



Promoting Health As a Sustainable State

Part 1

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Declines in mortality rates and variations in fertility rates, in both developed and developing countries, cannot be ascribed simply to improved medical interventions; the reasons must be sought in a whole range of socio-economic explanations, including improved nutrition and sanitation, access to employment and education, and more equitable distribution of resources. Within 30 years the world will have to support three billion more people than today, with the growth mostly in the South. Increased production of food and other goods and services to meet the needs of these increased numbers is subjecting the world's resources to unsustainable stress. The full context of the "population problem" includes not only the ecological, but also the technological and political constraints that determine the earth's carrying capacity. [M&GS 1995:162-175]

An anthropologist with great concern for the health and the health care services of an indigenous ethnic population in the Amazons came back quite worried from his last trip to the area, one of the many he has taken in the last 15 years. The health status of the communities he studies, in the process of getting "acculturated" to modern ways of life and modern health services, has been improving -- at least in terms of reduced infant and child mortality. As a consequence, the local population is growing very fast (4.6% per year, doubling time 15 years) [1].

Since the traditional means of subsistence cannot satisfy either the needs of the

expanding families or the new social requirements of modern life, most groups have already taken up market-oriented activities. People still practice slash and burn agriculture, forest hunting, and river fishing, but they have also started rearing cattle and growing cash crops, in the attempt to produce as much and as fast as they can.

This anthropologist is wondering about how long the land will be able to provide for the needs of a population in such rapid expansion (a fixed territory is assigned by the state to each community and cannot be increased without encroaching upon the land of other communities). How long will the people manage to maintain their cultural and social identity in the face of necessarily fast and pervasive change? How long will the local environment be able to cope with the mounting burden of stress and exploitation? Could the health gains of the last decades be

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lost again in a not too distant future? Is there anything that health professionals can do to prevent this from happening?

Part 1 of this paper reflects from an historical perspective on situations like the one just mentioned. It starts with a brief review of the demographic changes that occurred in the past -- in particular in the last couple of centuries -- and broadly outlines some health and socio-economic phenomena closely related to them. It then considers whether and in what ways the growth of population -- in many ways the result of splendid and unprecedented health achievements -- may actually endanger health and the environment of life in the long run.

Population growth increases the demand for resources and may intensify the pressure on natural environments beyond what is reason ably sustainable. Yet many other phenomena have an impact upon natural environments. Misguided national legislation and policies, lack of suitable management institutions, inequitable access to resources, insecurity of tenure, unchecked market demands, harmful technologies, poor accounting of costs and benefits of productive practices, and poor or non-existent technical support all contribute to socio-environmental degradation, often more severely than population growth. We need to face a whole range of phenomena -- and not only unchecked population growth -- to protect our natural environments and sustain our health achievements in the future. For us -- health professionals concerned with health as a sustainable state -- is there a way to contribute to escape from the "demographic trap" and to develop a more equitable and sustainable use of resources?

Community-Based Sustainability

Part 2 of the paper will recall a few lessons from past and recent history that stand out to provide positive indications. First, demographic and ecological problems possess unique and fundamental local dimensions, which can only be approached with the full involvement of the concerned communities. Second, such involvement can often be achieved via a participatory assessment of problems and a participatory development of solutions -- with emphasis on the full and active role of women. Third, effective and sustainable solutions are found when ever communities can manage their environment in a sustainable way while meeting their own needs (trying to obtain the one at the expense of the other is foolish). Fourth, for this process to unfold, communities need a strong internal organization as well as several forms of external support. Primary environmental care (PEC) -- a community-

Table 1. Estimates of World Population Growth and Doubling Times

Period	Pop size (millions)	Mean Annual Growth Rate (%)	Doubling Time (years)
8000 BC	5 - 10	0.036	2000
1-14 AD	300	--	--
1000	310	--	--
1500	490	--	--
1750	765	0.4	170
1850	1300	0.5	130
1950	2500	0.8	87
1975	4000	1.9	36
1990	5300	1.73	40
1995	(5770)	(1.63)	(43)

Sources: Durand (1977) [7], Murdoch (1980) [65] and WRI (1991) [33]
Data in parentheses are projections from WRI (1992) [9]

based approach to equitable and sustainable management of local resources developed on the basis of the above lessons -- will be described and illustrated with some examples. Health professionals can contribute in a variety of ways to promote and support primary environmental care and, thereby, uphold health as a sustainable state.

Part 1: The Growth of Population

The term "population problem" is often used with reference to the current demographic outlook of the world's population. As illustrated in Table 1, our current size and rate of growth stand out dramatically against the background of past millennia. From about half a million years ago to around 10,000 B.C. the world population (homo sapiens) is supposed to have remained well below ten million worldwide. The first rise took place with the development of agriculture and, 2,000 years ago, the world population was about 300 million and slowly growing (an estimated doubling time of 1,240 years is reported by Coale [15]). Today we are 18 times that size (5.5 billion), and we double in about 40 years. India alone has three times the entire world population than at the time of the birth of Christ.

The demographic change from 2,000 years ago to today has been neither smooth nor continuous, particularly for populations confined to specific areas that have shown rapid growth in times of peace and abundance, but sharp decreases due to epidemics, wars, and famines.¹ (Figure 1). Cases of severe depopulation and outright extinction of particular ethnic groups have also been documented up to our century [5,6].

