates. Further investments in them will have an additional but limited impact on population growth; therefore, other policy options, in particular measures to reduce high demand for births and limit population momentum, are needed.

The arithmetic of global population growth has become numbingly familiar: 1 billion in 1800, 2.5 billion in 1950, and 5.5 billion today. In the past four decades more people have been added to the globe than in all of history before the middle of this century. And growth continues unabated. The world's population is now expanding at the unprecedented rate of nearly 1 billion per decade, and the United Nations and the World Bank project an additional 6 billion inhabitants by the end of the next century (*1*, *2*). Virtually all of this growth is expected to occur in Africa, Asia, and Latin America; therefore, in this article I focus on the developing world.

Concern about the adverse effects of population growth on human welfare was expressed nearly 200 years ago by Thomas Malthus who concluded that "the power of population is indefinitely greater than the power in the earth to produce subsistence for man" (*3*). The result, he predicted, would be increasing deprivation and starvation as exponentially growing populations outstripped their food supply. Malthus was, of course, not without his critics who believed that increases in human knowledge and technological innovation would enable humankind to provide rising standards of living for growing populations. This debate has continued until today, with the optimists pointing to the notable successes in improving the welfare of much of humankind, whereas the neo-Malthusians emphasize the widespread poverty in the Third World and the many signs of stress in our environment: air, water, and soil pollution; global warming; and depletion of renewable and nonrenewable resources. Despite sharp disagreements about future prospects, there is broad agreement that a reduction in rapid population growth in the developing world will enhance the prospects for improved living standards of additional billions in the decades ahead. As a consequence, in recent decades concerted efforts to curb population growth have been undertaken in much of the developing world. An estimated $4 to $5 billion per year is now spent by the world on population programs in Africa, Asia, and Latin America (*4*).

In this article I review past approaches to population policy and assess alternatives available to governments of the developing countries. Such questions were discussed at the United Nations (U.N.) Conference on Environment and Development (the "Earth Summit") in Rio de Janeiro in 1992 and will be a focus at the U.N. International Conference on Population and Development in September 1994 in Cairo.

Population Policy Since 1950

The potential magnitude of the population problem became clear to demographers and a small group of development planners and activists in the early 1950s. Population had grown slowly over previous centuries, but a large expansion was expected after 1950. Although projections made in 1951 by the newly created Population Division of the U.N. considerably underestimated the actual course of growth (*5*), they led to strong concern about adverse effects of a large expansion of the human population on social and economic development in the developing world.

In response, organizations such as the International Planned Parenthood Federation (to link family planning programs appearing in many countries) and the Population Council (to serve as a scientific resource for the field) were created in 1952. India became the first country to adopt an official policy to reduce population growth by promoting family planning. However, on the whole, progress was slow initially, in part because birth control activists were not respected by the political establishment, and many governments were reluctant to intrude in the sensitive and private matters of human reproduction and sexuality. In addition, religious (mainly Catholic) and conservative groups strongly opposed birth control.

By the 1960s population growth had accelerated to more than 2.5% a year, and rates of growth were greater than 3% in many developing countries (*6*). The main cause was a decline in the death rate as a result of improved nutrition and public health measures such as immunization, antibiotics, and better sanitation. Birth rates remained high in much of the developing world. The threat of food shortages in the mid-1960s caused alarm about the race between food supply and population growth and provided an impetus for stronger government action, increased funding for population programs, and the establishment in 1967 of the U.N. Fund for Population Activities (UNFPA).

Governments concerned about the prospects of large increases in population typically responded by implementing family planning programs to provide information about and access to contraceptives. Newly available contraceptive methods, such as the birth control pill and the intrauterine device, greatly facilitated the delivery of family planning services. The rationale for this approach was largely provided by research on attitudes toward birth control and on knowledge and use of contraception. Surveys of women of reproductive age in the 1960s found that many women wanted to limit family size or space births but did not practice contraception (*7*, *8*). This information reassured policy-makers of the acceptability of action programs.

By the early 1970s concern about the adverse consequences of population growth had increased to the point that family planning became a worldwide social movement. Several books as well as the extensive media coverage of the first U.N. Conference on the Human Environment held in Stockholm in 1972 raised global awareness of population and environment issues. This led to strong support for action and a large increase in funding from the developed countries, especially the United States (*9*). In addition, the health and human rights rationales for family planning became increasingly important. Numerous governments initiated family planning programs even though this approach remained politically sensitive and was a source of contro-

The author is director of the Research Division, The Population Council, One Dag Hammarskjold Plaza, New York, NY 10017, USA.

versy. However, at the 1974 U.N.-sponsored World Population Conference, governments from the developing world resisted setting targets for lowering population growth and instead argued for a new international economic order to stimulate development. In the decade between the 1974 and 1984 World Population conferences, governments that were initially reluctant came to accept the importance of reducing population growth by implementing family planning programs (*10*). The Chinese government became so concerned about the consequences of population growth that it adopted a controversial one-child policy in 1978.

The implementation of family planning programs has in most countries been a key factor in assisting individuals in changing their reproductive behavior. In the developing world as a whole, the average number of children born per woman has declined from 6.1 in the mid-1960s to 3.8 in 1990, and the proportion of couples using contraception has risen sharply from less than 10% to 50% (*6, 11*). These averages conceal wide variations among regions (Table 1). The most rapid changes have occurred in East Asia where fertility has declined to 2.3 births per woman and contraceptive use is now at 75%—a level usually found in developed countries. In contrast, reproductive behavior has changed little in sub-Saharan Africa, although there are notable exceptions (for example, Botswana, Kenya, South Africa, and Zimbabwe) where fertility declines are now under way. These trends in reproductive behavior are also attributable to rapid social and economic development, which has reduced the motivation for large families. The relative contributions of family planning programs and socioeconomic development to fertility declines vary widely among countries. In a few (for example, China and Bangladesh), the effect of family planning programs predominates, whereas in many others socioeconomic development is more important.

By 1990 most governments of developing countries had adopted policies to reduce population growth, and 85% of the Third World's population now lives in countries in which the government considers the fertility rate too high (*12*). Most of these countries have implemented family planning programs, but the efforts and resources devoted to them vary widely (*13*), and the coverage and quality of services in many family planning programs need to be greatly improved.

Table 1. Estimates of total fertility rate and contraceptive prevalence rate for regions of the developing world, from 1960 to 1965 and in 1990 (*6, 11*).

Country	Total fertility rate (births per woman)		Contraceptive prevalence rate (% of married women)	
	1960 to 1965	1990	1960 to 1965	1990
Africa	6.8	6.1	5	17
East Asia*	5.9	2.3	13	75
South Asia†	6.0	4.3	7	41
Latin America	6.0	3.5	14	61
All developing countries	6.1	3.8	9	50

*Excluding Japan. †Including Southeast and West Asia.

Demographic Projections

Despite rapid changes in reproductive behavior during the past quarter century, population growth in the Third World continues at an unprecedented pace (Fig. 1). The population of the developing world is expected to grow from 4.1 in 1990 to 8.6 billion in 2050 and 10.2 billion in 2100, according to projections made by the World Bank (*2*). In 1990 Asia (excluding Japan, Australia, and New Zealand) had 3 billion inhabitants, nearly three quarters of the total of the developing world, and the population there is projected to more than double to 6.5 billion by 2100. Africa is projected to experience by far the largest relative growth: a nearly fivefold increase from 0.6 billion to 2.8 billion between 1990 and 2100. Latin America is the smallest of the three regions, and although its population size is expected to double to 0.9 billion over the same period, the absolute growth is substantially smaller than in Asia and Africa.

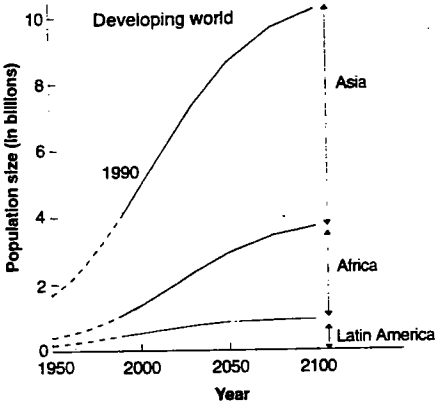

Fig. 1. Projections of population size for regions of the developing world, 1990 to 2100 (*2*).

The projected trend in population growth shown in Fig. 2 indicates that we are now at the climax of an unprecedented period of population expansion (*2*). Overall patterns of change in absolute annual additions to the population of the developing world (Fig. 2A) are similar to those in the rate of growth (Fig. 2B): At the beginning of this century, growth was low and it will again be low at the end of the next century, but there is rapid growth during the intervening years. Absolute annual population increments have been rising throughout this century, and during the 1980s, 774 million people were added to the Third World (*6*). More importantly, growth will likely exceed this level for the next three decades, adding 830 million in the 1990s and about the same again in the first two decades of the next century, before a decline is expected to occur as fertility reaches low levels.

Although the peak in absolute growth will occur in the next three decades, the rate of growth already reached its maximum in the late 1960s and has been declining since then. A declining growth rate is consistent with a growing absolute increment in population because the base population to which the growth rate applies keeps growing. When the fact that the growth rate had peaked became widely known in the late 1970s, some observers concluded that we had defused the population bomb (*14*). That conclusion is obviously incorrect because population will likely more than double before stabilizing, but the declining growth rate is good news and it is consistent with the claim that efforts to reduce population growth have had an impact.

