

# Trends in world population: how will the millenium compare with the past?\*

**Veena Soni Raleigh**

National Institute of Epidemiology, University of Surrey, Guildford GU2 5YL, Surrey, UK

This paper reviews historical and projected trends in world population numbers, and the underlying determinants of those trends. Whereas the world's population has shown little change over most of its one million-year history, the past 200 years have witnessed dramatic changes in fertility, mortality and population growth rates. Recent decades, in particular, have seen unprecedented demographic events, with more people added to the world's population in the past 50 years than in the preceding million. The demographic impact of HIV/AIDS, selective as it is to young adults and infants, is also unprecedented, with life expectancy among some populations reduced by almost 20 years. As we approach the end of the 20th century, further demographic changes are underway with, for the first time in recent human history, a slowing down of world population growth. Nonetheless, world population is projected to grow from 6 billion currently to about 9.4 billion by 2050 (medium fertility assumption), with ageing emerging as the most pressing demographic issue facing humanity in the millenium.

*Key words:* demography/life expectancy and population/world population

## TABLE OF CONTENTS

Introduction	500
Historical trends	500
The position now	501
Future trends	503
Demographic impact of HIV/AIDS	503
Conclusions	505
References	505

## Introduction

One of the most influential commentators on the equilibrium between population and resources was the Reverend Thomas Malthus, whose *First Essay on Population* was published in 1798 (Malthus, 1965). Malthus' thesis was that population growth would outstrip resources unless held in check by 'moral restraint' or 'positive checks' such as plague, famine and war. *"Population, when unchecked, increases in a geometrical ratio. Subsistence increases only in an arithmetical ratio. A slight acquaintance with numbers will shew the immensity of the first power in comparison of the second. By that law of our nature which makes food necessary to the life of man, the effects of these two unequal powers must be kept equal"*.

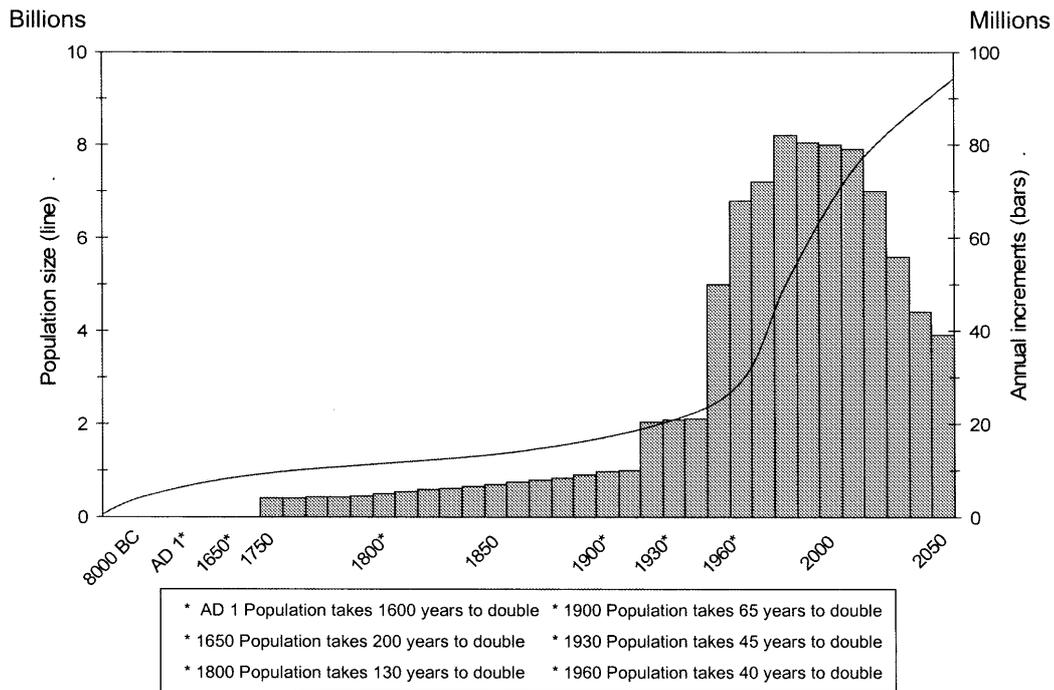
Although Malthus' analysis remains a formidable exercise in political economy, human ingenuity has largely disproved his predictions. This paper examines past and projected trends in world population, including some of the demographic issues, unforeseen by Malthus, that humanity will face in the millenium. It should be noted that demographic events have long-term 'knock-on' effects, current population trends being in large part predetermined by the fertility and mortality patterns of previous generations. They will, in turn, set the demographic scene for several decades to come.