Uncertainties about size and changes over time for the population of different areas

1. The matter is extensively discussed by [2,3,4].

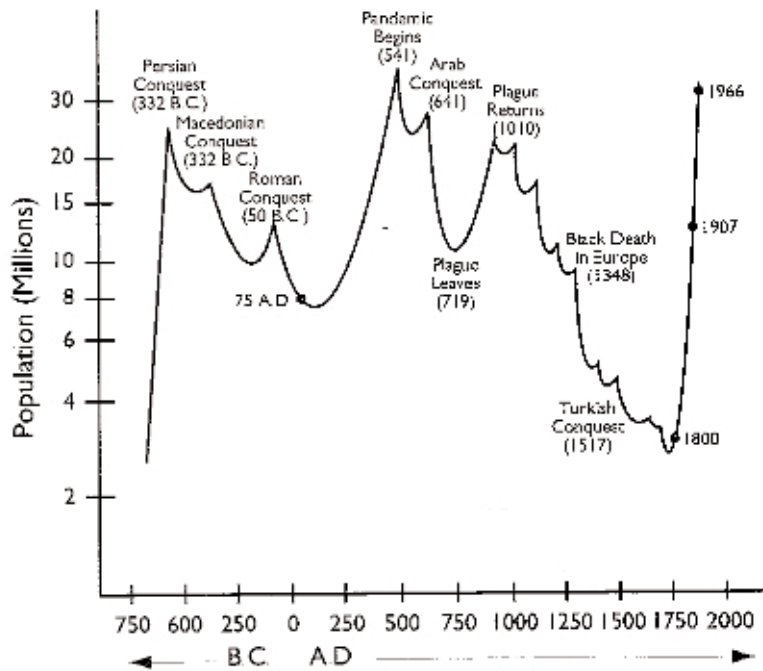


Figure 1. Population of Egypt, 664 BC to 1966 AD Redrawn from page 3 of Murdoch (1980) [65]

of the world are extensively discussed by Durand [7] (most of the estimates reported below are from his 1977 paper). There seems to be a general agreement on an initial growth from the beginning of the agricultural age to the beginning of the first millennium, followed by slower growth or stagnation during the first millennium. In Europe and China, demographic growth revived from 1000 to 1300 A.D., to be arrested again in the 14th and 17th centuries.²

For world figures, a setback probably occurred in the 16th century because of severe depopulation of the American continent after the arrival of Europeans [5,6]. Then, from 1750 on, global setbacks disappear and demographic growth picks up in all world regions.³

Interestingly, the trend is upward not only in western Europe -- where it has been associated with the unfolding of the industrial revolution -- but also in China, which in the 18th and 19th centuries did not experience any modernization of the economy and in Russia, where such a process was at best minimal. Substantial population increase in the 19th century is also reported for the Indian region, North Africa, South Asia, and

2 In Europe, the decline is associated with epidemics of black plague. The synchronism of the decline in Europe and China is remarkable (see also note 13).

3. Satisfactory documentation exists for Europe, India, China, Japan, Russia, and North America [7].

Middle and South America.⁴

In our century, the phenomenon has become a veritable "demographic avalanche."⁵ The term "avalanche" is not improper, as simple arithmetic can show. Although it took about a million years for us to become as many as we are today, at the recent pace of demographic expansion in about 700 years there would be standing room only on our planet⁶ Fortunately, there is evidence that the growth rate of world population⁷ has already peaked [9] (Table 1) and, although the absolute numbers are still bound to increase, there is hope of stabilizing our demographic size in a not-so-distant future. It is even possible to hypothesize a global non-catastrophic demographic decline sometime after the next century,⁸ although local catastrophes (e.g., famines, chronic malnutrition, disastrous flooding) are already exacting their toll, and are likely to increase in number and severity in the future [13,14].

The Determinants of Population Growth

What is the origin of our impressive demographic growth? In the absence of migration phenomena, a population grows only when the number of births becomes and remains consistently higher than the number of deaths, i.e. when fertility increases, or mortality decreases, or both. For the last couple of

4. For a possible explanation of this synchronism, see note 13.

5. Following [8], the author prefers to speak of an "avalanche" rather than an "explosion," since population growth is not a sudden event, as the word explosion may suggest, but a continuous, cumulative, and geometrically growing process that becomes more and more impressive with the passing of time.

6. This would correspond to one person per square foot of earth's surface, obviously an absurd scenario, mentioned only to picture how demographic growth at the current pace is unsustainable.

7. The growth rate in a given year is the rate at which a population is increasing (or decreasing) in that year due to natural increase (births minus deaths) and net migration (immigrants minus emigrants, which is nil for the world population). It is expressed as a percentage of the base population.

8. Recent UN projections are for a size of 8.5 billion in 2025 [10], and the World Bank estimated an hypothetical stationary population of 11.2 billion [11]. Projections for the year 2100 vary from a low of 7.2 billion to a high of 14.9 billion [12], strongly depending on changes in fertility that should happen now and in the very next future. In fact, if average fertility would change from 6 to 3, a woman starting her reproductive life today will have 27 great-grandchildren rather than 216.

centuries, historical demographers have ruled out any major and/or consistent rise in fertility.⁹ In fact, they rather point at a consistent decrease in mortality. Coale [15] estimates that at the beginning of the first millennium the crude death rate¹⁰ was about 50 per 1,000 and that 300 of 1,000 infants born alive could expect to die before reaching one year of age. Since population size was approximately stable, deaths and births roughly matched, i.e. the crude birth rate¹¹ was also about 50 per thousand. This means that 2,000 years ago a woman could expect to bear more than six children during her lifetime.

In the following centuries, mortality is likely to have varied widely according to time and location, but continuous data were collected only on rare occasions and for limited areas (e.g. an individual parish). Likely, fertility varied much less than mortality, and remained approximately constant and very high. Reliable series of national censuses taken at intervals of no more than 10 years became available only in the last couple of centuries. In Sweden, they began in 1750, in the U.S. in 1790, and in France, England, and Wales the first data were collected around 1800.¹² All the surveyed populations were found to be expanding [16], with a yearly excess of births over deaths. In addition, as shown in Figure 2, the mortality rate was on a declining trend.