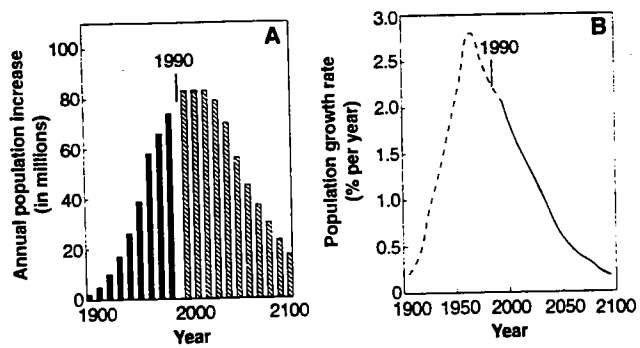

Fig. 2. Estimates and projections of (**A**) annual population increase and (**B**) population growth rate of the developing world (*2, 6*).

Future Policy Options

The already difficult task of reducing poverty and bringing about sustainable development in Africa, Asia, and Latin America will be made even more difficult by the expected addition of 6 billion people over the next century. Increased efforts to slow this population expansion are therefore desirable. Three broad policy options can be pursued.

1) *Reduce unwanted pregnancies by strengthening family planning programs.* The most direct way to bring about significant further fertility declines is by the implementation of comprehensive and high-quality family planning programs in all countries. Although past efforts have been substantial, services are still poor and limited in coverage in many countries. It is therefore not surprising that recent surveys in developing countries have found that many women who wish to delay or stop childbearing are not practicing contraception (*15*). Analysis of these findings suggests that one in six married women in the developing countries outside China has an unmet need for contraception—a total of about 100 million women (*16*). Estimates for unmarried women are not as readily available, but their needs are no doubt also substantial. The unmet need for contraception is highest in countries of sub-Saharan Africa (averaging near 25%), but even in Asia and Latin America, where services are much more accessible, unmet need levels of about 15% are typical in the countries for which data are available. These estimates are conservative because they are limited to women who are currently nonusers. There are, in addition, substantial numbers of contraceptive users who are not satisfied with their current method or who practice relatively ineffective methods that put them at risk of contraceptive failure.

The causes of this unmet need for contraception include (i) lack of knowledge of contraceptive methods or sources of supply; (ii) limited access to and low quality of family planning services; (iii) side effects and inconvenience of contraceptive methods; (iv) disapproval of husbands, family members, and others; and (v) cost of contraceptive commodities and travel.

Several of these problems can be addressed if family planning programs are strengthened by expanding coverage to unserved or underserved areas, improving service quality, providing more understandable contraceptive information through the media and in one-to-one communication with service providers, and giving ready access to a wider variety of birth control methods including abortion. In addition, existing programs need to reach out to groups such as adolescents and the sexually active unmarried who are now often excluded. With the implementation of these measures, programs can substantially increase the demand for contraception and reduce unmet need.

As a consequence of this unmet need for birth control, many women bear more children than they want. Approximately one in four births in the developing world (excluding China) is unwanted (*17*). In addition, there are approximately 25 million abortions annually, a large proportion of which take place under illegal or unsafe conditions, or both (*18*). Many of these undesirable pregnancies can be prevented if women are given greater control over their sexual and reproductive lives.

The central goal of family planning programs is to provide women and men with the information and means to control fully their fertility and thus eliminate mistimed and unwanted pregnancies. In addition to directly benefiting women and their families, the absence of unwanted childbearing would have a substantial effect on fertility and hence on population growth. I estimated the potential demographic effect of family planning programs by making a hypothetical projection of future population growth in which all unwanted fertility is eliminated after 1995. An estimated 20% of fertility in 1995–2000 will be unwanted (*19*), and I assumed that the trend in wanted fertility in the future is the same as the trend in total fertility projected by the World Bank, that is, a slow decline to replacement fertility in the middle of the next century (*2*). The results (Table 2) imply that the elimination of unwanted births after 1995 would reduce population growth and that the population size of the developing world would reach an estimated 7.5 billion in 2050 and 8.3 billion in 2100. This projection is considerably below the standard projection of the World Bank. The difference between the two projections provides an estimate of the demographic impact of unwanted fertility: 1.1 billion (8.6 minus 7.5) in 2050 and 1.9 billion (10.2 minus 8.3) in 2100. It should be emphasized that these projections are theoretical upper limits on what can be achieved. In practice, resource constraints, imperfect technology, human error, and reluctance of governments to take appropriate action pose limits on the impact of family planning programs. Even in countries with good programs, a significant proportion of women are reluctant to adopt methods because of concerns about their health and other side effects and pressures from spouses and other family members. However, there is no doubt that improvements in the quantity and quality of these programs can bring about substantial future reductions in fertility and population growth. In addition, strengthened support for family planning will bring substantial social and health benefits to women and children.

2) *Reduce the demand for large families through investments in human development.* Although family planning programs now claim the bulk of the attention and resources of population policy-makers, the potential effect of programs that provide supplies, services, and information is limited to reducing the unmet need for contraception. Because such programs are voluntary, they cannot reduce fertility below the level wanted by couples (*20*). As a consequence, this so-called "supply" approach cannot reduce population growth to zero in countries where, on average, desired fertility still exceeds two. This is apparently the case in most developing countries. An extensive survey program conducted in 27 countries in Africa, Asia, and Latin America in the late 1980s found no country with a desired family size at or close to two (*21*). These surveys documented a preference for large numbers of children in sub-Saharan Africa, and the average desired family size was close to six

Table 2. Projections of the population size of the developing world with and without unwanted births.

Projection	Projected population size (billions) in year	
	2050	2100
Standard* (with unwanted births)	8.6	10.2
Without unwanted births	7.5	8.3
Effect of unwanted fertility	1.1	1.9

*World Bank projection as quoted in Bos *et al.* (*2*).

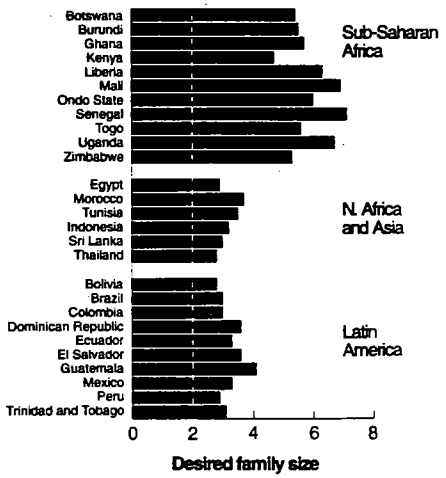

Fig. 3. Average desired family size among ever married women in selected developing countries, 1986 to 1989 (*15*).

(Fig. 3). Although the average desired number of surviving children in countries of Latin America, Asia, and North Africa was much lower, it still exceeded three in most cases. These preferences for high fertility remain one of the fundamental causes of high birth rates and rapid population growth.

A slow decline in fertility preferences is observable in most developing countries, and the expectation is that desired fertility will drop to around two children as these societies proceed through the transition from their traditional agricultural base to modern industrialized economies. Because this transition may take a long time, some policy analysts have advocated measures that reduce the demand for births through affirmative social and economic policies. The general objective is to change the costs and benefits of child rearing so that more parents will recognize the value of smaller families while simultaneously increasing the investment in children. Examples of factors potentially under government control include affecting (i) education levels, (ii) the status of women, and (iii) child mortality.

With regard to education, in traditional societies with largely agricultural economies, children are a valuable source of labor. The provision of educational opportunities, which require school attendance, lowers the labor value of children and raises their costs (for example, for books, uniforms, and school fees) (*22*). Of all the social and economic factors that have been studied for their potential effect on reproductive behavior, the level of education stands out as the most consistent (*23, 24*). This relation is attributable to shifts in the costs and benefits of children but also, and perhaps more importantly, to an acceleration in cultural change and the adoption of new, mostly western values that are facilitated by the introduction of mass schooling (*22*).

Improvements in the economic, social, and legal status of women can reduce desired fertility in several ways. Such improvements raise the cost of children by making nonmaternal roles more important. They also increase the willingness of women to make independent reproductive decisions and encourage them to engage in innovative contraceptive behavior. Empowering women is also likely to lead to reductions in the dominance of husbands (or other household members) over women, the societal preference for male offspring, and the value of (and thus need for) children as insurance against adversity (for example, in old age) and as securers of women's positions in families. Although the precise role of each of these effects varies among and within societies, there is little doubt that the overall effect of increasing gender equality significantly influences reproductive behavior (*25*).

A high death rate among children encourages high fertility for several reasons (*26*): (i) It makes the planning of families difficult because the number and timing of future deaths are unpredictable, thus contributing to fatalism. (ii) It discourages investments in children's health and education. (iii) It requires excess births to ensure that at least the desired number of children will survive to adulthood. All these effects can be counteracted by the implementation of public health measures to reduce infant and child mortality. The potentially important role of this variable is demonstrated empirically in that no population in the developing world has experienced a sustained fertility reduction without first having gone through a major decline in infant and child mortality.

Improving the education system, raising the status of women, and reducing child mortality are policy measures that are desirable in their own right. Indeed, most governments already pursue these socially desirable objectives independent of their potential role in lowering the rate of childbearing. The demographic benefits strengthen the rationale for intensifying these social policies.

Additional steps can be taken to encourage lower fertility. For example, monetary incentives for the adoption of specific birth control methods and disincentives for large families are features of population policies in a few countries (*27–29*). Although these measures can be successful, they raise serious ethical concerns and many governments are reluctant to adopt them (*29*). Another potential option for bringing about change in reproductive behavior is to increase a population's exposure to different life-styles through the media. Modern communication systems (radio, newspaper, and television) are powerful instruments for conveying ideas and messages about different nontraditional behaviors, family roles, and life-styles that are less compatible with large families (*30*). Although this exposure to mostly western ideas is considered a crucial element in ongoing fertility declines, it is rarely considered as a policy option because it would undermine increasingly popular efforts to strengthen national and ethnic identities of countries.