## Historical trends

Population growth is a very recent phenomenon. For almost all of human history since its inception about a million years ago, world population growth has been negligible. Numbers increased slowly from some 8 million in 8000 BC to 300 million in AD1; by 1750 the population was 800 million, having taken 1600 years to double (Figure 1) (Coale, 1974). It is only in the past 250 years that population growth accelerated, with numbers rising from 1 billion in 1800 to 1.7 billion by 1900—almost double the number 100 years before.

Until about 1750, high birth rates were matched by high death rates, with periodic catastrophic losses from famine, war

\*This is a modified and abridged version of a paper that will appear in *The Oxford Illustrated Companion to Medicine*, Editor Stephen Lock, to be published in 2000 Oxford University Press.



**Figure 1.** World population size and annual increments: 8000 BC to 2050 AD (projection based on medium fertility assumption). (From United Nations, 1998)

and epidemics (Carr-Saunders, 1964; Borrie, 1970; Habakkuk, 1971). Infectious disease—bubonic plague in particular, but also tuberculosis—ravaged Europe between the 6th and 14th centuries. When Black Death struck in 1348, England's population fell by 20% in just three years, and by 1400 was 50% lower than it would have been if plague had not occurred (Borrie, 1970). Life expectancy of 32–35 years in medieval England was reduced to under 18 years by the late 14th century. Checks to population growth in pre-industrial Europe also came from self-imposed, social restrictions on procreation, notably through deferred and low rates of marriage (Carr-Saunders, 1964; Borrie, 1970; Habakkuk, 1971). These were, in the main, social responses to available economic resources, although moral restraints also helped to keep fertility well below the physiological maximum.

It was Europe that first broke through the demographic stalemate. The disappearance of the great killer diseases by the mid-18th century ended the near-equilibrium between birth and death rates, leading to increased longevity and population. Although industrialization and urbanization brought their share of squalid living conditions and ill health, the public health measures, medical advances, and improvements in sanitation, personal hygiene, housing and living standards of the 19th century led to further declines in mortality. Improved survival was followed by the desire for smaller families and the growing use of abortion and contraception (primarily coitus interruptus). Major reductions in fertility and mortality followed over the next decades, doubling life expectancy and halving fertility.

Whereas the demographic transition in the developed world spanned two centuries, in the developing world it has largely been condensed into the second half of the 20th century (Figure 2). The ease with which well-established, advanced public health and preventive technologies can be applied in poor, agrarian societies has led to precipitous falls in mortality in the populous, developing world. Although fertility declines have followed (often aided by government family planning programmes), they have been much slower and delayed, leading to unprecedented world population growth—which is essentially a 20th century, post World War II phenomenon, outstripping anything known previously in human history (Figure 1). World population grew from 2.8 billion in 1955 to 5 billion by the mid-1980s and to 5.8 billion by 1996; it is expected to reach 6 billion by the end of the century, having taken only 40 years to double (United Nations, 1998). More people were added to the world's population in the past 50 years than in the preceding million years.

### The position now

The most rapid phase of world population growth is now past, with the 1990s marking a historical reversal (United Nations, 1998). Growth rates and annual increments have been falling since the 1980s. Even so, 81 million people are added to world population each year, with China and India alone contributing 35%.

Global fertility remained nearly constant at five births per woman until the 1970s, since when it has fallen to the present