Why was mortality declining and why did the decline take place roughly at the same time in all lands occupied by humans? A detailed discussion of the reasons of this phenomenon is beyond the aims of this paper.¹³ It may suffice

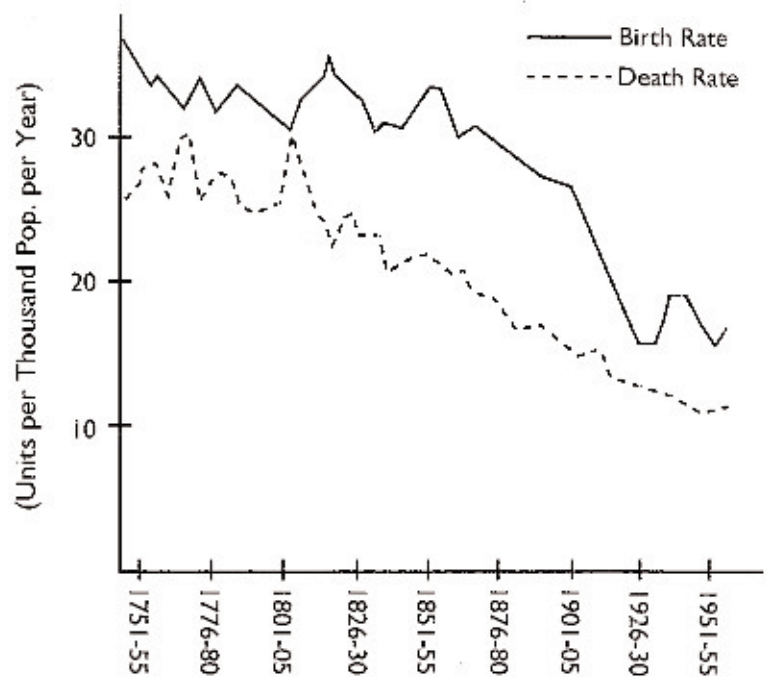


Figure 2. The demographic transition in Sweden. Redrawn from page 55 of Sundin (1990) [19]

to say that, for England, for Wales, and for Sweden, a great part of the decline has been ascribed to decreasing infant and child mortality from infectious diseases [18,19]. A well known interpretation states that fewer children died because their nutritional status was improving (in turn, due to the increased availability of food during the agricultural-industrial revolution) [20]. Others argue that protection from smallpox¹⁴ and improvements in safe

9. If anything, there is more evidence for a decline. In fact, such a decline is documented for France and the U.S. already from the beginning of the 19th century, while in other countries it began only towards the end of the century. Coale [15] points out a seemingly universal feature of the demographic transition, namely that while in times of high fertility and high mortality the birth rate is relatively constant and the death rate fluctuates (because of epidemics, variations in food supply, etc.), in times of low fertility and low mortality, the death rate remains quite constant, but the birth rate varies considerably.

10. The number of deaths per 1,000 population in a given year.

11. The number of births per 1,000 population in a given year (not to be confused with the growth rate or the fertility).

12. National censuses for China are available for earlier times, but their reliability has been questioned. The population of India, of Russia, and of a number of Latin American countries has been enumerated only since the late 19th century.

13. As pointed out by Braudel, the phenomenon is the more puzzling because it happened

simultaneously throughout the world. If for the European countries we could associate it with socio-economic change related to the industrial revolution, this is not possible for the rest of the world, and Braudel [3] speculates about a cause as far-reaching as global climate change. Such a hypothesis has been discussed with particular poignancy by Galloway [17] who argues that long term variations in climate may have influenced agricultural yields (and, therefore, nutrition, resistance to disease, and fertility) as well as mortality (harsher winter temperatures). Climate change could also be responsible for influencing the spreading of infections, and for creating an unpredictably variable weather capable of disrupting socio-economic life simultaneously throughout the world. If this is correct, from the 18th century on we would have a major example of a global climate change provoking a global demographic response (another such instance could be the population decline in Europe and China around 1400).

14. Braudel [3] reports that around 1770 smallpox was considered "the most general of all diseases," affecting 95% of all people, and with a

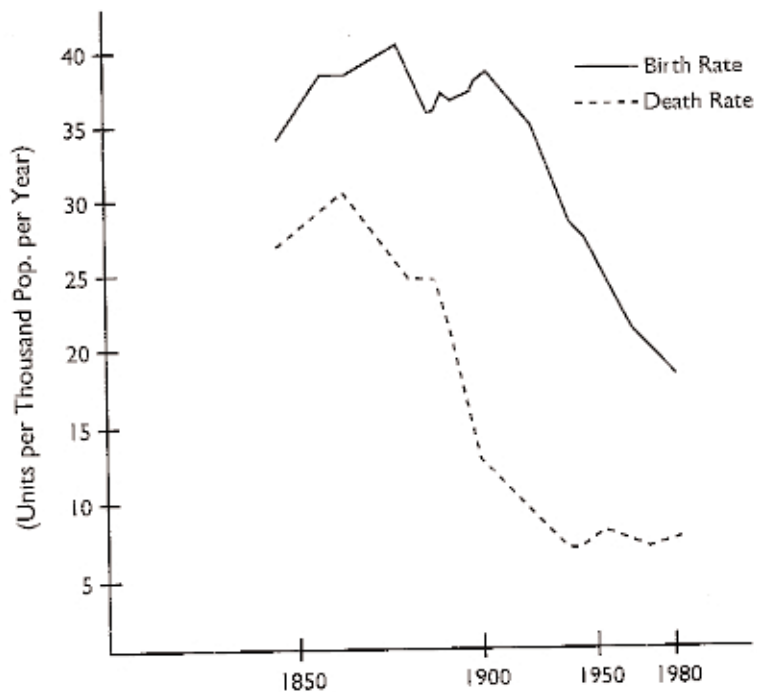


Figure 3. The demographic transition in Sri Lanka. Redrawn from Mahler (1980) [40]

water supply, sanitation, and hygiene¹⁵ were major contributors. Still others argue for a complex combination of events, including major changes in the virulence, transmission patterns, host habitats, and relative herd immunity of various infectious diseases¹⁶ [21,26]. Besides smallpox inoculation (introduced in the 18th century), medical interventions did not play a significant role in the reduction of mortality for infectious diseases, since effective medical therapies for such diseases only became available well into the 20th century, when most of the mortality decline had already occurred [18,8].