The potential demographic effect of additional efforts to implement policies to reduce fertility demand can be assessed by a comparison of population projections with and without such efforts. For this comparison I used the second projection in Table 2 because it assumes that high wanted fertility is the only reason for fertility to exceed the replacement level in the future. I also made a hypothetical new projection to simulate the potential effect of additional demand policies. In this new projection, the successful implementation of such policies is assumed to reduce fertility in all countries to the replacement level of two surviving children per woman after 1995. According to the results from these two projections, substantial further reductions in future population size, up to 0.6 billion in 2050 and 1 billion in 2100, are achievable by stronger measures to lower desired family size (Fig. 4). The relative role of demand for large families as a cause of population growth varies among countries and regions; it would, for example, be much larger in Africa than is the case in the decomposition for all developing countries shown in Fig. 4.

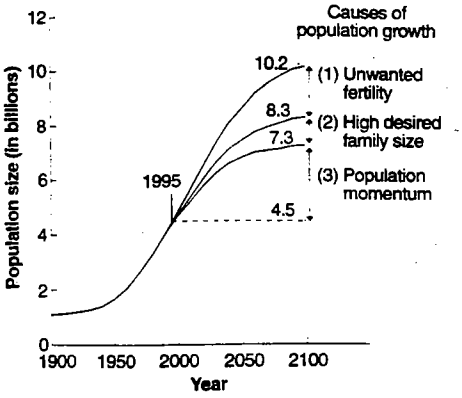

Fig. 4. Alternative projections of the population size for the developing world, 1995 to 2100, and three causes of population growth.

According to the standard projection of the World Bank (top graph in Fig. 4), the population size of the developing world will increase from 4.5 billion in 1995 to 10.2 billion in 2100. Aside from unwanted fertility and high desired family size, population momentum is responsible for the remaining growth over the next century (Fig. 4).

3) *Address population momentum.* Population momentum is the tendency of population size to increase for some time after fertility has reached a level consistent with long-range population stability (*31, 32*). As a result of the momentum, population growth would continue even if fertility could immediately be brought to the replacement level of two children per woman. Population momentum is primarily the consequence of a young population age structure (future mortality decline among adults is another, less important, cause of continued growth). Adjustments in the age structure after a decline in fertility take several decades to be completed, and it is only then that population size growth ceases. Unless efforts are made to reduce this momentum, the population of the developing world will grow to at least 7.3 billion. Attention to this neglected issue is essential because population momentum accounts for nearly half of the projected growth over the next century (Fig. 4).

There are two basic ways to bring about

Table 3. Simulated effect of delayed childbearing on population momentum if replacement fertility was reached in 1995.

Average age at childbearing	Population momentum* (billions)	Population in 2100, momentum only (billions)	Reduction resulting from delay (billions)
No change	2.8	7.3	0
Increase of			
2.5 years	2.2	6.7	0.6
5 years	1.6	6.1	1.2

*Momentum estimates include effect of future mortality decline.

Table 4. Average of median ages at marriage of ever married women ages 30 to 34 in 23 developing countries obtained from demographic and health surveys (*36*).

Level of education	Median age at marriage (years)	Median age at first birth (years)
None	17.6	19.3
Primary	19.1	20.2
Secondary	21.7	22.8

reductions in population momentum. The first involves additional declines in lifetime fertility to below the replacement level. In theory it is even possible to stop population growth completely by reducing fertility to the level needed to balance the number of births and deaths (assuming no migration). This is, of course, an undesirable option to implement because it would leave many women with only one birth, which is substantially fewer than most women want. It is unlikely that desired family size will drop substantially below two in most developing countries even with the demand measures discussed earlier.

A second option that has thus far received little attention is to raise the average age of women at childbearing. Research on the causes of fertility change in the United States has clearly demonstrated that the fertility in a given year is significantly affected by shifts in the timing of births. When successive age cohorts of women start their childbearing earlier and space their births closer together, fertility for that period temporarily rises. For example, Ryder concluded that much of the temporary rise in U.S. fertility in the 1950s (the "baby boom") was caused by changes in the timing of fertility rather than by variation in the desired fertility (*33*). Conversely, a delay in the onset of childbearing and wider spacing of births leads to a temporary decline in period fertility and hence in the population growth rate.

To determine the potential demographic effect of a rise in the age at childbearing, I used a simulation based on hypothetical population projections. I assumed that women over their life cycle bear children at the replacement level of two surviving births per woman, but that the mean age at childbearing is raised slowly over a 25-year period, from 1995 to 2020. Two postponements in timing were considered: 2.5 and 5 years (*34*). The results (Table 3) indicate that without changes in timing, the population momentum equals 2.8 billion in population growth between 1995 and 2100, that is, the difference between the 1995 population of 4.5 billion and the 7.3 billion projected for 2100 if fertility is kept at the replacement level (Fig. 4). This momentum would be reduced to 2.2 billion and 1.6 billion for delays of 2.5 and 5 years, respectively. Clearly, this approach to reducing population momentum has the potential for a substantial impact.

Governments that wish to encourage later childbearing have several options at their disposal. Legislation to raise the age at marriage has been moderately effective in a few countries (for example, Tunisia and China in the 1970s). However, legislation of this type has the drawback that it attempts to force rather than encourage changes in social customs. Indirect noncoercive approaches are preferable. An example of such an approach is greater investment in the education of girls, particularly at the secondary level. The longer girls stay in school, the later they marry and the greater the delay in childbearing. For example, in 23 developing countries, the median age of marriage of women with secondary education exceeded that of women with no education by 4 years (Table 4). This educational difference in age at marriage translates into a similar impact on the age at childbearing.

Another potentially effective approach is to address the neglected issues of adolescent sexuality and reproductive behavior. Many adolescents do not use contraception or use it sporadically when they become sexually active. As a result, childbearing often starts earlier than would be the case if young women had better information and services. Governments have been reluctant to address these problems of adolescents for social and political reasons.

Delays in childbearing can also be achieved by an increase in intervals between births. In general, however, the effect of a given increment in birth spacing on the mean age of childbearing (and hence on population momentum) is somewhat smaller than can be obtained by the same increment in the mean age at first birth, because spacing only affects subsequent births. Lengthening birth intervals also provides substantial health benefits for mothers and children; therefore, it should be encouraged for health as well as for demographic reasons.

Outlook

Past debates on alternative population policy approaches have frequently been contentious, with supporters of the supply and demand approaches each emphasizing their particular perspectives. In reality each of these approaches can be effective and neither of them should claim predominance. More importantly, the different approaches complement and reinforce one another. Reductions in demand for children or delays in childbearing that are achieved (for example, by increasing levels of education) do not by themselves reduce fertility. Instead, they raise the demand for contraception, and only if this demand is satisfied (for example, by services provided through family planning programs) will lower fertility be obtained. The fertility impact of the demand and delay strategies, therefore, depends to a significant extent on the availability of contraceptive information and services. Conversely, family planning programs are more successful in meeting couples' needs for contraception in societies with high levels of human development. For example, in a given supply environment, well-educated women satisfy their demand for contraception more effectively than their uneducated counterparts. The reasons for this are not entirely clear, but they presumably relate to the greater ability of educated women to control their lives as well as their superior knowledge of the fertility regulation methods and sources of supply. As a consequence, investments in family planning programs produce larger reductions in unwanted fertility when social conditions such as education and gender equality are favorable.

A comprehensive effort to implement all available policy options is required if humankind is to prevent the potentially severe, adverse consequences of continued rapid population growth. If the broad range of approaches proposed here is vigorously pursued, large reductions in future population growth can be achieved without resorting to the types of coercive measures that are objectionable to the majority of the world community.