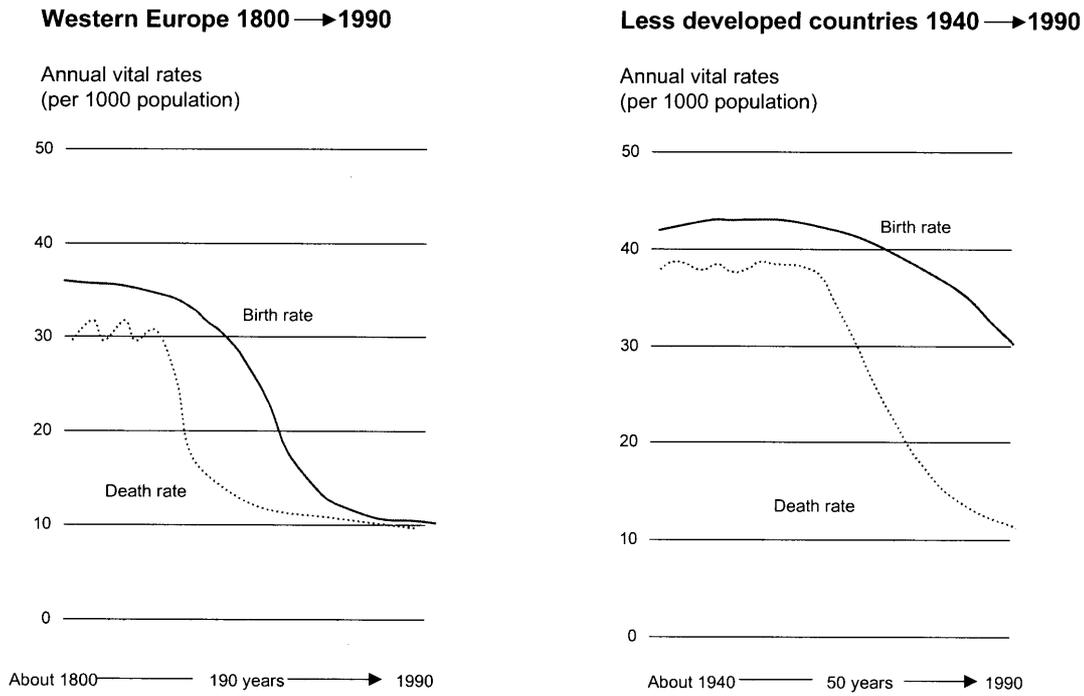


Figure 2. The demographic transition. (From Borrie, 1970)

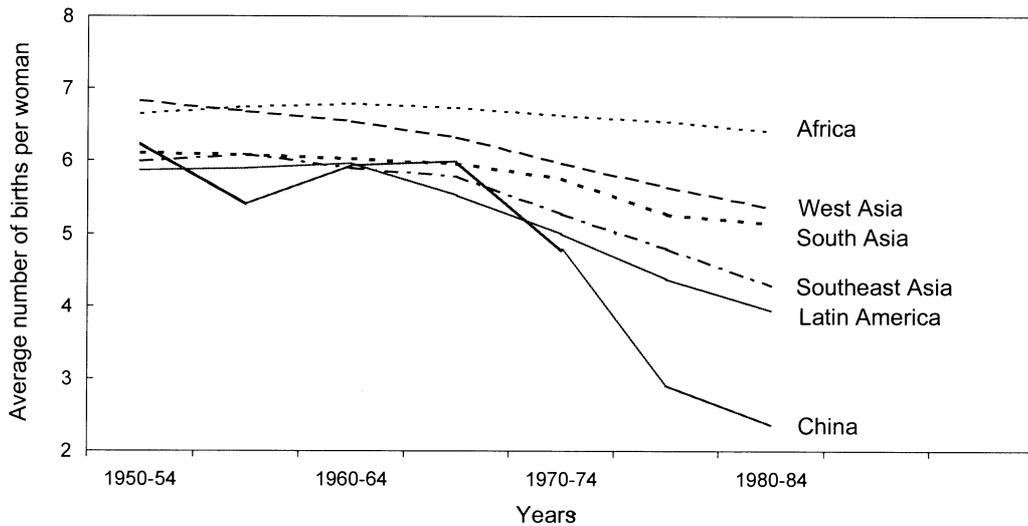
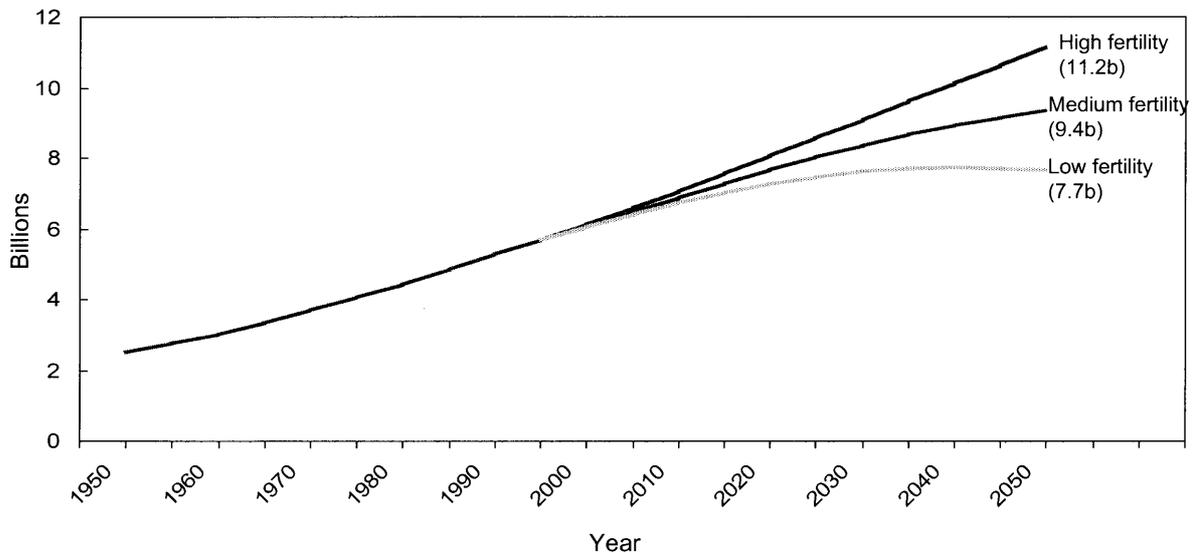


