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Population, resources and sustainable development: what relationship?

Silvana Salvini

Università degli Studi
di Firenze

Dipartimento di Statistica "G. Parenti" – Viale Morgagni 59 – 50134 Firenze - www.ds.unifi.it

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Department of Statistics, University of Florence, salvini@ds.unifi.it

1. Aim of the paper

In this paper initially I will describe the recent trends of population and fertility, the basic cause of the high demographic growth in developing countries. In a second time, I will point out my attention on the main theoretical models linking population, environment and sustainable development. Finally, the relationships with conflicts will be analysed, taking into account some examples. Some case-studies will be shown to verify the impact on resources of demographic trends. In particular, I shall point my attention on the water scarcity and the effects on food availability.

2. Introduction

We may read in "*The State of World Population 2001 - Footprints and Milestones: Population and Environmental Change*" (UNPFA, 2001):

"Over three and a half million years ago, two of modern humanity's ancestors left their footprints in the sand near what is now Laetoli in the United Republic of Tanzania. This couple was walking barefoot along a plain. Their people probably numbered in the hundreds or thousands and possessed very rudimentary implements. Only a remarkable chain of coincidences preserved their trail for our current inspection and wonder.

Today the footprints of humanity are impossible to miss. Human activity has affected every part of the planet, no matter how remote, and every ecosystem, from the simplest to the most complex. Our choices and interventions have transformed the natural world, posing both great possibilities and extreme dangers for the quality and sustainability of our civilizations, and for the intricate balances of nature.

The great questions for the 21st century are whether the activities of the 20th century have set us on a collision course with the environment, and if so, what can we do about it? Human ingenuity has

brought us this far. How can we apply it to the future so as to ensure the well-being of human populations, and still protect the natural world?

The stewardship of the planet and the well-being of its people are a collective responsibility. Everywhere we face critical decisions. Some are about how to protect and promote fundamental values such as the right to health and human dignity. Others reflect trade-offs between available options, or the desire to broaden the range of choice. We need to think carefully but urgently about what the choices are, and to take every action that will broaden choices and extend the time in which to understand their implications.

Today every part of the natural and human world is linked to every other. Local decisions have a global impact. Global policy, or the lack of it, affects local communities and the conditions in which they live. Humans have always changed and been changed by the natural world; the prospects for human development now depend on our wisdom in managing the relationship.

One of the key factors will be population. It is also one of the areas where action to broaden choices is universally available, affordable and agreed upon.

Population and the environment are closely related, but the links between them are complex and varied, and depend on specific circumstances. Generalizations about the negative effects of population growth on the environment are often misleading. Population scientists long ago abandoned such an approach, yet policy in some cases still proceeds as if it were a reality.

As human populations increase and globalization proceeds, key policy questions are: how to use available resources of land and water to produce food for all (Bongaarts, 1996); how to promote economic development and end poverty so that all can afford to eat; and, in doing so how to address the human and environmental consequences of industrialization and concerns like global warming, climate change and the loss of biological diversity.

Environmental devastation is not simply a waste of resources; it is a threat to the complex structures that support human development.

Understanding the ways in which population and environment are linked requires detailed consideration of the way in which factors interrelate, including affluence, consumption, technology and population growth, but also previously ignored or underrated social concerns such as gender roles and relations, political structures, and governance at all levels".

How do conflicts interact with relationships between population and environmental changes?

Several research projects associated with the *Peace and Conflict Studies Program* at the University of Toronto can give an answer to the questions. Firstly hypotheses, conceptual frameworks and

methodology are performed, and then different situations and different countries' experience are analysed: the cases of Bangladesh, Bihar-India, Philippines, Indonesia, China are deeply studied and reveal the cause-effect linkages among environment, population and security, environmental scarcities, state capacity and civil violence (Homer-Dixon, 1995; Homer-Dixon, Boutwell and Rathjens, 1996). The Earth's human population is expected to pass eight billion by the year 2025, while rapid growth in the global economy will spur ever increasing demands for natural resources. The world will consequently face growing scarcities of such vital renewable resources as cropland, fresh water, and forests. These environmental scarcities will have profound social consequences -- contributing to insurrections, ethnic clashes, urban unrest, and other forms of civil violence, especially in the developing world. Water shortages in China, population growth in sub-Saharan Africa, and land distribution in Mexico, for example, show that scarcities stem from the degradation and depletion of renewable resources, the increased demand for these resources, and/or their unequal distribution. These scarcities can lead to deepened poverty, large-scale migrations, sharpened social cleavages, and weakened institutions. Violence can result from these social effects, as in the cases of Chiapas, Mexico and in many African and Asian countries (Homer-Dixon, 1999).