REFERENCES AND NOTES

1. United Nations, Department of International Economic and Social Affairs (UNDIESA), *Long Range World Population Projections: Two Centuries of Population Growth 1950–2150* (United Nations, New York, 1992).
2. E. Bos, M. T. Vu, A. Levin, R. Bulatao, *World Population Projections 1992–93 Edition* (Johns Hopkins Univ. Press, Baltimore, MD, published for the World Bank, 1992).
3. T. R. Malthus, *Population: The First Essay* (1798; reprinted by Ann Arbor Paperbacks, Univ. of Michigan Press, Ann Arbor, MI, 1959).
4. *Effective Family Planning Programs* (World Bank, Washington, DC, 1993).
5. UNDIESA, *The Past and Future Growth of World Population: A Long-Range View* (United Nations, New York, 1951).
6. ———, *World Population Prospects 1990* (United Nations, New York, 1992).
7. R. Freedman, *Stud. Fam. Plann.* **18**, 57 (1987).
8. B. Berelson, in *Family Planning and Population Programs*, Proceedings of the International Conference on Family Planning Programs, Geneva, August 1965 (Univ. of Chicago Press, Chicago, 1966), pp. 655–668.
9. S. Conly and J. Speidel, *Global Population Assistance* (Population Action International, Washington, DC, 1993).
10. J. Finkle and B. Crane, *Popul. Dev. Rev.* **11**, 1 (1985).
11. UNDIESA, *Levels and Trends of Contraceptive Use as Assessed in 1988* (United Nations, New York, 1989).
12. ———, *World Population Monitoring Report 1991* (United Nations, New York, 1992).
13. W. P. Mauldin and J. A. Ross, *Stud. Fam. Plann.* **22**, 350 (1991).
14. For a comment on the related debate, see P. Demeny, *Popul. Dev. Rev.* **5**, 141 (1978).
15. C. Westoff, "Unmet need and the demand for family planning," *Demographic and Health Surveys, Comparative Studies No. 5* (Institute for Resource Development, Columbia, MD, 1991).
16. J. Bongaarts, *Popul. Dev. Rev.* **17**, 293 (1991).
17. ———, *ibid.* **16**, 487 (1990).
18. S. K. Henshaw and J. van Vort, *Abortion Factbook, 1992 Edition* (Alan Guttmacher Institute, New York, 1992).
19. For each country the proportion of fertility that is wanted (P) is estimated from the equation $P = 1.22 - 0.231TFR + 0.0252TFR^2$, where TFR is the projected level of the total fertility rate projected by Bos *et al.* for 1995–2000 (*2*). This equation was obtained by fitting a quadratic equation to estimates of TFR and P given in (*17*). Country-specific estimates of wanted fertility are calculated as $P \times TFR$, and their weighted average gives the level of the developing world as a whole. Because China is a special case, I assumed $P = 1.0$. The resulting estimate of 80% for the proportion of wanted births is, as expected, slightly below the 87% estimated for the United States in 1973 (*35*). The age-specific fertility rates in the baseline period (1995–2000) for age groups 15–19 to 45–49 were, respectively, 40, 147, 155, 111, 55, 17, and 2 births per 1000 women per year.
20. Some family planning programs also try to encourage couples to desire smaller families through information and education campaigns. Such efforts are considered to be relatively ineffective (*27*).
21. C. Westoff, "Reproductive preferences: A comparative view," *Demographic and Health Surveys, Comparative Studies No. 3* (Institute for Resource Development, Columbia, MD, 1991).
22. J. Caldwell, *Popul. Dev. Rev.* **6**, 225 (1980).
23. J. Cleland and G. Rodriguez, *Popul. Stud.* **42**, 419 (1988).
24. S. Cochrane, *Fertility and Education: What Do We Really Know?* (Johns Hopkins Univ. Press, Baltimore, MD, published for the World Bank, 1979).
25. K. Mason, *Sociol. Forum* **2**, 718 (1987).
26. C. Lloyd and S. Ivanov, *Stud. Fam. Plann.* **19**, 141 (1988).
27. B. Berelson, *Fam. Plann. Perspect.* **9**, 214 (1977).
28. P. Mauldin and S. Sinding, "Review of existing family planning policies and programmes: Lessons learned," *Working Paper No. 50*, presented at the United Nations Expert Group Meeting on Family Planning, Health, and Family Well-Being, Bangalore, India, 26 to 30 October 1992 (Population Council, Research Division, New York, 1993).
29. J. Cleland and W. Robinson, in *Family Planning Programmes and Fertility*, J. Phillips and J. Ross, Eds. (Clarendon, Oxford, 1992), pp. 159–177.
30. R. Freedman, in *International Encyclopedia of Population*, J. Ross, Ed. (Free Press, New York, 1982), vol. 1, pp. 450–451.
31. T. Frejka, in *ibid.*, pp. 950–451; T. Merrick, *Popul. Bull.* **41** (no. 2) (1989).
32. N. Keyfitz, *Demography* **8**, 71 (1971).
33. N. B. Ryder, in *Demographic Patterns in Developed Societies*, R. W. Hiorns, Ed. (Taylor and Francis, London, 1980), pp. 15–24. An analysis of the effects of changes in the timing of future childbearing on population growth in China is provided in J. Bongaarts and S. Greenhalgh, *Popul. Dev. Rev.* **11**, 585 (1985).
34. The estimates of the effect of delays in childbearing on future population growth are based on the assumption that current fertility levels in the developing world are not affected by changes in timing. Recent evidence of trends in age at first birth for Demographic and Health Survey countries suggests that this is a reasonable assumption (*36*).
35. L. B. Williams, *Fam. Plann. Perspect.* **23**, 212 (1991).
36. "An assessment of DHS-I data quality," *DHS Methodological Reports, No. 1* (Institute for Resource Development, Columbia, MD, 1990). Estimates of median ages at marriage and first birth are derived from computer data files for each country with a demographic and health survey.

The Tragedy of the Commons

The population problem has no technical solution; it requires a fundamental extension in morality.

Garrett Hardin

At the end of a thoughtful article on the future of nuclear war, Wiesner and York (*1*) concluded that: "Both sides in the arms race are . . . confronted by the dilemma of steadily increasing military power and steadily decreasing national security. *It is our considered professional judgment that this dilemma has no technical solution.* If the great powers continue to look for solutions in the area of science and technology only, the result will be to worsen the situation."

I would like to focus your attention not on the subject of the article (national security in a nuclear world) but on the kind of conclusion they reached, namely that there is no technical solution to the problem. An implicit and almost universal assumption of discussions published in professional and semipopular scientific journals is that the problem under discussion has a technical solution. A technical solution may be defined as one that requires a change only in the techniques of the natural sciences, demanding little or nothing in the way of change in human values or ideas of morality.

In our day (though not in earlier times) technical solutions are always welcome. Because of previous failures in prophecy, it takes courage to assert that a desired technical solution is not possible. Wiesner and York exhibited this courage; publishing in a science journal, they insisted that the solution to the problem was not to be found in the natural sciences. They cautiously qualified their statement with the phrase, "It is our considered professional judgment. . . . ." Whether they were right or not is not the concern of the present article. Rather, the concern here is with the important concept of a class of human problems which can be called "no technical solution problems," and, more specifically, with the identification and discussion of one of these.

It is easy to show that the class is not a null class. Recall the game of tick-tack-toe. Consider the problem, "How can I win the game of tick-tack-toe?" It is well known that I cannot, if I assume (in keeping with the conventions of game theory) that my opponent understands the game perfectly. Put another way, there is no "technical solution" to the problem. I can win only by giving a radical meaning to the word "win." I can hit my opponent over the head; or I can drug him; or I can falsify the records. Every way in which I "win" involves, in some sense, an abandonment of the game, as we intuitively understand it. (I can also, of course, openly abandon the game—refuse to play it. This is what most adults do.)

The class of "No technical solution problems" has members. My thesis is that the "population problem," as conventionally conceived, is a member of this class. How it is conventionally conceived needs some comment. It is fair to say that most people who anguish over the population problem are trying to find a way to avoid the evils of overpopulation without relinquishing any of the privileges they now enjoy. They think that farming the seas or developing new strains of wheat will solve the problem—technologically. I try to show here that the solution they seek cannot be found. The population problem cannot be solved in a technical way, any more than can the problem of winning the game of tick-tack-toe.

The author is professor of biology, University of California, Santa Barbara. This article is based on a presidential address presented before the meeting of the Pacific Division of the American Association for the Advancement of Science at Utah State University, Logan, 25 June 1968.

What Shall We Maximize?

Population, as Malthus said, naturally tends to grow "geometrically," or, as we would now say, exponentially. In a finite world this means that the per capita share of the world's goods must steadily decrease. Is ours a finite world?

A fair defense can be put forward for the view that the world is infinite; or that we do not know that it is not. But, in terms of the practical problems that we must face in the next few generations with the foreseeable technology, it is clear that we will greatly increase human misery if we do not, during the immediate future, assume that the world available to the terrestrial human population is finite. "Space" is no escape (*2*).

A finite world can support only a finite population; therefore, population growth must eventually equal zero. (The case of perpetual wide fluctuations above and below zero is a trivial variant that need not be discussed.) When this condition is met, what will be the situation of mankind? Specifically, can Bentham's goal of "the greatest good for the greatest number" be realized?

No—for two reasons, each sufficient by itself. The first is a theoretical one. It is not mathematically possible to maximize for two (or more) variables at the same time. This was clearly stated by von Neumann and Morgenstern (*3*), but the principle is implicit in the theory of partial differential equations, dating back at least to D'Alembert (1717–1783).

The second reason springs directly from biological facts. To live, any organism must have a source of energy (for example, food). This energy is utilized for two purposes: mere maintenance and work. For man, maintenance of life requires about 1600 kilocalories a day ("maintenance calories"). Anything that he does over and above merely staying alive will be defined as work, and is supported by "work calories" which he takes in. Work calories are used not only for what we call work in common speech: they are also required for all forms of enjoyment, from swimming and automobile racing to playing music and writing poetry. If our goal is to maximize population it is obvious what we must do: We must make the work calories per person approach as close to zero as possible. No gourmet meals, no vacations, no sports, no music, no literature, no art. . . . I think that everyone will grant, without

argument or proof, that maximizing population does not maximize goods. Bentham's goal is impossible.

In reaching this conclusion I have made the usual assumption that it is the acquisition of energy that is the problem. The appearance of atomic energy has led some to question this assumption. However, given an infinite source of energy, population growth still produces an inescapable problem. The problem of the acquisition of energy is replaced by the problem of its dissipation, as J. H. Fremlin has so wittily shown (*4*). The arithmetic signs in the analysis are, as it were, reversed; but Bentham's goal is still unobtainable.

The optimum population is, then, less than the maximum. The difficulty of defining the optimum is enormous; so far as I know, no one has seriously tackled this problem. Reaching an acceptable and stable solution will surely require more than one generation of hard analytical work—and much persuasion.

We want the maximum good per person; but what is good? To one person it is wilderness, to another it is ski lodges for thousands. To one it is estuaries to nourish ducks for hunters to shoot; to another it is factory land. Comparing one good with another is, we usually say, impossible because goods are incommensurable. Incommensurables cannot be compared.