Figure 3. Fertility decline in the developing world. (From IIASA; Lutz, 1994)

three. The most spectacular example is that of China, where births per woman fell from six to two during a period of 15 years, a demographic change that took 150 years in Europe (Figure 3). Although virtually all high-fertility countries are now experiencing declines, fertility worldwide still ranges from 1.2 births for Italian and Spanish women (well below replacement level) to 6.4 for some African women (United Nations, 1998). Globally, 132 million babies are born each year.

Compared with this, approximately 52 million people die each year, over 20% of them children aged under 5 years. About one-third of these deaths are due to infectious and parasitic diseases (primarily diarrhoea, tuberculosis, malaria, respiratory infections and AIDS), one-third to circulatory diseases, and 12% to cancers (World Health Organization, 1998). Premature mortality remains a major problem in the developing world, with 10 million child deaths annually, 600 000 women dying in pregnancy or childbirth, and three out



**Figure 4.** World population size: past and projections based on low-, medium- and high-fertility variants, 1950–2050. (From United Nations, 1998)

of four people in the least-developed countries dying before the age of 50 years (World Health Organization, 1998). Moreover, the rich–poor divide in health is widening. Child health programmes (immunization and oral rehydration in particular) in developing countries are having dramatic effects, reducing deaths from 21 million in 1955 to 10 million in 1997, and to a projected 5 million by 2025. On the other hand, the AIDS pandemic and resurgence of (drug-resistant) malaria and tuberculosis will continue to check the pace of mortality decline, particularly in sub-Saharan Africa, and chronic non-communicable diseases are assuming a prominent role in the developing world.

### Future trends

Even though women today are having fewer babies than their mothers or grandmothers, previous high fertility means that growing cohorts of women are entering the reproductive ages. Given this ‘dominoes effect’ of demographic events, the decline in births per woman will not result in fewer births globally until after 2025. Substantial growth in the world population during the next half century is, therefore, unavoidable. The future pace of fertility decline is now the most important determinant of future population size.

Based on assumptions of low, medium and high fertility (each differing by half a child per woman), population projections by the United Nations for the year 2050 are estimated at 7.7, 9.4 and 11.2 billion respectively, the medium scenario being the most probable (Figure 4) (United Nations, 1998). These are increases of 33%, 62% and 93% respectively over the 1996 population. All major areas will grow with the exception of Europe, the only region projected to decline in numbers. Europe’s population in 2050 will be the same as it was 20 years ago, its share of world population falling from

22% in 1950 to 13% in 1996 and to 7% by 2050 (United Nations, 1998).

The most notable feature of population trends in the 21st century will be population ageing, caused by both falling fertility and increased longevity (Figures 5 and 6). Ageing is a familiar feature of the current demography of industrialized countries, but will increasingly affect the developing world also. The world’s population aged 60+ years will increase from 9% of the total in 1990 to 16% by 2030 and to 22% by 2050, similar to the ‘oldest’ region today—Western Europe (Lutz, 1994). China, in particular, will experience very rapid ageing, because of the abrupt and large fertility declines it experienced under its government’s one-child policy. In 35 years, China will have a higher old-age dependency ratio than the USA, and there will be 274 million Chinese aged 60+, outnumbering the current US population (Lutz, 1994). One of the biggest challenges of the 21st century—particularly in the poorer countries—will be how to organize and finance the health and quality of life of an ageing population. Western Europe took a century to develop social security schemes for the elderly, and even so is contending with serious resource limitations today. Providing for their growing elderly populations will therefore be a major undertaking for less-developed countries.