3. World population trends: a comparison North-South

During industrial revolution world population initiated a period of decisive and sustained growth. In the following two centuries population increased about tenfold, at a annual growth rate of 6 per 1000 (doubling time 116 years). This process was the result of a rapid accumulation of resources, control of the environment and mortality decline, and has culminated in the second half of the 20th century. In the period post 1950 population has again doubled and the rate of growth has tripled to 18 per 1000. In spite of the evidence that growth is slowing, the present population momentum will certainly carry world population to 8 billion by about 2030, and ten billion close to the end of this century (tables 1 and 2) (Livi Bacci, 2001). Population growth rates increased after World War II as health care improved and death rates fell, while fertility remained high. Therefore, the main events concerning world population in 20th Century are represented by highest population growth rate, largest annual population increase, shortest doubling time for population, shortest time to add 1 billion persons, revolutionary declines in mortality, unprecedented declines in fertility, significant international migration, increased urbanization and emergence of mega-cities.

Table 1 - Population, total births, and years lived, 1750-2000 in the world

	1750	1950	2000
Population (millions)	771	2521	6055
Annual growth	0.064	0.594	1.752
Doubling time (years)	1083	116	40
Life expectancy e0	27	35	56

Source: Livi Bacci, 2001.

Table 2 - Continental populations (millions)

Periods	Asia	Europe	USRR*	Africa	America	Oceania	World
1750	500	111	35	104	18	3	771
1950	1376	393	182	224	332	13	2520
2000	3611	510	291	784	829	30	6055

* 2000: territories of former USRR

Source: Livi Bacci, 2001.

Six countries account for half of the world's annual addition: India (16 million), China (9 million), Pakistan (4 million), Nigeria (4 million), Bangladesh (3 million), and Indonesia (2 million). The 48 countries classified as least developed have even more rapid population growth. If current trends continue, the combined populations of these nations will almost triple by mid-century—from 658 million to 1.8 billion. Among the 16 countries with extremely high fertility rates (seven children or more per woman) are Afghanistan, Angola, Burkina Faso, Burundi, Liberia, Mali, Niger, Somalia, Uganda and Yemen. These countries had not yet experimented the process of demographic transition, the passage from a pattern characterized by high levels of mortality and fertility, to a situation where renewal flows are low. Determinants of demographic transition are represented by modernization, urbanization, passage from an agricultural to an industrial society, diffusion of mass education, female empowerment, and family planning programs. In summary, in much of the developing world —nearly 5 billion people—populations are still growing rapidly. Even with anticipated declines in fertility rates, the developing world is projected to have 8.2 billion people by 2050 (see the website:www.earth-policy.org/Indicators/indicator1.htm).

Opposite is the case of European countries. For at least 25 years, 20 European countries and Japan have had below replacement-level fertility rates (2.1 children per woman). By now a total of 44 countries have similar fertility levels and many of them – among these, Italy too –present very low

levels of total fertility rate (around 1.2 children per woman) . Without the projected gain of 2 million immigrants a year from developing countries, many industrial nations would shortly experience population declines.

We must examine together the demographic situation and the socio-economic context of poor countries *vs.* industrialized ones. If we look at the data reported in the table 3, we can verify that high level of growth rates are often associated with a low woman status and a social context characterized by low survivorship.

Table 3 - Some socio-demographic indicators, around end 90s.

Countries	GDP p.c. (PPP US$)	Total population (millions)	Pop. Growth rate (% p.a.)*	Child mortality (0-5 years)	School Enrolment % Females (Males)	Females Economically Active (% Males)	Expectation of life at birth Females (Males)
U.S.	31,872	280.4	1.0	8	99 (91)	80	79.7 (73.9)
Canada	26,251	30.5	1.1	6	98 (96)	81	81.4 (75.9)
Japan	24,898	126.8	0.5	4	81 (83)	67	84.1 (77.3)
Germany	23,742	82.0	0.2	5	93 (95)	69	80.6 (74.3)
Rep. Korea	15,712	46.4	1.1	5	85 (95)	69	78.4 (70.9)
Argentina	12,277	36.6	1.4	22	86 (80)	45	77.0 (69.9)
Chile	8,652	15.0	1.6	12	77 (78)	48	78.5 (72.5)
Mexico	8,297	97.4	2.1	33	70 (71)	47	75.8 (69.8)
Brazil	7,037	168.2	1.1	40	80 (79)	52	71.8 (63.9)
Columbia	5,749	41.4	2.0	31	73 (73)	60	74.6 (67.8)
Philippines	3,805	74.2	2.4	42	84 (80)	61	71.1 (67.0)
China	3,617	1264.8	1.3	41	73 (73)	86	72.5 (68.3)
Egypt	3,420	66.7	2.3	52	72 (80)	44	68.5 (65.3)
Indonesia	2,857	209.3	1.8	52	61 (68)	67	67.7 (63.9)
India	2,248	992.7	2.0	98	49 (62)	50	63.1 (62.4)
Pakistan	1,834	137.6	2.8	112	28 (51)	41	59.5 (59.8)
Bangladesh	1,483	134.6	2.4	89	33 (41)	76	59.0 (58.9)
Uganda	1,167	22.6	3.1	131	41 (49)	88	43.8 (42.5)
Nigeria	853	110.8	2.9	187	41 (49)	56	51.7 (51.3)
Ethiopia	628	61.4	2.6	176	19 (26)	67	44.9 (43.3)
Tanzania	501	34.3	3.1	141	32 (33)	93	52.2 (50.0)

* Average 1975-99

Source: Compiled from various Tables in *The Human Development Report 2001: Making New Technologies Work For Human Development*, By UNDP, Oxford University Press,New York.