Theoretically this may be true; but in real life incommensurables *are* commensurable. Only a criterion of judgment and a system of weighting are needed. In nature the criterion is survival. Is it better for a species to be small and hideable, or large and powerful? Natural selection commensurates the incommensurables. The compromise achieved depends on a natural weighting of the values of the variables.

Man must imitate this process. There is no doubt that in fact he already does, but unconsciously. It is when the hidden decisions are made explicit that the arguments begin. The problem for the years ahead is to work out an acceptable theory of weighting. Synergistic effects, nonlinear variation, and difficulties in discounting the future make the intellectual problem difficult, but not (in principle) insoluble.

Has any cultural group solved this practical problem at the present time, even on an intuitive level? One simple fact proves that none has: there is no prosperous population in the world today that has, and has had for some time, a growth rate of zero. Any people that has intuitively identified its optimum point will soon reach it, after which its growth rate becomes and remains zero.

Of course, a positive growth rate might be taken as evidence that a population is below its optimum. However, by any reasonable standards, the most rapidly growing populations on earth today are (in general) the most miserable. This association (which need not be invariable) casts doubt on the optimistic assumption that the positive growth rate of a population is evidence that it has yet to reach its optimum.

We can make little progress in working toward optimum poulation size until we explicitly exorcize the spirit of Adam Smith in the field of practical demography. In economic affairs, *The Wealth of Nations* (1776) popularized the "invisible hand," the idea that an individual who "intends only his own gain," is, as it were, "led by an invisible hand to promote . . . the public interest" (*5*). Adam Smith did not assert that this was invariably true, and perhaps neither did any of his followers. But he contributed to a dominant tendency of thought that has ever since interfered with positive action based on rational analysis, namely, the tendency to assume that decisions reached individually will, in fact, be the best decisions for an entire society. If this assumption is correct it justifies the continuance of our present policy of laissez-faire in reproduction. If it is correct we can assume that men will control their individual fecundity so as to produce the optimum population. If the assumption is not correct, we need to reexamine our individual freedoms to see which ones are defensible.

Tragedy of Freedom in a Commons

The rebuttal to the invisible hand in population control is to be found in a scenario first sketched in a little-known pamphlet (*6*) in 1833 by a mathematical amateur named William Forster Lloyd (1794–1852). We may well call it "the tragedy of the commons," using the word "tragedy" as the philosopher Whitehead used it (*7*): "The essence of dramatic tragedy is not unhappiness. It resides in the solemnity of the remorseless working of things." He then goes on to say, "This inevitableness of destiny can only be illustrated in terms of human life by incidents which in fact involve unhappiness. For it is only by them that the futility of escape can be made evident in the drama."

The tragedy of the commons develops in this way. Picture a pasture open to all. It is to be expected that each herdsman will try to keep as many cattle as possible on the commons. Such an arrangement may work reasonably satisfactorily for centuries because tribal wars, poaching, and disease keep the numbers of both man and beast well below the carrying capacity of the land. Finally, however, comes the day of reckoning, that is, the day when the long-desired goal of social stability becomes a reality. At this point, the inherent logic of the commons remorselessly generates tragedy.

As a rational being, each herdsman seeks to maximize his gain. Explicitly or implicitly, more or less consciously, he asks, "What is the utility *to me* of adding one more animal to my herd?" This utility has one negative and one positive component.

1) The positive component is a function of the increment of one animal. Since the herdsman receives all the proceeds from the sale of the additional animal, the positive utility is nearly +1.

2) The negative component is a function of the additional overgrazing created by one more animal. Since, however, the effects of overgrazing are shared by all the herdsmen, the negative utility for any particular decision-making herdsman is only a fraction of −1.

Adding together the component partial utilities, the rational herdsman concludes that the only sensible course for him to pursue is to add another animal to his herd. And another; and another. . . . But this is the conclusion reached by each and every rational herdsman sharing a commons. Therein is the tragedy. Each man is locked into a system that compels him to increase his herd without limit—in a world that is limited. Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons. Freedom in a commons brings ruin to all.

Some would say that this is a platitude. Would that it were! In a sense, it was learned thousands of years ago, but natural selection favors the forces of psychological denial (*8*). The individual benefits as an individual from his ability to deny the truth even though society as a whole, of which he is a part, suffers.

Education can counteract the natural tendency to do the wrong thing, but the inexorable succession of generations requires that the basis for this knowledge be constantly refreshed.

A simple incident that occurred a few years ago in Leominster, Massachusetts, shows how perishable the knowledge is. During the Christmas shopping season the parking meters downtown were covered with plastic bags that bore tags reading: "Do not open until after Christmas. Free parking courtesy of the mayor and city council." In other words, facing the prospect of an increased demand for already scarce space, the city fathers reinstituted the system of the commons. (Cynically, we suspect that they gained more votes than they lost by this retrogressive act.)

In an approximate way, the logic of the commons has been understood for a long time, perhaps since the discovery of agriculture or the invention of private property in real estate. But it is understood mostly only in special cases which are not sufficiently generalized. Even at this late date, cattlemen leasing national land on the western ranges demonstrate no more than an ambivalent understanding, in constantly pressuring federal authorities to increase the head count to the point where overgrazing produces erosion and weed-dominance. Likewise, the oceans of the world continue to suffer from the survival of the philosophy of the commons. Maritime nations still respond automatically to the shibboleth of the "freedom of the seas." Professing to believe in the "inexhaustible resources of the oceans," they bring species after species of fish and whales closer to extinction (*9*).

The National Parks present another instance of the working out of the tragedy of the commons. At present, they are open to all, without limit. The parks themselves are limited in extent—there is only one Yosemite Valley—whereas population seems to grow without limit. The values that visitors seek in the parks are steadily eroded. Plainly, we must soon cease to treat the parks as commons or they will be of no value to anyone.

What shall we do? We have several options. We might sell them off as private property. We might keep them as public property, but allocate the right to enter them. The allocation might be on the basis of wealth, by the use of an auction system. It might be on the basis of merit, as defined by some agreed-upon standards. It might be by lottery. Or it might be on a first-come, first-served basis, administered to long queues. These, I think, are all the reasonable possibilities. They are all objectionable. But we must choose—or acquiesce in the destruction of the commons that we call our National Parks.

Pollution

In a reverse way, the tragedy of the commons reappears in problems of pollution. Here it is not a question of taking something out of the commons, but of putting something in—sewage, or chemical, radioactive, and heat wastes into water; noxious and dangerous fumes into the air; and distracting and unpleasant advertising signs into the line of sight. The calculations of utility are much the same as before. The rational man finds that his share of the cost of the wastes he discharges into the commons is less than the cost of purifying his wastes before releasing them. Since this is true for everyone, we are locked into a system of "fouling our own nest," so long as we behave only as independent, rational, free-enterprisers.

The tragedy of the commons as a food basket is averted by private property, or something formally like it. But the air and waters surrounding us cannot readily be fenced, and so the tragedy of the commons as a cesspool must be prevented by different means, by coercive laws or taxing devices that make it cheaper for the polluter to treat his pollutants than to discharge them untreated. We have not progressed as far with the solution of this problem as we have with the first. Indeed, our particular concept of private property, which deters us from exhausting the positive resources of the earth, favors pollution. The owner of a factory on the bank of a stream—whose property extends to the middle of the stream—often has difficulty seeing why it is not his natural right to muddy the waters flowing past his door. The law, always behind the times, requires elaborate stitching and fitting to adapt it to this newly perceived aspect of the commons.

The pollution problem is a consequence of population. It did not much matter how a lonely American frontiersman disposed of his waste. "Flowing water purifies itself every 10 miles," my grandfather used to say, and the myth was near enough to the truth when he was a boy, for there were not too many people. But as population became denser, the natural chemical and biological recycling processes became overloaded, calling for a redefinition of property rights.

How To Legislate Temperance?

Analysis of the pollution problem as a function of population density uncovers a not generally recognized principle of morality, namely: *the morality of an act is a function of the state of the system at the time it is performed* (*10*). Using the commons as a cesspool does not harm the general public under frontier conditions, because there is no public; the same behavior in a metropolis is unbearable. A hundred and fifty years ago a plainsman could kill an American bison, cut out only the tongue for his dinner, and discard the rest of the animal. He was not in any important sense being wasteful. Today, with only a few thousand bison left, we would be appalled at such behavior.

In passing, it is worth noting that the morality of an act cannot be determined from a photograph. One does not know whether a man killing an elephant or setting fire to the grassland is harming others until one knows the total system in which his act appears. "One picture is worth a thousand words," said an ancient Chinese; but it may take 10,000 words to validate it. It is as tempting to ecologists as it is to reformers in general to try to persuade others by way of the photographic shortcut. But the essense of an argument cannot be photographed: it must be presented rationally—in words.

That morality is system-sensitive escaped the attention of most codifiers of ethics in the past. "Thou shalt not . . ." is the form of traditional ethical directives which make no allowance for particular circumstances. The laws of our society follow the pattern of ancient ethics, and therefore are poorly suited to governing a complex, crowded, changeable world. Our epicyclic solution is to augment statutory law with administrative law. Since it is practically impossible to spell out all the conditions under which it is safe to burn trash in the back yard or to run an automobile without smog-control, by law we delegate the details to bureaus. The result is administrative law, which is rightly feared for an ancient reason—*Quis custodiet ipsos custodes?*—"Who shall

watch the watchers themselves?" John Adams said that we must have "a government of laws and not men." Bureau administrators, trying to evaluate the morality of acts in the total system, are singularly liable to corruption, producing a government by men, not laws.