In 19th century Europe, some enlightened health professionals originated a body

mortality rate of about 7 out of 100 affected. Inoculation -- for centuries known and practiced at a folk level in Arabia, North Africa, Persia, and India -- began to be widely practiced in rural England and the English colonies of America in the early 18th century, while in urban England and other countries of continental Europe the practice spread only in the 19th century. McNeill [2] stresses that smallpox inoculation reinforced and expanded demographic growth.

15. See [19], although some historians would dispute that such improvements affected any relevant number of people before the end of the 19th century. For Sweden, Sumdin also points at a possible beneficial effect of increased breast feeding practices.

16. For Livi-Bacci, the increased immunity derived from a self-sustaining disease-disease interaction, i.e. fewer people died, because their immune system was stronger, because it had

of knowledge and practice that can be described as "social epidemiology",¹⁷ based on the following premises:

* socio-economic conditions have a decisive effect on health (epidemiological facts have social roots);

* the effects of socio-economic conditions on health need to be thoroughly investigated and public health should be a matter of utmost importance to the state (epidemiological facts have social meaning);

* whenever socio-economic improvements are found to be more effective than "medical" ones, these should be pursued (epidemiological facts demand social responses).

Among the first health professionals who clearly espoused these principles were Salomon Neumann (1847) and Rudolf Virchow (about 1858). "Medical science is intrinsically and essentially a social science...without social statistics there can be no efficient organization of medical activity...it is the duty of society -- i.e. of the state -- to protect and, when endangered, to save the lives and the health of its citizens...", Neumann has written. According to Virchow, "Medicine is a social science, and politics is nothing more than medicine in a larger scale."

Virchow was convinced that while the health care service can play a significant part in reducing inequalities in health, measures of even greater importance are the ones that reduce inequities and improve the material standards of living in the home, at work, and in everyday social and community life.¹⁸ Thus, according to the "social epidemiologists," these measures should be at the roots of the mortality decline.

In European countries and North

not been weakened by prior diseases. Possibly this was initiated by ecological change of disease agents and/or by the establishment of endemic conditions of diseases (increased mobility of the human population). Livi-Bacci also stresses that, prior to the industrial revolution, there were elite social groups who could enjoy a much richer diet than the rest of population. Their mortality rates, however, did not differ substantially from the ones of the rest of their contemporary population. Thus, the disease-disease interaction, rather than the nutrition-disease interaction would be the main determinant of decreased mortality [4,21].

17. The author prefers the term "social epidemiology" to "social medicine," given the clear non-clinical orientation.

18. See [22] and references therein. In 1828, L.R. Villerme had proved that mortality and morbidity rates in Paris were a function of the liv-

America the decline continued unabated in the 20th century, paralleled by a combination of far-reaching socio-economic and behavioral change. These included improvements in safe water supply, sanitation, and nutrition (including breast feeding), personal hygiene, income from regular employment, social security, education, preventive measures in public health (such as vaccination and inspection of food premises), and curative measures in medicine (such as antibiotics, early diagnosis, and surgical treatments). The change factors are so many and so interrelated that it is extremely difficult to separate their single contributions. It has been stressed, however, that -- common beliefs notwithstanding -- even in the 20th century the influence of "medical" interventions on the total mortality decline (including the influence of effective vaccines and drugs) has been very limited.¹⁹

Beginning around the second quarter of our century the collection of fertility and mortality data became common in all countries, including the countries of the South that were slowly emerging from colonial domination.²⁰ These data²¹ reveal a mortality decline that took place throughout the world at a more rapid pace than the one in England

ing conditions of the working class and, in 1842, E. Chadwick found a similar relationship between class and mortality in London [23]. Around the middle of the century, Friedrich Engels discussed at length the social origins of disease [24], and John Snow and others -- who produced some of the first and most enlightening epidemiological investigations of cholera in England [25] -- stated that its prevention included better living and working conditions for the poor. About the socio-political determinants of cholera epidemics in the last century, see also the enlightening study of Evans [26]. Virchow was also a "precursor" of Health Impact Assessment studies, since he explicitly stressed that these improvements (what today we call "development projects") should be associated with preventive measures (so that new technologies, new working procedures, changes in lifestyle, etc. do not undermine what has already been achieved).

19. A detailed study of mortality for specific diseases in the U.S. from 1900 through 1973 reveals that the greatest part of the decrease was achieved before effective means of prevention and cure were adopted. For influenza, pneumonia, diphtheria, pertussis, and poliomyelitis only 3.5% of the mortality decline could be ascribed to medical procedures [28].

20. In this paper the author does not deal with the increased mortality and depopulation that has accompanied the European expansion during colonialism (see, for instance, [5] and [29]).

21. See [30], [31], [32]. The accuracy and reliability of the data, however, are not often impressive.

Declining Human Mortality Over Three Centuries

Using data that first started to become available in the mid-1700s, demographers have observed a sharp decline in mortality rates in Europe and the U.S. A number of reasons have been suggested for the decline, including:

- * decreasing infant and child mortality from infectious diseases;
- * improvements in nutrition and increased availability of food;
- * improvements in safe water supply, sanitation, and hygiene;
- * changes in infectious disease transmission patterns;
- * introduction of smallpox inoculations;
- * improved socio-economic conditions, including employment income, social security, education, and preventive public health measures.

and Sweden during the previous century²² (Figure 3). Unfortunately, the trend has at places slowed down [34] and "pockets" of very high mortality remain, especially among the very poor [35].