### Demographic impact of HIV/AIDS

No commentary on future population trends would be complete without mention of the devastating impact of HIV/AIDS on some populations. Although it does not compare with the decimation of populations by pre-industrial killer diseases, the emergence of AIDS during the sharply falling mortality of the late 20th century is an unparalleled phenomenon. Of the 52 million deaths annually, about 2.5 million—predominantly young adults in their peak productive

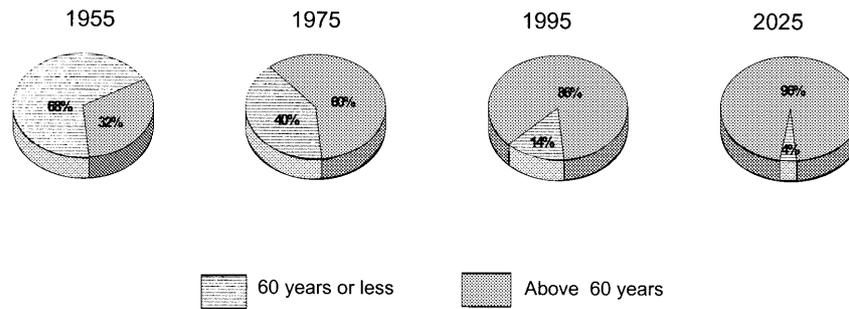


Figure 5. Percentage of world population with life expectancy at birth <60 years or >60 years. (From World Health Organization, 1998)

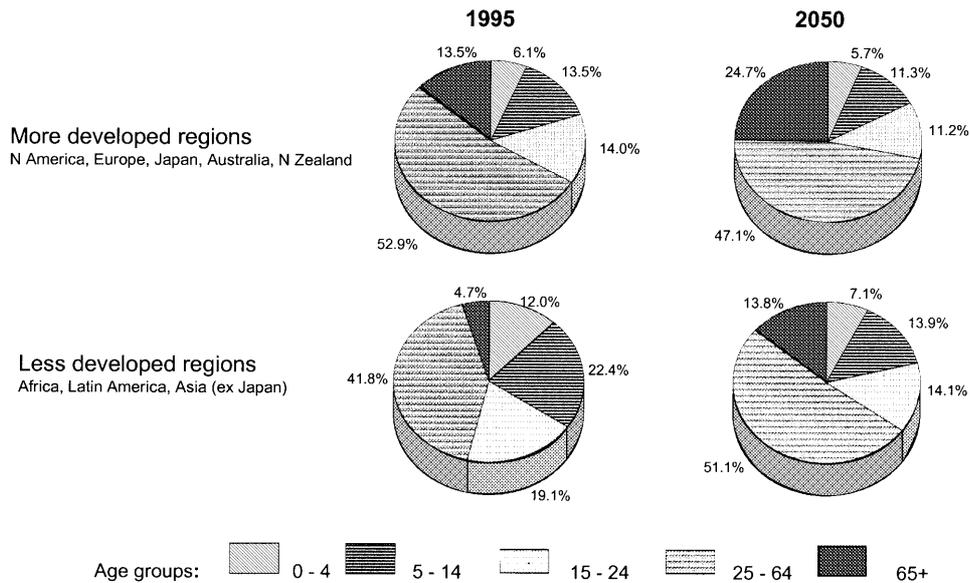


Figure 6. Age structure of the world population by level of development. (From United Nations, 1998)

years—are from AIDS (UNAIDS, 1998). In comparison, malaria—also a leading killer—claims about a million lives annually. Over 0.5 million children die annually of AIDS, and 1 in 10 new HIV infections is a child.

It is estimated by UNAIDS that currently there are 33.4 million people living with HIV/AIDS, over 95% of them in developing countries, the vast majority in sub-Saharan Africa. In parts of Africa (Botswana, Namibia, Uganda, Zambia, Swaziland, Zimbabwe), more than one in five adults aged 15–49 has HIV/AIDS, the average for sub-Saharan Africa being 8% (UNAIDS, 1998). Surveillance data for Zimbabwe show that 20–50% of pregnant women are infected. Other countries with large and rapidly increasing numbers of HIV cases are India, China, Thailand and Brazil. The United Nations estimates that in India and Thailand there will be 22 million fewer people by 2050 as a result of AIDS (United Nations, 1998). For Africa the figure is 52 million. In the five worst-affected African countries, mortality at the turn of the century will be almost 50% higher because of AIDS, and by 2050 there will be 13% fewer people as a result; however, high

fertility means that these populations will nonetheless treble between 1995 and 2050.