Prohibition is easy to legislate (though not necessarily to enforce); but how do we legislate temperance? Experience indicates that it can be accomplished best through the mediation of administrative law. We limit possibilities unnecessarily if we suppose that the sentiment of *Quis custodiet* denies us the use of administrative law. We should rather retain the phrase as a perpetual reminder of fearful dangers we cannot avoid. The great challenge facing us now is to invent the corrective feedbacks that are needed to keep custodians honest. We must find ways to legitimate the needed authority of both the custodians and the corrective feedbacks.

Freedom To Breed Is Intolerable

The tragedy of the commons is involved in population problems in another way. In a world governed solely by the principle of "dog eat dog"—if indeed there ever was such a world—how many children a family had would not be a matter of public concern. Parents who bred too exuberantly would leave fewer descendants, not more, because they would be unable to care adequately for their children. David Lack and others have found that such a negative feedback demonstrably controls the fecundity of birds (*11*). But men are not birds, and have not acted like them for millenniums, at least.

If each human family were dependent only on its own resources; *if* the children of improvident parents starved to death; *if*, thus, overbreeding brought its own "punishment" to the germ line—*then* there would be no public interest in controlling the breeding of families. But our society is deeply committed to the welfare state (*12*), and hence is confronted with another aspect of the tragedy of the commons.

In a welfare state, how shall we deal with the family, the religion, the race, or the class (or indeed any distinguishable and cohesive group) that adopts overbreeding as a policy to secure its own aggrandizement (*13*)? To couple the concept of freedom to breed with the belief that everyone born has an equal right to the commons is to lock the world into a tragic course of action.

Unfortunately this is just the course of action that is being pursued by the United Nations. In late 1967, some 30 nations agreed to the following (*14*):

> The Universal Declaration of Human Rights describes the family as the natural and fundamental unit of society. It follows that any choice and decision with regard to the size of the family must irrevocably rest with the family itself, and cannot be made by anyone else.

It is painful to have to deny categorically the validity of this right; denying it, one feels as uncomfortable as a resident of Salem, Massachusetts, who denied the reality of witches in the 17th century. At the present time, in liberal quarters, something like a taboo acts to inhibit criticism of the United Nations. There is a feeling that the United Nations is "our last and best hope," that we shouldn't find fault with it; we shouldn't play into the hands of the archconservatives. However, let us not forget what Robert Louis Stevenson said: "The truth that is suppressed by friends is the readiest weapon of the enemy." If we love the truth we must openly deny the validity of the Universal Declaration of Human Rights, even though it is promoted by the United Nations. We should also join with Kingsley Davis (*15*) in attempting to get Planned Parenthood-World Population to see the error of its ways in embracing the same tragic ideal.

Conscience Is Self-Eliminating

It is a mistake to think that we can control the breeding of mankind in the long run by an appeal to conscience. Charles Galton Darwin made this point when he spoke on the centennial of the publication of his grandfather's great book. The argument is straightforward and Darwinian.

People vary. Confronted with appeals to limit breeding, some people will undoubtedly respond to the plea more than others. Those who have more children will produce a larger fraction of the next generation than those with more susceptible consciences. The difference will be accentuated, generation by generation.

In C. G. Darwin's words: "It may well be that it would take hundreds of generations for the progenitive instinct to develop in this way, but if it should do so, nature would have taken her revenge, and the variety *Homo contracipiens* would become extinct and would be replaced by the variety *Homo progenitivus*" (*16*).

The argument assumes that conscience or the desire for children (no matter which) is hereditary—but hereditary only in the most general formal sense. The result will be the same whether the attitude is transmitted through germ cells, or exosomatically, to use A. J. Lotka's term. (If one denies the latter possibility as well as the former, then what's the point of education?) The argument has here been stated in the context of the population problem, but it applies equally well to any instance in which society appeals to an individual exploiting a commons to restrain himself for the general good—by means of his conscience. To make such an appeal is to set up a selective system that works toward the elimination of conscience from the race.

Pathogenic Effects of Conscience

The long-term disadvantage of an appeal to conscience should be enough to condemn it; but has serious short-term disadvantages as well. If we ask a man who is exploiting a commons to desist "in the name of conscience," what are we saying to him? What does he hear?—not only at the moment but also in the wee small hours of the night when, half asleep, he remembers not merely the words we used but also the nonverbal communication cues we gave him unawares? Sooner or later, consciously or subconsciously, he senses that he has received two communications, and that they are contradictory: (i) (intended communication) "If you don't do as we ask, we will openly condemn you for not acting like a responsible citizen"; (ii) (the unintended communication) "If you *do* behave as we ask, we will secretly condemn you for a simpleton who can be shamed into standing aside while the rest of us exploit the commons."

Everyman then is caught in what Bateson has called a "double bind." Bateson and his co-workers have made a plausible case for viewing the double bind as an important causative factor in the genesis of schizophrenia (*17*). The double bind may not always be so damaging, but it always endangers the mental health of anyone to whom it is applied. "A bad conscience," said Nietzsche, "is a kind of illness."

To conjure up a conscience in others

is tempting to anyone who wishes to extend his control beyond the legal limits. Leaders at the highest level succumb to this temptation. Has any President during the past generation failed to call on labor unions to moderate voluntarily their demands for higher wages, or to steel companies to honor voluntary guidelines on prices? I can recall none. The rhetoric used on such occasions is designed to produce feelings of guilt in noncooperators.

For centuries it was assumed without proof that guilt was a valuable, perhaps even an indispensable, ingredient of the civilized life. Now, in this post-Freudian world, we doubt it.

Paul Goodman speaks from the modern point of view when he says: "No good has ever come from feeling guilty, neither intelligence, policy, nor compassion. The guilty do not pay attention to the object but only to themselves, and not even to their own interests, which might make sense, but to their anxieties" (*18*).

One does not have to be a professional psychiatrist to see the consequences of anxiety. We in the Western world are just emerging from a dreadful two-centuries-long Dark Ages of Eros that was sustained partly by prohibition laws, but perhaps more effectively by the anxiety-generating mechanisms of education. Alex Comfort has told the story well in *The Anxiety Makers* (*19*); it is not a pretty one.

Since proof is difficult, we may even concede that the results of anxiety may sometimes, from certain points of view, be desirable. The larger question we should ask is whether, as a matter of policy, we should ever encourage the use of a technique the tendency (if not the intention) of which is psychologically pathogenic. We hear much talk these days of responsible parenthood: the coupled words are incorporated into the titles of some organizations devoted to birth control. Some people have proposed massive propaganda campaigns to instill responsibility into the nation's (or the world's) breeders. But what is the meaning of the word responsibility in this context? Is it not merely a synonym for the word conscience? When we use the word responsibility in the absence of substantial sanctions are we not trying to browbeat a free man in a commons into acting against his own interest? Responsibility is a verbal counterfeit for a substantial *quid pro quo*. It is an attempt to get something for nothing.

If the word responsibility is to be used at all, I suggest that it be in the sense Charles Frankel uses it (*20*). "Responsibility," says this philosopher, "is the product of definite social arrangements." Notice that Frankel calls for social arrangements—not propaganda.

Mutual Coercion

Mutually Agreed upon

The social arrangements that produce responsibility are arrangements that create coercion, of some sort. Consider bank-robbing. The man who takes money from a bank acts as if the bank were a commons. How do we prevent such action? Certainly not by trying to control his behavior solely by a verbal appeal to his sense of responsibility. Rather than rely on propaganda we follow Frankel's lead and insist that a bank is not a commons; we seek the definite social arrangements that will keep it from becoming a commons. That we thereby infringe on the freedom of would-be robbers we neither deny nor regret.

The morality of bank-robbing is particularly easy to understand because we accept complete prohibition of this activity. We are willing to say "Thou shalt not rob banks," without providing for exceptions. But temperance also can be created by coercion. Taxing is a good coercive device. To keep downtown shoppers temperate in their use of parking space we introduce parking meters for short periods, and traffic fines for longer ones. We need not actually forbid a citizen to park as long as he wants to; we need merely make it increasingly expensive for him to do so. Not prohibition, but carefully biased options are what we offer him. A Madison Avenue man might call this persuasion; I prefer the greater candor of the word coercion.

Coercion is a dirty word to most liberals now, but it need not forever be so. As with the four-letter words, its dirtiness can be cleansed away by exposure to the light, by saying it over and over without apology or embarrassment. To many, the word coercion implies arbitrary decisions of distant and irresponsible bureaucrats; but this is not a necessary part of its meaning. The only kind of coercion I recommend is mutual coercion, mutually agreed upon by the majority of the people affected.

To say that we mutually agree to coercion is not to say that we are required to enjoy it, or even to pretend we enjoy it. Who enjoys taxes? We all grumble about them. But we accept compulsory taxes because we recognize that voluntary taxes would favor the conscienceless. We institute and (grumblingly) support taxes and other coercive devices to escape the horror of the commons.

An alternative to the commons need not be perfectly just to be preferable. With real estate and other material goods, the alternative we have chosen is the institution of private property coupled with legal inheritance. Is this system perfectly just? As a genetically trained biologist I deny that it is. It seems to me that, if there are to be differences in individual inheritance, legal possession should be perfectly correlated with biological inheritance—that those who are biologically more fit to be the custodians of property and power should legally inherit more. But genetic recombination continually makes a mockery of the doctrine of "like father, like son" implicit in our laws of legal inheritance. An idiot can inherit millions, and a trust fund can keep his estate intact. We must admit that our legal system of private property plus inheritance is unjust—but we put up with it because we are not convinced, at the moment, that anyone has invented a better system. The alternative of the commons is too horrifying to contemplate. Injustice is preferable to total ruin.