As in the case of European countries and the U.S., the determinants of mortality decline in the countries of the South include the diffusion and use of effective means of preventive and curative care and it cannot be excluded that some broad ecological change in the conditions leading to presence, type, and virulence of pathogens played an important role.²³ The key factors, however, are again reported to be broad improvements in nutrition, safe water supply, sanitation, improved housing, personal hygiene, access to employment and education, and socio-political change (such as more equitable distribution of resources and services, improved status of women, greater community involvement in decision-making).²⁴

The following quote illustrates the

22. Virtually no country remained unaffected, but different societies achieved mortality declines at a different pace. For instance, in the last two decades or so Ethiopia increased its life expectancy by less than 3 years, Iraq by 11, and Nicaragua by nearly 12. The extent of the decline varied broadly as well, since a person born in 1990 in Somalia or Afghanistan can still expect to live about 10 years less than a person born in Tanzania or Yemen, 20 years less than a person born in Guatemala or Peru, 30 years less than a person born in Korea or Chile, and nearly 40 years less than a person born in Japan or Switzerland [33]. Within a given country, there are also important differences among different social strata, between rural and urban inhabitants and in urban areas, between the well established and the marginal residents.

23. One such change -- the current spread of HIV infection and consequent acquired immunological deficiency syndrome -- may prove to be a demographically disastrous event in the next decades.

24. These factors are discussed -- among others -- by [36,37,38,39,40,41,42,43,44,45,46,47,48,49,

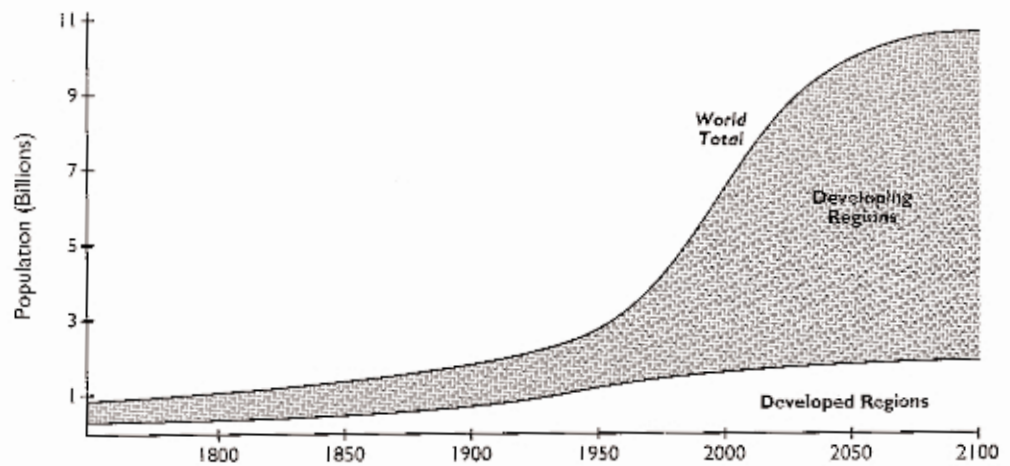


Figure 4. Prospects of population growth. Redrawn from page 16 of IIED and WRI (1989) [80]

broad range of issues that can be found at the heart of today's "social epidemiology":

The health and survival of children depend on many factors: on the health of their fathers and mothers; on the survival skills of their families; on the relative peace or violence in their communities; on the economic and political status of their nations; on whether the wages that people earn or the land they till provide enough to eat; on the availability, quality and cost of education, health services, water, shelter and transportation; on the ability of people to organize and

35,50]. The influence of particular factors has been found to vary considerably from place to place [51] and the ways of change have been quite different, since some of the most remarkable results have been achieved by countries as diverse as Marxist China and capitalist South Korea, and by health policies that emphasize medical interventions (Cuba, Chile) as well as by policies that pursue health via social equity and broad socio-economic improvements (Kerala, Sri Lanka, Costa Rica). Importantly, only a few countries have already seen a decrease in fertility matching or approaching the size of their decrease in mortality. The combination of the factors leading to mortality decline and general health improvements is articulated in the comprehensive Primary Health Care strategy promoted by the World Health Organization [52]; see also [53]. Others (e.g. [54]) have stressed the need for a more "selective" approach, privileging the promotion of breast feeding, immunization against childhood infections, oral rehydration therapy, and growth monitoring ("...a veritable child survival revolution has begun to spread across the world...taken together, immunization and oral rehydration therapy are saving the lives of approximately 2 million children each year..." [55]). For a review of the debate, see [56].

defend their rights; on local consumption of alcohol, tobacco and narcotics; on who has power over whom; on war;...on military expenditures relative to public service expenditures; on international trade relations; on preservation or destruction of the environment; on how far a mother has to walk to get firewood or cow manure for cooking;...on undermining of grassroots movements;...on whether the banks will be permitted to continue protecting their billions by taking away food, health care and education from destitute children [57].

The Demographic Transition

Lower mortality means that more people reach adulthood and generate children of their own. Thus, until the birth rate decreases to match the lower death rate, or a large wave of out-migration takes place, a population is bound to expand. This is what happened in European countries such as Sweden and England (including Wales), whose birth rates remained considerably higher than their death rates for several generations, and whose demographic size respectively doubled and quadrupled from 1800 to 1900. In these countries fertility decreased,²⁵ but later and/or less rapidly than mortality. Recently, fertility has come down again to match mortality in most industrialized countries and their populations have regained a sort of

25. Fertility is defined as the average number of children projected to be born to each woman upon completion of her childbearing years, assuming that the current age-specific fertility rates will remain constant. This paper does not discuss the determinants of such an historical decline, an extremely rich subject in social and demographic literature. The author wishes to mention only one of them: the increased use of

equilibrium.²⁶ Again -- similar to the situation that pertained 2,000 years ago -- there is little or no natural growth, but only one out of a hundred infants is likely to die before age one, the average life expectancy is above 75, and women tend to bear no more than two children in their lifetime.