The decline in infant mortality in developing countries has been adversely affected because of mother-to-child transmission of HIV infection, with infant mortality more than 50% higher in some African countries as a result. Over the past decade and the next, there will be 2.5 million AIDS-related child deaths in Africa, 9% higher than otherwise. WHO anticipates that “one of the biggest hazards to children in the twenty-first century will be the continuing spread of HIV/AIDS... which could reverse some of the major gains achieved in child health over the past 50 years” (World Health Organization, 1998).

AIDS has had a major impact on life expectancy in the worst-affected countries, and will continue to do so until well into the 21st century. In several African countries, life expectancy has actually fallen since the 1980s, and by 2000 AD longevity will be up to 17 years lower than it would have been in the absence of AIDS (United Nations, 1998). Although malaria, tuberculosis and smoking-related diseases are also

major killers globally, they do not have the age-selective demographic impact of AIDS, which strikes cohorts of young adults and infants, and is leaving millions of African children orphaned.

## Conclusions

Given that a sizeable growth in world population is unavoidable, how many people can the earth support? Will resources determine the limits of population growth? Many distinguished minds have pondered the 'carrying capacity' of our planet—the balance between natural resources and population size. The diversity of conclusions ranges from under 1 billion to 100 billion and higher (Lutz, 1994). Some argue that there are no limits to population growth (Marchetti, 1978; Simon, 1981); others argue that we have already passed the limits of sustainability and are on the way to ecological disaster (Meadows *et al.*, 1992).

However gloomy some of the prognostications, humanity has, in general, not merely survived, it has thrived. Global life expectancy is 68 years compared with 48 in 1955, and is projected to rise to 73 years by 2025 (World Health Organization, 1998). Food supply has more than doubled in the past 40 years, growing much faster than population growth, adult literacy rates have increased more than 50% since 1970, and per capita gross domestic product has risen more than 2.5 times in real terms in the past 50 years. Most of the world's children are now immunized against the major childhood diseases, although 2 million children still die each year from vaccine-preventable diseases. The gains have not been uniformly shared. Millions of the poorest and most needy have seen little if any improvement, and there remains a wide gap in life expectancy between rich and poor nations. But there are few countries today where longevity does not far exceed that of earlier centuries. The undernutrition and famines seen in our times are largely man-made, and are not the result of agricultural limits on carrying capacity.

The astonishing growth of world population this century is a triumph of man over his environment. Although Malthus remains a pioneer in the field of human ecology, the application of science to agricultural and industrial production has so far kept the Malthusian bogy at bay. The demographic history of world population has demonstrated that the carrying capacity of the earth is not a constant, but a dynamic equilibrium determined not only by resources and the level of technology, but also by the ingenuity with which we shape our worldwide economic, social and political arrangements (Lutz, 1994).

## References

- Borrie, W.D. (1970) *The Growth and Control of World Population*. Weidenfeld and Nicolson, London.
- Carr-Saunders, A.M. (1964) *World Population: Past Growth and Present Trends*. Frank Cass and Co. Ltd, London.
- Coale, A.J. (1974) The history of the human population. In *The Human Population*. W.H. Freeman & Co, San Francisco.
- Habakkuk, H.J. (1971) *Population Growth and Economic Development Since 1750*. Leicester University Press, Leicester.
- Lutz, W. (1994) *The Future Population of the World: What Can We Assume Today?* International Institute for Applied Systems Analysis. Earthscan Publications Ltd, London.
- Malthus, T.R. [1965 (1798)] *First Essay on Population*. A.M. Kelly, New York.
- Marchetti, C. (1978) *On 1012: A Check on Earth Carrying Capacity for Man*. International Institute for Applied Systems Analysis, Laxenburg, Austria.
- Meadows, D.H., Meadows, D.L. and Randers, J. (1992) *Beyond the Limits: Global Collapse or a Sustainable Future*. Earthscan Publications Ltd, London.
- Simon, J. (1981) *The Ultimate Resource*. Princetown University Press, New Jersey.
- UNAIDS (1998) *Report on the Global HIV/AIDS Epidemic*. New York.
- United Nations (1998) *World Population Prospects: The 1996 Revision*. United Nations Secretariat, Department of Economic and Social Affairs, Population Division, New York.
- World Health Organization (1998) *The World Health Report 1998: Life in the 21st Century – A Vision For All*. World Health Organization, Geneva.

*Received on December 14, 1998; accepted on June 7, 1999*