It is one of the peculiarities of the warfare between reform and the status quo that it is thoughtlessly governed by a double standard. Whenever a reform measure is proposed it is often defeated when its opponents triumphantly discover a flaw in it. As Kingsley Davis has pointed out (*21*), worshippers of the status quo sometimes imply that no reform is possible without unanimous agreement, an implication contrary to historical fact. As nearly as I can make out, automatic rejection of proposed reforms is based on one of two unconscious assumptions: (i) that the status quo is perfect; or (ii) that the choice we face is between reform and no action: if the proposed reform is imperfect, we presumably should take no action at all, while we wait for a perfect proposal.

But we can never do nothing. That which we have done for thousands of years is also action. It also produces evils. Once we are aware that the

status quo is action, we can then compare its discoverable advantages and disadvantages with the predicted advantages and disadvantages of the proposed reform, discounting as best we can for our lack of experience. On the basis of such a comparison, we can make a rational decision which will not involve the unworkable assumption that only perfect systems are tolerable.

Recognition of Necessity

Perhaps the simplest summary of this analysis of man's population problems is this: the commons, if justifiable at all, is justifiable only under conditions of low-population density. As the human population has increased, the commons has had to be abandoned in one aspect after another.

First we abandoned the commons in food gathering, enclosing farm land and restricting pastures and hunting and fishing areas. These restrictions are still not complete throughout the world.

Somewhat later we saw that the commons as a place for waste disposal would also have to be abandoned. Restrictions on the disposal of domestic sewage are widely accepted in the Western world; we are still struggling to close the commons to pollution by automobiles, factories, insecticide sprayers, fertilizing operations, and atomic energy installations.

In a still more embryonic state is our recognition of the evils of the commons in matters of pleasure. There is almost no restriction on the propagation of sound waves in the public medium. The shopping public is assaulted with mindless music, without its consent. Our government is paying out billions of dollars to create supersonic transport which will disturb 50,000 people for every one person who is whisked from coast to coast 3 hours faster. Advertisers muddy the airwaves of radio and television and pollute the view of travelers. We are a long way from outlawing the commons in matters of pleasure. Is this because our Puritan inheritance makes us view pleasure as something of a sin, and pain (that is, the pollution of advertising) as the sign of virtue?

Every new enclosure of the commons involves the infringement of somebody's personal liberty. Infringements made in the distant past are accepted because no contemporary complains of a loss. It is the newly proposed infringements that we vigorously oppose; cries of "rights" and "freedom" fill the air. But what does "freedom" mean? When men mutually agreed to pass laws against robbing, mankind became more free, not less so. Individuals locked into the logic of the commons are free only to bring on universal ruin; once they see the necessity of mutual coercion, they become free to pursue other goals. I believe it was Hegel who said, "Freedom is the recognition of necessity."

The most important aspect of necessity that we must now recognize, is the necessity of abandoning the commons in breeding. No technical solution can rescue us from the misery of overpopulation. Freedom to breed will bring ruin to all. At the moment, to avoid hard decisions many of us are tempted to propagandize for conscience and responsible parenthood. The temptation must be resisted, because an appeal to independently acting conscience selects for the disappearance of all conscience in the long run, and an increase in anxiety in the short.

The only way we can preserve and nurture other and more precious freedoms is by relinquishing the freedom to breed, and that very soon. "Freedom is the recognition of necessity"—and it is the role of education to reveal to all the necessity of abandoning the freedom to breed. Only so, can we put an end to this aspect of the tragedy of the commons.

References

1. J. B. Wiesner and H. F. York, *Sci. Amer.* **211** (No. 4), 27 (1964).
2. G. Hardin, *J. Hered.* **50**, 68 (1959); S. von Hoernor, *Science* **137**, 18 (1962).
3. J. von Neumann and O. Morgenstern, *Theory of Games and Economic Behavior* (Princeton Univ. Press, Princeton, N.J., 1947), p. 11.
4. J. H. Fremlin, *New Sci.*, No. 415 (1964), p. 285.
5. A. Smith, *The Wealth of Nations* (Modern Library, New York, 1937), p. 423.
6. W. F. Lloyd, *Two Lectures on the Checks to Population* (Oxford Univ. Press, Oxford, England, 1833), reprinted (in part) in *Population, Evolution, and Birth Control*, G. Hardin, Ed. (Freeman, San Francisco, 1964), p. 37.
7. A. N. Whitehead, *Science and the Modern World* (Mentor, New York, 1948), p. 17.
8. G. Hardin, Ed. *Population, Evolution, and Birth Control* (Freeman, San Francisco, 1964), p. 56.
9. S. McVay, *Sci. Amer.* **216** (No. 8), 13 (1966).
10. J. Fletcher, *Situation Ethics* (Westminster, Philadelphia, 1966).
11. D. Lack, *The Natural Regulation of Animal Numbers* (Clarendon Press, Oxford, 1954).
12. H. Girvetz, *From Wealth to Welfare* (Stanford Univ. Press, Stanford, Calif., 1950).
13. G. Hardin, *Perspec. Biol. Med.* **6**, 366 (1963).
14. U. Thant, *Int. Planned Parenthood News*, No. 168 (February 1968), p. 3.
15. K. Davis, *Science* **158**, 730 (1967).
16. S. Tax, Ed., *Evolution after Darwin* (Univ. of Chicago Press, Chicago, 1960), vol. 2, p. 469.
17. G. Bateson, D. D. Jackson, J. Haley, J. Weakland, *Behav. Sci.* **1**, 251 (1956).
18. P. Goodman, *New York Rev. Books* **10**(8), 22 (23 May 1968).
19. A. Comfort, *The Anxiety Makers* (Nelson, London, 1967).
20. C. Frankel, *The Case for Modern Man* (Harper, New York, 1955), p. 203.
21. J. D. Roslansky, *Genetics and the Future of Man* (Appleton-Century-Crofts, New York, 1966), p. 177.

1

The Challenge of Limits

A funny thing happened on the way to the second nationwide Earth Day in 1990. Twenty years earlier the first Earth Day had been saluted with much talk about population problems. At that time world population stood at 3.6 billion. But when the second Earth Day rolled around, the topic of population was almost completely ignored. Was that because world population had stopped growing? Hardly: in the intervening two decades it had increased 47 percent to an estimated 5.3 billion—an increase of 1.7 billion (more than six times the present population of the United States).

Common sense tells us that the per capita share of environmental riches must decrease as population numbers increase, and waste disposal necessarily becomes an ever greater problem. Of course common sense is sometimes wrong. But if that is so in this instance, the celebrants of the 1990 Earth Day should have been shouting, "We've found the secret of perpetual growth!" A few incurable optimists did defend this position, but most people lumped their claims with those of the flat earthers, ignoring both. The celebrants were generally silent about the 47 percent increase in population. Why?

The answer comes in two parts, the first being historical. It is now known that the planners of Earth Day 1990 were under economic pressure to leave population out of the picture. When directors of philanthropic foundations and business concerns were solicited for financial support they let it be known that they would not look kindly on a population emphasis. Money talks, silence can be bought. (Why the bankrollers shied at population will become clear later.)

The second aspect of the answer is more subtle. It has long been recognized that some of our most deeply held views are not neat, precise propositions but broadly "global" attitudes that act as the gatekeepers of the mind, letting in only those propositions that do not challenge the dominant picture of reality. Germans call such gatekeeper attitudes *Weltanschauungen,* an impressive mouthful that is quite adequately translated as "worldviews." For all but the last few hundred years of human history the dominant worldview was a limited view: resources were limited, human nature was fixed, and spending beyond one's income was a sin. This essentially conservative perception prevailed until about 1600.

Then science and technology shook the foundations. One presumed limit after another was shown to be, in part, false. Age-old justifications for conservative, thrifty action were questioned. In our century the new spirit was deftly captured in the advertisement of an airline: "Fly now, pay later!" Since man, an optimistic animal, usually presumes that "we" will be richer later, conservatism was redefined as living on credit cards. In the public mind the limited worldview was replaced by a limitless worldview. The new orientation was intoxicating.

An effective gatekeeper of the mind does not call attention to itself. It actuates a psychological mechanism called a *taboo.* This South Sea island word was introduced into the English language by Captain Cook in 1777. That population discussions have been significantly hemmed in by taboo from Cook's time to the present can be easily demonstrated. Ten years before the English word was created, the Scottish economist Sir James Steuart, after attributing poverty to overpopulation, ended by confessing: "How to propose a remedy for this inconveniency, without laying some restraint upon marriage; how to lay a restraint upon marriage without shocking the spirit of the times, I own I cannot find out; so I leave every one to conjecture." Thomas Robert Malthus, who really got the population debate off the ground in 1798, was only a year old when Steuart thus bowed to the power of taboo.

The population taboo, while far from absolute, is still with us, as is illustrated by two examples from among many. In 1980 *Newsweek* published a 2,600-word essay on "Vanishing Forests," in which not a single word was said about the role of population growth in causing worldwide deforestation. In 1989 *The New Yorker* published a 26,000-word extract of an environmentalist book *The End of Nature* which included only seventy-nine guarded words on population.

An element of behavior that is transferred from one culture to another is likely to suffer a sea change. So it has been with taboo. Pacific islanders apparently have no hesitancy in explicitly giving taboo as a reason for stopping a discussion. By contrast, Westerners, with their cherished tradition of free speech and open discussion, would be embarrassed to say (for instance), "We will not discuss population because it is under a taboo." Instead, they change the subject. Hundreds of articles are written every year about the pathological effects of overpopulation—traffic congestion, deforestation, loss of species, soil erosion, and air pollution—without any mention of population growth as an essential cause.