The period and process by which a country moves from a condition of high mortality and fertility to one of low mortality and fertility -- which is usually the period in which a population dramatically expands -- has come to be referred to as "demographic transition" [58]. For most European countries this period lasted well above a century and, as population grew, the economy expanded and migration to foreign countries was possible as a means to relieve the pressure. For today's developing countries the situation is quite different [59]. The great part of the mortality decline that took two hundred years in Sweden is happening in a few decades in a country such as China or Egypt, and in many areas of the world fertility rates still are (or have been until recently) far higher than those of Sweden in the 18th century [33]. The resulting population growth is well in excess of 2% per year -- a value never attained during the demographic transition in Europe and North America -- and is often unmatched by the country's economic growth. In addition, many of these countries lack political stability, favorable international terms of trade, and chances of migration to foreign countries -- all points of strength for the industrial-demographic pioneers in the last century.²⁷ Taken as a whole, the demographic stresses of today are unprecedented.

Despite the challenge, there are several success stories. China and Thailand, which

contraceptives by married couples, probably following a change in perceived benefits and liabilities of large families.

26. In Sweden, the UK, other European countries, and North America, fertility has declined so much that is now below replacement level (deaths over number births). (Fertility rate at replacement level is about 2.1, and the average value for 1985-1990 for Sweden was 1.7 and for the UK 1.8). These populations have nearly reached a demographic equilibrium, with a death rate of about 12 per 1,000 matching a birth rate of about 12 per 1,000. Noticeably, with fertility rate below replacement level, births can still exceed deaths because of the demographic "momentum" accumulated in previous cohorts of population. And population can still grow because of that, or because of foreign immigration.

27. In addition, many high fertility countries are not favored in terms of climate, natural resources, potential for exploiting new technologies, and cultural attitudes towards fertility, including religious beliefs and customs that

started with fertility rates above six about 40 years ago, have nearly reached the replacement level (a little above two); Cuba and South Korea have gone lower yet; and other countries, such as Brazil and South Africa, have achieved levels lower than the ones anticipated a few years ago [33]. In the same period, however, other countries that started with high fertility rates (e.g., Nepal, Tanzania, and Bolivia) have hardly seen any change and some (e.g., India, Bangladesh, Iran, and Pakistan) are now projected to have considerably higher populations than was foreseen some years ago [33].

A population that is expanding possesses a relatively large number of young people who, as they enter the reproductive age, constitute a powerful momentum for further demographic growth.²⁸ This is why the populations of China and Thailand will still expand for a while before stabilizing in a not too distant future. The long term prospects are different for countries such as Ivory Coast, Zambia, Saudi Arabia, Kenya, and Niger, whose women, on average, still bear more than seven children, and whose populations are bound to grow in the decades to come. In fact, it has been estimated that Nigeria's population (with fertility nearly constant at seven for the last 30 years) will be able to reach a stationary state only by the time its size has attained 618 millions, approximately the size of the whole of Africa's present population²⁹ [61].

Many factors have played a role in creating and maintaining these differences in fertility.

In some countries, such as China and Taiwan, birth rates have fallen as a consequence of vigorous family planning campaigns instituted by governments [62] and in others, such as Cuba and Sri Lanka, they have done so more as a consequence of socio-economic development and equitable distribution of its benefits [63]. The access to contraceptives and services in family planning played an important role³⁰ but so also did urbanization and the sustained decrease in

compel women to marry at very early ages. See the extensive discussion by Todaro [60].

28. The faster a population expands, the stronger its momentum for growth and the more difficult to reverse it, since the percentage of people entering reproductive age increases correspondingly.

29. As a continent, Africa remains the one with highest fertility (average above 6) and highest birth rate (average about 45 per 1,000 per year, to be compared with the average death rate of 15 per 1,000 per year).

30. Better results could be obtained if women could freely chose the techniques according to their own felt needs [63].

childhood mortality [64]. Virtually in all countries, an increased access to education and employment by women has been a very important factor.³¹

The "child survival hypothesis" states that poor families (for whom children are a source of labor and the only assurance of help in the parents' old age) need to be sure that at least a few of their children survive their early, dangerous years. If personal experience and/or community perception tell them that the chances of survival of their children are improving, they are less likely to have many children.³² There is evidence that this hypothesis is correct, but not in all circumstances, and in particular not wherever labor is the limiting factor of production or where there is limited or no access to means of contraception [68]. A related view states that poor people have large families because this is for them an economically rational decision [69,65] and will continue to be so as long as there are power structures maintaining a skewed distribution of life-sustaining resources [70]. In this view, fertility is expected to fall only with the effort to establish social justice and economic welfare [71]. An appropriate indicator of such welfare would be the level of education and income of the parents, and especially of the mother [65], who needs to acquire alternative sources of status and security and more power of choice over her reproductive life [63,70].

All the factors just mentioned, although generally important in influencing fertility, should not be generalized or interpreted as necessary predictors for any specific population: reproductive behavior is a culture-specific and context-specific phenomenon. Yet, if one indication is to be drawn from history, this is that the well being and independence of women are key determinants of fertility. Countries in which women have full access to education, employment, health and family planning services, and legal rights are usually the ones in which fertility has a chance to decrease, and to decrease fast [72,55,64,66].

31. See, for instance, [65,67,61,66]. The association between fertility reduction and women's formal education appears only after a few years of schooling, approximately when primary education is completed. Increased income of women, however, seems always to be an important factor in fertility decrease. Noticeably, in many high fertility countries the dominant religion is Islam, and the levels of literacy, years of formal education, employment and income of women are quite low.

32. Besides parental motivations, lower child mortality may influence fertility because breast feeding women are less likely to become pregnant for both physiological and socio-cultural reasons.

A "Population Problem?"

Given the brief account sketched above, we can ask the first key question of this paper: is demographic growth a "problem?" For a health professional, it may look exactly the opposite. Our growth reveals the success of our biological and cultural adaptation to the environment, and it is the grandiose facade of a variety of improvements in life conditions: fewer children die, people live longer (and healthier) lives and have access to goods and services they could not dream of just a few years ago. For the sheer number of people affected, these phenomena represent magnificent achievements and should never be underestimated, especially by those who have no direct experience of times and places with a life expectancy of 30 or 35. Why, then, should we worry about our expanding numbers and about the ways of dealing with nature that have enabled us to achieve them? Some reasons we should have to do with equity, quality of life, and sustainability.