4. Key Variables in Fertility Decline

For decades the principal question about fertility in developing countries was whether the transition from high to low fertility was underway. Now that fertility decline has begun in most countries, attention has shifted to the equally important question of the pace of decline.

One of the decisive determinants of the pace of fertility decline is the relationship between people's economic aspirations for themselves and their children and their expectations of what they are likely to achieve; moreover, the role of female empowerment (and particularly, diffusion of female education) is extremely important (Salvini, 1997).

How readily the fall in desired fertility results in actual fertility decline depends on the strength of the obstacles to using birth control, in particular concerns about health side effects and such social costs as familial or religious opposition to contraception. Where these costs are high, a large fraction of couples will have unmet need for contraception, the term that describes the circumstance of wanting to avoid pregnancy but not practicing contraception. Once the various stumbling blocks are removed, however, fertility can decline precipitously, in particular in those countries that have supported family planning programs (Casterline, 2001).

Projections of the World Bank illustrate the importance of the pace of decline, particularly in areas where fertility is highest, in Africa and some regions of Asia. In sub-Saharan Africa and Southwest Asia, the increase in population between 2000 and 2050 will be 73 to 105 percentage points greater if a slow-decline path is followed rather than a rapid-decline path. The differences are less pronounced in the more populous countries of South Asia but large nevertheless: under the slow-decline scenario, the growth in population in this region will be 33 percentage points greater over this 50-year period than under the rapid-decline scenario.

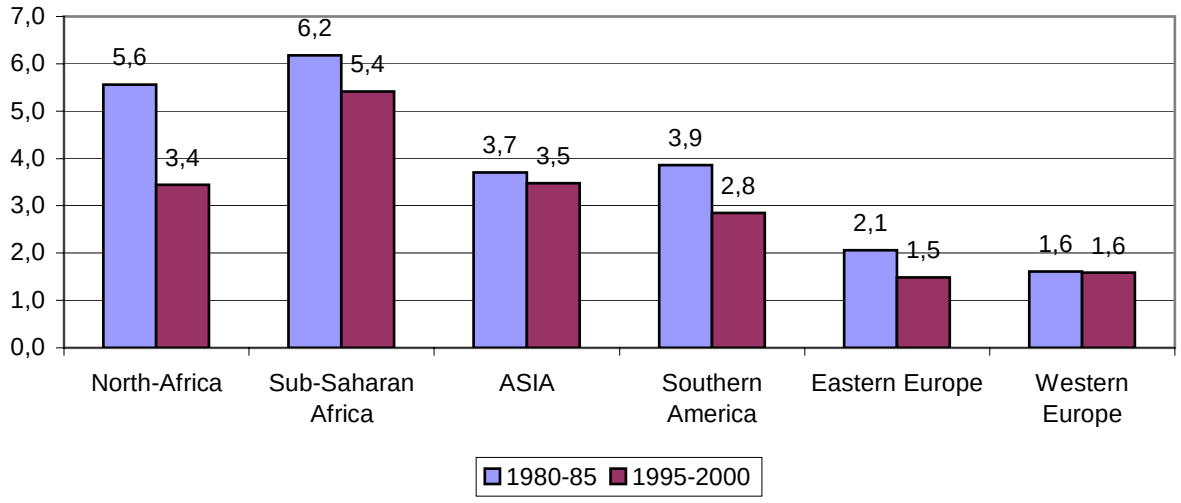
For decades, demographers have assumed that fertility rates in developing countries will eventually fall to replacement level – about 2 children per woman – and then stabilize at that level. However, over the past decade, more and more developing countries have joined developed countries in seeing their fertility levels fall below this replacement fertility floor, challenging the assumption that there is some inherent magnet drawing populations to a replacement-level equilibrium.

The past few decades have witnessed dramatic declines in fertility levels. Since 1965, world fertility has declined from 5.0 to 2.7 births per woman.

Many countries have recorded striking reductions in fertility rates to levels below those needed to ensure population replacement. Given that 40 per cent of the world's population lives in those

countries that have begun but not completed their transition from high to low fertility, and the large impact of fertility on projected population size, it is crucial to make a well-informed projection of fertility in intermediate-fertility countries. Will fertility stagnate? Will it decline to around the replacement level? Or will fertility follow the European pattern and decline to below replacement level? Will we assist to a process of "demographic convergence" even if it is difficult to imagine socio-economic convergence (Wilson, 2001). The outcome of this fertility transition will be a vital determinant of the size of world population in the twenty-first century.

Figure 1- Total fertility rates, 1980-85, 1995-2000 (Source: UN, 2003).



Today there are 74 countries with intermediate-level fertility, i.e., above 2.1 and below 5 children per woman. This group includes some of the most populous countries in the world, such as Bangladesh, Brazil, Egypt, India, Indonesia, Iran, Mexico, and Philippines. Even if below-replacement levels are achieved in future, the current, moderately high fertility levels in these countries mean that several billion additional people are expected before population size peaks. Of course, the assumption of future below-replacement fertility for these countries is contingent upon broad social and economic development as well as continued increases in family planning prevalence.