In the United States in the middle of the 1980s the practical issue of population control became entangled with the moral issue of abortion. This is somewhat puzzling because there is no *necessary* connection between the two. Limiting population growth is easier to achieve when abortion is readily available, but population control is quite possible in a nation that prohibits abortion. A thorough political history of this entanglement is yet to be written, but it is safe to say that, beginning about 1980, abortion became a red herring that was deliberately dragged across the path of nearly every discussion of population. Since abortion, a tabooed topic only three decades earlier, was still regarded as indecent by millions of Americans, the topic of population control got tarred with the same brush.

But this has been a late development. In the first century after Malthus resistance to discussing population control came from other sources, principally from the social pioneers who were reshaping European culture into a more humane one. Reformers who were trying to persuade society to deal compassionately with children, women, and poor people often considered population a distraction.

Earlier, the principal supporters of population studies had been economists. Malthus, the first British professor of economics (then called "political economy"), pioneered in emphasizing the connection between economics and population.

John Stuart Mill kept the connection alive in the 1850s, but by the centennial of Steuart's statement the subject of population had virtually disappeared from the discipline of economics. Now, after yet another century, the topic is still missing from most economics textbooks.

Marxists have confidently asserted that the advance of technology, coupled with distributional justice, would automatically solve all problems mistakenly labeled "population." A similar conclusion was reached in the capitalist world, where the spirit of laissez-faire was invoked to generate a theory of automatic (and nearly painless) population regulation. The theory of "benign demographic transition" and the "child survival hypothesis" (to be discussed later) have, in effect, told people "Not to worry!" So ambiguous is statistical evidence that both of these optimistic theories of automatic population control survived nearly half a century before being abandoned by professionals. (They still persist on college campuses and in the popular press.)

The "Don't worry" theories of population control amount to a reaffirmation of the religious idea of Providence. Professional publicists know there is always a good living to be made by catering to the public's craving for optimistic reports. Such behavior finds no justification in the attitude of the Buddha, expressed five centuries before Christ: "I teach only two things: the cause of human sorrow and the way to become free of it." The present work, though written by a non-Buddhist, proceeds along the Buddhist path—first to reveal the causes of human sorrow in population matters and then to uncover promising ways to free ourselves of the sorrow.

Hearing the Buddha's statement today many people think, "How depressing! Why accept such a pessimistic outlook on life?" But they are wrong: it is not a pessimistic view if we reword it in terms that are more familiar to our science-based society. Reworded: "Here's something that isn't working right. I want to fix it, but before I can do that I have to know exactly why it doesn't work right." One who looks for causes before seeking remedies should not be condemned as a pessimist. In general, a great deal of looking for causes must precede the finding of remedies.

A great source of shared sorrow comes to us these days from an environment that has been badly mistreated for many centuries. Describing and looking for remedies to this sorrow is the obligation of ecology. Though the science of ecology was named more than a century ago, the public scarcely became aware of it until Rachel Carson's *Silent Spring* was published in 1962. Since then an avalanche of discouraging reports on the environment has engulfed the public.

Broadly stated, most ecological problems reduce to the single problem of balancing supply and demand. That may sound simple enough, but the two words *supply* and *demand* stand for utterly disparate things. Supply is strictly limited, though we often cannot state the limits with any precision. Demand, however, is essentially unlimited, because the word implies *demands made by human beings*. There is no intrinsic limit to the demands that can be made by people. The natural tendency to produce an imbalance between supply and demand is the source of Buddhistic "sorrow." Preventing, or at least minimizing, this sorrow requires solving the population problem. Such was Malthus's view; and such must ours be.

Two centuries of intermittent wrestling with population problems have produced useful insights about the reality and nature of limits, the meaning of progress, the properties of exponential growth, the utility of usury, scale effects, and the consequences of diminishing returns. Enlightenment has come from many quarters, not least from the engineering theory of controls. Journalists hanker after simple, one-paragraph answers to the threat of overpopulation: unfortunately there is no persuasive brief answer. However I think we can now see the *form* that acceptable answers must take. These are summarized in the concluding chapter.

Four centuries of sedation by the delusion of limitlessness have left humanity floundering in a wilderness of rhetoric. The history of population theories is a history of wishful thinking. By myriads of ruses hucksters have tried to divert attention from the conservation principles of science, implying that to accept the reality of limits is to become a pessimist.

But scientists are not saddened by conservation laws. Instead they agree with an aphorism attributed to Hegel: "Freedom is the recognition of necessity." From this it must be inferred that some day political conservatism will once again be defined as contented living within limits. The limitless world view will have to be abandoned. Before we can accept this necessity we must rid ourselves of many illusions that have in the past supported unworkable theories of population growth. To these we now turn our attention.

Too Many People? Not by a Long Shot

By Steven W. Mosher

Confounding the doomsayers, world population growth is slowing dramatically. The U.S. Census Bureau recently reported that the globe's population grew by only 79.6 million in 1996. This is seven million fewer than the 86-plus million in 1994, the high-water mark of population growth. It is a round 20 million less than the 100 million figure population-control alarmists like Vice President Al Gore were tossing around until recently.

The immediate reason for this decline, which has since been confirmed by the United Nations Population Division, is shrinking family size. The Census Bureau reports that the world's total fertility rate—the number of children born per woman during her lifetime—has declined to 2.9, its lowest level ever. In 1985 the world-wide total fertility rate was 4.2. In many countries, couples commonly stop at one or two children.

There are now 79 countries—representing fully 40% of the world's population—with fertility rates below the level necessary to stave off long-term population decline. The developed nations are in the worst straits. Already 15 of them, including Russia, Germany and Italy, each year fill more coffins than cradles. Virtually all the others will soon follow suit. Efforts by anxious governments to arrest this looming demographic disaster have proved largely futile. In Germany and Japan, for example, despite hefty financial rewards to women willing to welcome more children into the world, the maternity wards remain empty.

But this "birth dearth," as Ben Wattenberg has called it, has now spread well beyond the developed world. There are now 27 "developing" countries where women are averaging fewer than 2.2 children. These include such unlikely candidates as Sri Lanka and Thailand. The human face of this population implosion is melancholy—villages bereft of children, schools closed for lack of students—and the economic consequences are grim: Labor shortages cramp production, the housing market grows moribund, and this in turn creates a drag on real estate and other sectors of the economy. How much of Japan's continuing economic malaise can be directly traced to a lack of young people to power the economy?

While the population of portions of Africa, Asia and Latin America will continue to grow for several more decades, the rest of the world will soon be in demographic free fall. The bottom line: Population will peak at seven billion or so in 2030, and then begin a long descent. (This is essentially the U.N. Population Division's Nov. 13 "low variant" prediction, with African, Asian and Latin American total fertility rates adjusted to converge on those of present-day Europe, or 1.35 children per woman.)

How have those in the population-control crowd taken all this "good" news? Their response has been curiously schizophrenic. On the one hand, they are quick to claim credit for progress made and ask for money "to finish the job." But in the same breath, they hotly deny that they are principally interested in reducing human fertility at all, claiming they have other, laudable goals in mind, such as reducing maternal and infant mortality, improving reproductive health care, "investing in women," and the like.

Anyone who has seen the checkered path of other countries' family-planning programs will find it hard to take either claim seriously. Something over two-thirds of the world's fertility decline can be accounted for by simple modernity, as women marry later, have greater educational opportunities and work outside the home. The only population-control programs that have enjoyed conspicuous success have relied on the more or less compulsory sterilization of large numbers of women. The most notorious example is China, where for a decade and a half the government has mandated the insertion of intrauterine devices after one child, sterilization after two children, and abortion for those pregnant without permission.

But the use of force in family-planning programs is not limited to China. Doctors in Mexico's government hospitals are under orders to insert IUDs in women who have three or more children. This is often done immediately after childbirth, without the foreknowledge or consent of the women violated.

Perhaps the practice in Peru, where women are offered 50 pounds of food in return for submitting to a tubal ligation, cannot properly be called coercive. Still, there is something despicable about offering food to poor, hungry Indian women in return for permission to mutilate their bodies. And the potential for direct coercion is ever present, given that Peruvian government doctors must meet a quota of six certified sterilizations a month or lose their jobs.

So tainted with coercion is the whole notion of population control that many of its strongest advocates have quietly reinvented themselves, and are now posing as social reformers eager to help women. The whole process resembles the strange metamorphosis of Soviet communists into Russian social democrats after the U.S.S.R. collapsed. It deserves the same level of credence.

But let us, for the sake of dialogue, take at face value all the fine words about improving health and saving lives of Third World women and children. Let us then agree to redirect the $385 million to be spent on population control programs this year into bona fide health-care programs run by bona fide health-care agencies (not family planning groups in disguise). Let us save the 2.1 million children each year who, according to Unicef, are dying from vaccine-preventable diseases. Let us provide Vitamin A supplements to poor children, averting one to two million deaths each year.

Humanity's long-term problem is not going to be too many children, but too few: too few children to fill the schools and universities, too few young people entering the work force, too few couples buying homes and second cars. In short, too few consumers and producers to drive the economy forward. The imploding markets of Europe and the economic sluggishness of Japan will spread soon enough to the U.S. and the rest of the world. Why spend hundreds of millions of dollars a year on contraception and sterilization that will only bring that day closer?

Mr. Mosher is president of the Population Research Institute and author of "A Mother's Ordeal: One Woman's Fight Against One-Child China" (HarperCollins, 1994).

LAUCKS FOUNDATION, INC.

P. O. BOX 5012, SANTA BARBARA, CA. 93150-5012