Equity and Quality of Life

Thirty years from now the world will have to support three billion more people than today [10]. These people will be born mostly in the countries of the South (Figure 4) and, among them, in the poorest ones and the ones in which income is most unevenly distributed.³³ In such situations, children are expected to be an economic asset for a family, and a chance to diversify its strategy of survival. Unfortunately, on a finite and already deteriorating base of resources and in the context of inappropriate and insufficient increases in production, such family expectations may never be fulfilled.

Today, one person in five still cannot get enough food to support an active working life. One quarter of the world's people still are without safe drinking water, and many more are without proper housing and sanitation. Millions of children still die from malnutrition and preventable diseases, and half a million women die each year from pregnancy-related problems. Is it reasonable to expect that vast increases in human numbers will be compatible with improvements in health and quality of life for the multitudes in need?³⁴ For some it is more reasonable to expect that the weight of population growth will end up as another

33. Most of the variability in fertility among developing nations can be "explained" by the level of economic welfare of the poorest families in each country [65]. In general, high fertility is a problem of the poor, both internationally and nationally.

34. An intriguing argument presented by Esther Boserup [73] sees demographic growth as a main stimulus towards technological

burden on the shoulders of the poor [74].

Before 1940, nearly all the world's region but Europe were food exporters. Today, only the U.S., the European Community, Canada, Australia, New Zealand, Argentina, and Thailand produce more food than their inhabitants can consume. Most other countries are net food importers and have become dependent on foreign production for their basic necessities of life. Is it reasonable to expect that the sub Saharan region -- unable to feed its present population -- will soon produce (or be able to buy in the international market) extra food for 15-20 million additional people every year? If not, what quality of life could these people hope for?

And there is more to "quality of life" than satisfying material needs. As Heyneman wrote in 1984:

The essence of pre-industrial, indigenous societies is their variety and local adaptation. Each is tied to a specific habitat, and has evolved its cultural and behavioral expression. The wide variety of resulting human social forms is a response to an equal variety of habitats, each with a set of distinctive environmental constraints. In almost diametrical opposition, industrial technological development is characterized by a controlled, relatively uniform and highly simplified environment....High levels of environmental pauperization and widely distributed homogenization characterize industrial societies in

progress. Increased numbers of people would have promoted the use of fire, the domestication of animals, the storage of food and, finally, the development of agriculture, a productive system able to take care of much larger populations than hunting-gathering. In the following millennia, population growth would have again driven improvements in agricultural productivity via both technical innovations and the reorganization of societies. More recently, population growth would be the motor of the industrial revolution and of contemporary development (in fact, Boserup expects it to be in the future the motor of other innovations, which will take care of the problems created by our swelled demographic size). A price needs to be paid for the improvements in productivity (perhaps longer working hours or a more disciplined society) but Boserup stresses that human ingenuity has managed to improve, or at least maintain, the quality of life even on the face of increasing numbers. Indeed, population growth is seen by some governments as a compelling reason to modernize their economy. Whether and to what extent modernized economies succeed in meeting the needs of their growing population is a question that can only be answered by history.

all political and economic systems throughout the world [75].

Thus, some fear that increased numbers of people could be sustained only by technological might and pervasive socio-cultural change, all at the expense of patiently crafted cultural peculiarities. Throughout centuries, local cultures evolved through slow and unique combinations of resistance and adaptation to their environments. Today these cultures are simultaneously facing the impact of pervasive socio-economic change (including expanded markets and loss of access and control over local resources, in particular the ones that were held in communal property regimes) and the impact of rapid change in ecological conditions (e.g. lesser quantity and quality of resources, loss of biological diversity, increased size of human population). Indicators of "quantitative" health and welfare -- e.g. a decline in mortality rate and an increased national product per capita -- tell us little about quality of life, a phenomenon involving culturally relative perceptions of well being, independence, productivity, social involvement, and meaning of existence. In the words of McNicoll:

...the submergence of local cultural forms and traditions in a homogeneous culture of mass consumption seems an inescapable part of the development process and leaves a society poorer in many aesthetic respects even though, in real consumption terms, it is much richer....[76]

Environmental Sustainability

A mortality reduction and/or an increase in the number of births are immediate determinants of demographic expansion. A more basic determinant, underlying the immediate ones, is the growth in production of essential goods and services -- in particular production of food. It was one of the key points of Malthus (1798)³⁵ [77] that the growth of population, potentially in geometrical progression, would be kept in check by the more limited potential for growth in food production. This premise will inevitably prove correct in the long run, but -- so far -- global food production has managed to keep pace with the growth of population as well as with the growth of demand due to greater affluence.³⁶ How has this been possible? During the so-called agricultural revolution

35. And of Giovanni Botero (The Causes of the Greatness of Cities, 1588) more than two hundred years before him.

36. Each "affluent" person consumes well above twice the quantity of basic staple food (e.g.

and industrial revolution, from the second half of the 18th century, agricultural productivity improved dramatically under the influence of advances in farming systems (e.g. the use of new ploughs, planting methods, rotations of crops and nitrogen-fixing plants, improved animal breeding, and cultivation of new crops, such as turnips, maize, and potatoes), the enclosure and agricultural use of new fields, and the development of a market-oriented production mentality [79]. Among the new fields were the lands of North America, which were rapidly brought under cultivation and their products transferred to Europe by new means of transportation (railways, steamships, etc.). In China, increased food production was possible because of the progressive introduction of new crops, for instance corn (around 1550), sweet potatoes and peanuts (around 1600), and white potatoes (around 1750) [8].