In summary, in 2050 we will have larger population, nearly all growth in developing regions, slower growth, lower fertility and mortality, aged and more urbanized population and increased migration.

Future challenges will be represented by the check on decline of fertility through female empowerment and mass education, strong and enlightened leadership, check on resources, sustainable development with respect to environment looking at the future generation (Eswaran, 2002).

5. Population and environment. What relationship?

What we know at present supports the position that population growth has contributed and is contributing to a variety of environmental changes. Some, but not all, of these changes would be classified as ailments or degradations. These undoubtedly include the destruction of forests, especially tropical forests; soil erosion and degradation in certain major regions, especially within sub-Saharan Africa; and the loss of species of plants and animals (Preston, 1994).

Documentation of population-environment linkages has too often consisted of a simple listing of population trends side-by-side with environmental trends, on the assumption that one is the direct cause of the other, while effective measures for dealing with how human populations affect the environment require a good understanding of the way things interact (Preston, 1994). Important recent studies use this approach modelling relationships among different population aspects and environment components, such as population growth and air quality, environmental degradation and child mortality, population and resources (Cramer, 1998; Das Gupta, 2000; Kulczycki and Saxena, 2000; Sastry, 2002).

The main topics concerning relationships between population and environmental resources look at food production and agrarian resources, industrial production, institutions or other social factors and policy options.

The expansion of human numbers contributed to deforestation, soil degradation, and species loss. The basic element of this topic recognizes man's prodigious need for food. To support more people, more food must be produced. To produce more food, more resources are required in food production.

The patterns of land use have changed dramatically as human numbers have expanded. Forests that covered nearly all of Europe in 900 AD had virtually disappeared by 1900. They were converted primarily into agricultural fields and pastures to feed Europe's growing population (Wolman, 1993). A similar process is occurring on a much-compressed time scale in most developing countries today.

So there is clearly an association over time between population growth and loss of forest. But association do not establish causation, of course. One alternative explanation is that both population growth and changes in land use were a product of a third factor, a change in productive technology.

This interpretation is implausible, however, because the technology of forest clearance for food production is one of the oldest known to man.

Civilization came with the clearing of forests for permanent cultivation; nevertheless, the transformation of forest into cultivated land in Europe in the past was not accompanied by soil degradation but, in general, by maintenance or improvement of soil quality. The situation is currently quite different in tropical areas, where population is growing today at almost 2% a year (and in the past decades also at 3% a year), rather than less than 1% a year, a rate that was typical of Europe during its period of landscape transformation. This slower pace permitted the evolution of institutions and practices aimed at soil protection. The result is that, relative to Europe, the response to population growth in these areas more often takes the form of occupying new land rather than of intensifying production on old land (Grainger,1990).

Man does not live by bread alone, and expanded human numbers are also accompanied by increased demand for other goods and services. The production and consumption of these goods and services very frequently has environmental implications as well. In particular, air and water resources often serve as a repository or sink for the byproducts of production. How much population growth contributes to the pollution of these resources has not, however, been established with any degree of precision. As we will see in the following paragraph, most analysts approach this question with the I=PAT equation, wherein the environmental impact I is expressed as a product of population size P, production per capita A, and impact per unit of production T. There are many problems with the way this equation has been used. First of all, it ignores interactions among the elements, for example the effect of population growth on per capita production (Demeny 1991) and the clear tendency of more affluent nations to choose technologies that are less polluting. Moreover, this formula establishes that, whatever impact is on the left-hand side, the contribution of population growth to it will always be the same, equal to whatever the proportionate change in population is.

Furthermore, each element of the “pressure” side of the equation is affected by many factors. Population change, for example, is determined by fertility, mortality and migration. Each of these, in turn, is affected by a host of other factors: proximate factors and background factors. In the case of fertility, proximate variables are represented from marriage, breastfeeding, contraception and abortion, while main basic variables are status and education of women, work participation, child health, distribution of land and income, urbanization, and the opportunities for migration.

Near the impact of population on resources scarcity and industrial pollution, it is most important to recognize that humans create institutions that can mitigate the environmental impact of population

growth. The most important of these institutions are those that govern ownership and access to natural resources, especially land. Over and over again in the literature, one finds that land tenure systems, which in many instances provide incentives for resource preservation, are a key variable conditioning the relationship between population growth and land use changes. In some places in Africa, ownership rights are acquired simply by clearing land. In other places, farmers who let their land lie fallow risk losing their ownership rights. In still other places, incentives for high fertility are provided by systems in which the allocation of land is a function of family size. In all of these instances, land tenure systems are not functioning effectively to preserve land resources for future generations (Mortimore, 1993; Wolman 1993).

Population growth is not the only factor capable of affecting the extent of resource degradation. Depending on time, place, and criterion, it may not be the most important factor. The World Bank's (1990) review of population/environment/and agricultural linkages in sub-Saharan Africa lists a huge array of obstacles to expanded food production and better resource management. These include not only land tenure and credit systems, but also biased agricultural prices and exchange rates, adverse tax policies, weak agricultural extension services, excessive government control, and civil wars; but few if any of these problems will be resolved through rapid population growth.