In our century, increased food demands have been met by progressively increasing the total amount of land under cultivation. Estimates are that land under cultivation worldwide more than doubled from 1850 to 1950 [80] and has tripled by now. More recently, production increases have profited from new technologies (e.g. tractors, harvesters), buildings and engineering works (e.g. green houses, storage tanks, irrigation systems) and especially from an intensive use of inputs like water, fertilizers, and pesticides to cultivate new "high-response" crop varieties (green revolution). Industrial food production is energy intensive, and much of the energy (e.g. for irrigation, for the fertilizers and pesticides, for running agricultural machines) derives from fossil fuels. In a sense, we could say that people have become capable of turning oil into food, but this is not without serious ecological costs, and cannot be sustained ad infinitum.³⁷

For many, this is the core of the problem. Increasing numbers of people can only be supported by increasing production of goods and services. To accomplish this, the world resources are being subjected to unsustainable stress. In fact, primary forests have already been

wheat, corn, and rice) of poorer people. Such consumption is often indirect, with the staple food being fed to livestock and poultry, which are then consumed. Thus, the rise in the number of affluent people adds to the rise in food demand due to population growth [60,78].

37. A well argued estimate of a maximum planetary carrying capacity of 7.5 billion people is offered by Gilland [81]. There are, however, people who do not worry in the least, and expect technological change to take care of virtually any size of population in our planet [82]. Data relative to the state of world resources are listed and discussed in [9].

cut, marginal lands put under cultivation, fragile pastures overgrazed and degraded, soils exhausted and eroded, and freshwater sources depleted. Swelled cities and industries have already multiplied the demands for energy and non-renewable resources, and produced huge amounts of waste. Large scale pollution has already ensued, including phenomena contributing to global warming, ozone depletion in the stratosphere, and acid rain. Many unique habitats have already disappeared and, with them, irreplaceable genetic varieties and species are gone forever. In many ways -- the argument goes -- this global pattern of environmental degradation can only end up by undermining human life, both indirectly (e.g. because of failure of production, and/or consequent social unrest) and directly (e.g. because of natural catastrophes or changing patterns of disease).

In addition, an environmentally sound use of natural resources implies the capacity to invest capital, time, and labor for long term goals. This can be afforded more easily by a relatively stable population than by an expanding population, whose needs and requirements swell at least as much as the number of people.³⁸ Moreover, the expanding numbers are the ones of the poor. On the one hand, the poor are the most careful caretakers of resources. On the other, they do not possess many alternatives to satisfy their daily requirements. In times of emergency or dire need they may be forced to scrape the "environmental barrel" to the very bottom. In the long run, continuous increases in human numbers will surely work against a sustainable use of resources.

The picture is frightening. Yet if it is true that we need to act rapidly to stabilize the population before exhausting natural resources, it is also true that people are not only mouths to be fed or producers of waste. They are also ideas, personal and social relations, productive work, emotions, culture, solutions. Population growth is not "only a problem" [84,85]. Even more important, it is not the only nor the major cause of environmental degradation. Exploiting resources to benefit the increasingly affluent lifestyles of a few is often much more disruptive than doing so to satisfy the needs of the many poor.³⁹ Throughout the world, the rich consume more and produce more waste than the poor.⁴⁰ Often it is lack of equitable access and secure tenure that prevents a wise use of resources. Or it is lack of protective regula-

38. See, however, the contrasting views of Simon [83] and Boserup [73].

39. For the specific problem of global warming see [86].

40. The relationship between poverty and environmental degradation often assumed to be

tions and adequate pricing for common goods, such as clean air, water, forests, seas, and biological diversity. Most frequently, environmental pollution and degradation can be directly related to inappropriate technology, institutional constraints, and careless policies.⁴¹ Surely population growth is not "the only" problem.

Recent history provides enough evidence for the above, since a combination of inequitable land distribution, unchecked market forces, misguided policies, and ineffective systems of resource management -- quite independently of population growth -- have been at the root of much environmental damage. Moreover, the same market forces that -- through trade -- can greatly improve the amount and quality of goods available to a given community, can also provide an insatiable demand for a local resource and result in its rapid depletion, even in conditions of stable or decreasing population size. Finally, the breakdown of traditional systems of local management⁴² -- too often violently imposed by state policies -- has replaced much local environmental care with next to nothing. This, in the opinion of many, is the real "tragedy of the commons."⁴³

The above leads us towards considering population growth within its real context, which is certainly more than purely ecological. It is only within a particular set of socio-economic, political, and technological constraints that one can (roughly) calculate a "number of people who can be sustained" on an environmental resource basis (a sort of carrying capacity) and thus have a term of

straightforward, with the former causing the latter -- is poignantly criticized by Mitlin and Satterthwaite [87].

41. In rough terms, an environmental impact I can be described by the following relationship: $I = P \times C \times T$, with P = total number of people, C = average consumption per capita and T = technology involved in the particular consumption. While some stress the powerful effects of the P factor [88], others calculate that the dominant factor is T [89], in particular because of misguided policies [90,91]. Still others would argue that the "equation" is too simplistic, since P, C, and T are treated as independent variables, which they are not [92]. A number of illustrative papers are collected in [93].

42. For centuries, communal property resources have been successfully managed by sophisticated systems based on local institutions and cultures. Foreign invasions, colonial domination, and the omni-pervasive (albeit weak) character of modern state powers have undermined or destroyed many such systems with disastrous social and ecological results. See, for instance: [94,95,96].

43. See [96] in opposition to the better known version of [97].

reference for "excessive" population size. But these constraints are not unchangeable; people can expand or contract the carrying capacity of their environment. We can, for instance, modify lifestyles and consumption patterns, improve policies, technologies, and management practices, increase or decrease trade with outside communities and, in general, change the local systems of access, tenure, and decision-making over resources.

It follows from the above that environmental protection can benefit from stabilising population but only in the context of other changes, such as policy reforms, improved technological options, and more equitable access and tenure arrangements [98,99]. In fact, blaming only population growth for the degradation of natural resources simply "...allows inept or corrupt governments to shift the blame for either their behavior or their inaction -- as the case may be -- to 'promiscuous' peasants" [96].

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