Because they have multiple origins, it would be foolhardy to think that problems of food production and resource maintenance can or should be solved by population policy alone. While this approach helps us understand certain features of resource use, it is entirely inadequate as a guide to policy because it ignores the vast repertoire of social arrangements that humans have constructed to govern their behaviour. Problems of poverty and resource degradation have multiple sources and admit to multiple forms of intervention.

Theorist that sustain IPAT model (Ehrlich and Holdren, 1971; Ehrlich and Ehrlich, 1991) agree that overall human pressure on the environment is a product of three factors: population, consumption per person and technology. That determines how many resources are used and how much waste or pollution is produced for each unit of consumption. Often a single one of these factors is emphasizes as the dominant cause of our rising environmental impact. For some, this is inexorable population growth. For others, it is polluting technology. Still others stress excessive consumption, policy and market failures, or common ownership of key environmental resources (see the website: http://www.ourplanet.com/aaas/pages/overview02.html).

Included in this approach we underline the debate “Crisis *vs.* adaptation models”. We recall “Malthusian crisis” approach (Ehrlich and Ehrlich, 1991) on one side, while on the opposing side is

what might be called the “Economic adaptation approach”, fervently championed by Simon (1981; 1984) and Boserup (1975): she suggested that population growth was the principal force driving societies to find new agricultural technologies.

Crisis *vs.* adaptation models are used in the analysis of relationships between fertility and conflicts. Evidence is supplied as it concerns Lebanon (adaptation to insecurity is expressed by a constant level of fertility during war), Ethiopia and Angola (with a lower level of fertility caused by conflicts, with a subsequent rebound) (Kulczycki and Saxena, 1999; 2000; Lindstrom and Berhanu, 1999; Agadjanian and Prata, 2002).

The major flaw with both the *Adaptationist* and the *Malthusian* approaches lies in their claim to universality. In reality, both may be true in different civilizations at different historical periods, and a comprehensive theory must be able to account for both approaches.

Consequently, reality is more complex and in front of this complexity, IPAT model is not sufficient, even if many scholars have used this approach. One step forward is been represented by system approach, that has two key differences from conventional approaches: (i) it does not focus on a single factor, but instead builds in as many potential factors as possible; and (ii) it does not see human impact on the environment simply as a one-way street. There is feedback. Changes in the environment have an impact on human welfare. This is primarily a result of resource depletion or degradation and the resulting shortages and scarcities; loss of a valued amenity such as natural wilderness areas or beautiful landscapes; impacts on human health and fertility.

A systems approach sees our interactions with the environment in terms of pressure, state, feedback and response. Failures of adaptation can occur at many points in the cycle. The systems approach allows us to see the Malthusian and adaptationist outcomes as special cases occurring under different conditions. The human response to environmental change can be effective and timely when the impacts are perceived and properly understood; those affected can act directly or compel the political and legal system to act; the science is good and the measures are well-chosen (Cramer, 2002).

In the presentation of conceptual models in the population-environment field, one typically finds different boxes connected by arrows. Recent complex approaches instead go on to a still more general level in which the human population is not seen as something outside nature but as just one distinct species on this planet in which we happen to have a special interest because we belong to it.

It seems very strange to think of the human population and the natural environment as two independent autonomous systems. One cannot draw a line about nature and see the human population as outside this line. Nothing is independent of the environment, including the human species, which is

part of nature and in all basic life-supporting functions depends on the environment. Rather than viewing population-environment linkages in terms of a linear causal chain of separate boxes, it should be visualized as a series of concentric circles where the inner circles are fully embedded in the broader ones (Lutz et al., 2002). Within the sphere of the human-made environment, people are the agents. At the centre of the concentric circles, the human population classified by individual characteristics (age, sex, rural/urban place of residence, educational attainment) is placed. Interactions between the human population and the natural environment go in both directions and in both cases the impacts are mediated through human-made infrastructure, development, and institutions. In this approach, population-environment study can either try to analyse the salient features of the full environmental circle or can examine only a slice (for example, as we have underlined before., the sector focusing on population and water) of the concentric circles that contains elements of both population and environment, as usually studies are carried out. Naturally, every such slice linking population with a specific aspect of environment will contain elements from the human-made environment as well (Lutz et al., 2002).

6. Population, environment and conflicts. Main issues and case studies

We have already introduced the element of population growth that can be related with the environmental sustainability. But which are the element of environment at risk in this beginning of Millennium? And which are the components of the relationships between resources, population and environmental stress and between resources and development (UN, 2001a; UN, 2001b; UN, 2001c, UN, 2003) ?

Resources and environmental stress linkages regard average annual internal renewable water resources available per capita; water stress; forest cover; energy consumption per capita; number of motor vehicles per 1000 population and carbon dioxide emissions per capita. In the complexity of interaction between resources and development, we can underline the role of cropland per capita, percentage undernourished, gross domestic product per capita and, synthetically, poverty rate (IIASA, IUSSP, UNI, 2002). Data showing the relationship are reported in the following tables 4-6.

Table 4 – Demographic indicators for world regions at the beginning of the 3rd Millennium

Regions	Total population	Density	Growth rate		
			Total	Urban	Rural
World	6134	45	1.2	2.0	0.4
More Dev.Countries	1194	23	0.2	0.5	-0.8
Less Dev.Countries	4940	60	1.5	2.7	0.6
Least Dev.Countries	675	33	2.5	4.5	1.6
Africa	813	27	2.3	3.7	1.2
Asia	3721	117	1.3	2.5	0.4
Europe	726	32	-0.2	0.3	-1.0
Latin America	527	26	1.4	1.9	0.0
North America.	317	15	0.9	1.0	-0.3
Oceania	31	4	1.2	1.2	1.2

Source: UN, 2001a.

Table 5 – Components of environmental stress for world regions at the beginning of the 3rd Millennium

Regions	Water resources mc annual	Water stress*	Forest Cover**	Cropland Per capita°
World	7113	Low	-0.2	0.26
More Dev.Countries	10852	…	0.1	0.51
Less Dev.Countries	6196	…	-0.5	0.20
Least Dev.Countries	7065	…	-0.8	0.22
Africa	5157	Low	-0.8	0.28
Asia	3159	Medium	-0.1	0.16
Europe	9027	Medium	0.1	0.43
Latin America	27354	…	-0.5	0.32
North America.	8839	Medium	0.2	0.66
Oceania	53711	Low	0.0	1.94

*Ratio of water withdrawals to water supply. Levels low <10%; medium 10-19%; medium-high 20-40%; high >40%. ** Average annual change in %, 90-2000. ° hectares
Source: UN, 2001a.

Table 6 – Resources and environmental components for world regions at the beginning of the 3rd Millennium

Regions	Under-nourished %	GDP p.c. (PPP int'l $) °	Energy consumption p.c.	Motor vehicles per 1000 pop.	CO2 emission**
World	…	6380	1671	124	4.2
More Dev.Countries	…	19069	4741	473	11.3
Less Dev.Countries	18	3243	838	30	2.1
Least Dev.Countries	39	1017	300	5	0.2
Africa	27	1905	733	26	1.1
Asia	…	3798	926	41	2.5
Europe	…	14063	3505	343	8.0
Latin America	12	6572	1180	92	2.7
North America.	…	28998	7947	746	19.6
Oceania	…	17423	5354	498	12.2

° Total output of goods and services for final use occurring within the domestic territory of a given region. It is converted to current international $ by using PPP rates and dividing by mid-year pop.
**The amount of carbon dioxid emitted in metric tons per person from industrial processes. Emissions are calculated using conversion factor based on global average fuel chemistry and oxidation rates.
Source: UN, 2001a.

6.1 Water, food scarcity and development

Water deficits is growing in many countries and water shortages may cause food shortages. The world is incurring a vast water deficit. It is largely invisible, historically recent, and growing fast.

Because this impending crisis typically takes the form of aquifer overpumping and falling water tables, it is not visible. Unlike burning forests or invading sand dunes, falling water tables cannot be readily photographed. They are often discovered only when wells go dry.

Here are briefly described some cases of water scarcity, all characterised by fast population growth. In Yemen, a country of 19 million, the water table under most of the country is falling by roughly 2 meters a year as water use far exceeds the sustainable yield of aquifers. "*…groundwater is being mined at such a rate that parts of the rural economy could disappear within a generation.*" (Brown, 2002). In the basin where the capital, Sana'a, is located and where the water table is falling 6 meters (nearly 20 feet) per year, the aquifer will be depleted by the end of this decade.

Also Iran, a country of 70 million people, is facing an acute shortage of water. Under the agriculturally rich Chenaran Plain in northeastern Iran, the water table was falling by 2.8 meters a year in the late 1990s. But in 2001 the cumulative effect of a three-year drought and the new wells being drilled both for irrigation and to supply the nearby city of Mashad dropped the aquifer by an extraordinary 8 meters. Villages in eastern Iran are being abandoned as wells go dry, generating a swelling flow of water refugees.

Shortages of water in Egypt, which is entirely dependent on the Nile River, are well known. With the Nile now reduced to a trickle as it enters the Mediterranean, the three principal countries of the Nile River Basin--Egypt, Ethiopia, and Sudan--can each increase its take from the river only at the expense of the other two. With the combined population of these countries projected to climb from 167 million today to 264 million in 2025, all three are facing growing grain deficits as a result of water shortages.

In Mexico, where 104 million people live and where absolute demographic increase amounts two millions per year, the demand for water has outstripped supply in many states. In the agricultural state of Guanajuato, for example, the water table is falling by 1.8-3.3 meters a year. Mexico City's water problems are legendary. How the United States and Mexico share the water of the Rio Grande has become a thorny issue in U.S.-Mexican relations.

Although military conflicts over water are always a possibility, future competition for water seems more likely to take place in world grain markets. This can be seen with Iran and Egypt, both of which now import more wheat than Japan, traditionally the world's leading importer. Imports supply 40 percent or more of the total consumption of grain in both countries. Numerous other water-short countries also import much of their grain. Morocco brings in half of its grain. For Algeria and Saudi

Arabia, the figure is over 70 percent. Yemen imports nearly 80 percent of its grain, and Israel, more than 90 percent.

Seventy percent of world water use, including all the water diverted from rivers and pumped from underground, is used for irrigation, 20 percent is used by industry, and 10 percent goes to residences. Thus if the world is facing a water shortage, it is also facing a food shortage. Water deficits, which are already spurring heavy grain imports in numerous smaller countries, may soon do the same in larger countries, such as China or India.

From the beginning of agriculture until the middle of the twentieth century, increases in world food production have come largely from expanding agricultural land. Between 1950 and 1981, the area in grain expanded from 587 million hectares to its historical peak of 732 million hectares. (1 hectare = 2.47 acres.) By 2000 it had fallen to 656 million hectares. Meanwhile, with population expanding from 2.5 billion in 1950 to 6.1 billion in 2000, the cropland area per person shrank from 0.23 to 0.11 hectares—an area half the size of a housing lot in suburban America. (Larsen, 2002)

As we have already underlined, half of the world's annual population growth occurs in just six countries—India, China, Pakistan, Nigeria, Bangladesh, and Indonesia. Each of these nations faces a steady shrinkage of grainland per person and thus risks heavy future dependence on grain imports. This raises two important questions. Will these countries be able to afford to import large quantities of grain as land hunger increases? And will grain markets be able to meet their additional demands?

In India, where one out of every four people is undernourished, 16 million people are added to the population each year. The grain area per person in India has shrunk steadily for several decades and is now below 0.10 hectares—less than half that in 1950. As land holdings are divided for inheritance with each succeeding generation, the 48 million farms that averaged 2.7 hectares each in 1960 were split into 105 million farms half that size in 1990, when India's grainland expansion peaked. The average Indian family, which now has three children, will be hard pressed to pass on viable parcels of land to future generations.

The scarcity of arable cropland in sub-Saharan Africa helps to explain the region's declining production per person in recent decades. Nigeria, for example, Africa's most populous country, has seen its population four time higher since 1950, while its grainland area doubled—effectively halving the grainland per person. In northern Nigeria, pastoralists and farmers fleeing the encroaching Sahara, which annually claims 350,000 hectares of land, have increased demands on the already scarce land elsewhere in the country, sparking ethnic tensions. With a population that has rebounded to 8.1

million, and with the average family having six children, pressure on the land in Rwanda is again mounting.

By 2050, India and Nigeria would cultivate 0.06 hectares of grainland for each person, less than one tenth the size of a soccer field. China, Pakistan, Bangladesh, and Ethiopia would drop even lower, to 0.04-0.05 hectares of grainland per person. Faring worse would be Egypt and Afghanistan with 0.02 hectares, as well as Yemen, the Democratic Republic of the Congo, and Uganda, with just 0.01 hectares. These numbers are in stark contrast to those of the less densely populated grain exporters, which may have upwards of 10 times as much grainland per person. For Americans, who live in a country with 0.21 hectares of highly productive grainland per person, surviving from such a small food production base is difficult to comprehend (see the website: www.earth-policy.org/Alerts)

6.2 Population, environment and political instability

The experience in Rwanda, Africa's most densely populated country, highlights the potentially serious ramifications of land scarcity. Between 1950 and 1990, Rwanda's population tripled from 2.1 million to 6.8 million. The per capita grain land availability fell to 0.03 hectares. These stresses ignited the undercurrent of ethnic strife, erupting in civil war in the early 1990s and culminating in horrific genocide in 1994, when some 800,000 people were killed.

As the effects of globalization are creating further disparities and inequalities, around the world we are seeing an increase in violence and human rights abuses as disputes about territories, food and water are spilling into wars and internal conflicts. People are fighting for basic needs and some areas of current and future tension are represented by many countries in sub-Saharan Africa; the Middle East, where national interests in the vast oil fields have led to wars and influence from states like USA and UK; Israel and Jordan, where Israel cut water supplies to Jordan due to sever drought; Israel and Palestine also are fighting over water resources as well because water scarcity in the Gaza region has contributed to the tensions in the Middle East. But also in the Nile area there are “water problems” between Egypt and Ethiopia. Environmental scarcity and social tensions in Pakistan have led to a worsening situation.

Tensions exist in many regions in India between indigenous people and the government: India, the country that places at the third places as “dams builder” (Roi, 1999). Degradation on the environment and an increase in population is fueling tension in South Africa. In Equador, it is predicted that

extreme violence is going to be seen at indigenous protests against giant oil corporations (www.globalissues.or/population; www.globalissues.or/geopolitics).

6.3 Focussing on Africa.

"*Africa has become an attractive and profitable dumping ground for nations and arm manufacturers eager to get rid of weapon stocks made superfluous by the end of the Cold War or by technological developments*" -- from a Center for Defense Information weekly *update*, November 4, 1999.

There have been over 9.5 million refugees and hundreds and thousands of people have been slaughtered in Africa from a number of conflicts and civil wars. If this scale of destruction and fighting was in Europe, then people would be calling it World War III with the entire world rushing to report, provide aid, mediate and otherwise try to diffuse the situation.

While the international media, NATO leaders and others were very vocal about the plight of the ethnic Albanians in Kosovo and insisted on a new humanitarian based model of military intervention in the Kosovo conflict, the attitude toward African conflicts and its victims has been one of almost indifference.

The Niger Delta in Nigeria has attracted the attention of environmentalists, human rights activists and fair trade advocates around the world. The activities of large oil corporations such as Mobil, Chevron, Shell, Elf, Agip etc have raised many concerns and criticisms. Oil, which could potentially have allowed Nigeria to be one of the wealthiest countries in Africa, has instead led it to become one of the poorest.

The conflict in the Democratic Republic of Congo (formerly known as Zaire) has involved seven nations. There have been a number of complex reasons, including conflicts over basic resources such as water, access and control over rich minerals and other resources and various political agendas. This has been fueled and supported by various national and international corporations and other regimes which have an interest in the outcome of the conflict.

Sierra Leone has seen serious and grotesque human rights violations since 1991 when the civil war erupted. According to Human Rights Watch, over 50,000 people have been killed to date, with over one million people having been displaced. In Sierra Leone, main problems are represented by the interests the corporations, the diamond connection, the gross abuses committed by both rebel and government forces and the problems of the current peace treaty (see the websites: www.globalissues.org; www.geopolitics/Africa.asp)

7. Final remarks

"*If we all lived like Americans, we would need two additional planet Earths to produce resources and absorb wastes ...and good planets are hard to find*!" –

> *A little boy wanted to know the sum of one plus one. First he asked a physicist, who said, "If one is matter, and the other is antimatter, then the answer is zero. But if one is a critical mass of uranium and the other is a critical mass of uranium, then that's an explosive question." Unenlightened, the little boy asked a biologist. She said, "Are we talking bacteria, mice or whales? And for how long?" In desperation, the boy hired an accountant. The accountant peered closely at the little boy and said, "Hmmm. One plus one? Tell me, little boy, how much do you want one plus one to be*?", Cohen 1995, p.261

The "Science" of ecological limits is often used to conclude that population growth and numbers are the major cause of environmental degradation and we have above underlined that – at least in part – this is true: excess of demographic growth can enlarge problems related to sustainable development and, moreover, related to impact on environment.. However, while the study of ecological capacities and limits is important, the conclusions by some are a major source of contention. Some conclude, looking at the usually credible data of the effects, that the causes of environmental degradation are totally due to populations, by virtue of numbers and that as a result, we are "over" populated. Yet, these are not automatic conclusions and cannot be taken as a given. Such conclusions are even flawed due to the number of assumptions made as well as the number of other important issues not taken into account.

Many environmentalists – and other scholars who study ecological problems – conclude population pressures to be the root, and point out quite accurately and with detailed knowledge the various limits on different ecologies based on current patterns of human activities.

At a very high level, this is true. Humans require resources to survive. Those resources come from the environment. And hence, non-natural environmental degradation is a result of human activities. Nevertheless, from this high vantage point, where all people and their impacts on the planet are seen as "equal", inappropriate conclusions form on where the root problems come from. Hence, "over" population (in the poorer countries) is the often-attributed root cause. However population/demographic issues are just one aspect of "human activities". How we organize ourselves to

make use of resources – i.e. our *political and economic choices* – is another major important aspect, perhaps the main issue.

So too is for *what reason* we make use of resources, as it is not an obvious assumption that it is to meet all our needs (in fact currently – and historically – our economic policies are for increasing accumulation of capital, not necessarily to benefit all of society and the environment) (see the website: www.globalissues.org/EnvIssues/Population/Stress.asp).

Also important is how all these things *interact* with each other, and with the many other facets of "human activities". For example, economic/political *causes* of population growth (and decline) are often not factored in, resulting in assumptions based on religious beliefs, uncontrollable urges, lack of contraceptives, and so on. By making this base assumption of looking at population issues as a root cause, rather than a symptom of others, because that is so obviously a "human impact", the risks of promoting ineffective policies, and even blaming victims of deeper causes increase, while underlying causes remain. Changes in these root causes would change the limits of ecologies to sustain a different lifestyle. These major "variables" would lead to different "answers" in these complex "equations".

Finally, I want to conclude citing Sen (1999). Perhaps the most important variable in the equation linking "Population-Environment-Development" is represented by inequality. As Sen has underlined, *Development is freedom*, and inequality is one of the obstacles to the freedom. In particular, freedom and empowerment of women are determinant for environment: *"Obtaining equality between sexes, inverting the trend of different social and economic impediments that deprive women of the power to express themselves and to act, could be one of the ways to save environment and to pursue sustainable development. This goal can contrast the dangers of overpopulation and of the demographic pressure. The voice of the women has a basic role for the future of the world - not only for the future of the same women"* (Sen, 1999).

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