# 4. Environment, poverty and resources

## Introduction

The distribution of the population in a country is a reflection of history and the response to global economic, environmental and even cultural changes (Sklair, 1991; García Canclini, 1999; Bauman, 2007). Both processes affect all the different scales, from the local to the global. This global interdependence and the new scale of urban systems demand, as stated by Berry (2007: 3), a fundamental response in connection with the role of domestic urban policy.[1] Therefore, based on what this author suggests, it is also necessary to answer the question: *What do we understand by, and what is the scope of, an urban settlement or city?*[2] But there is another adjective, which has now become unavoidable, that refers to *sustainability*. Sustainability requires thinking about the relationship between population and resources, today and tomorrow. The context is that of urban aspects, poverty and environmental deterioration.

The process of production and reproduction of human groups in the geographic space is expressed in a differentiated dynamics of growth and distribution of the population in a certain territory. Spatial differentiation, the humanized space (as the French would call it), is the result of the combination of multiple historical, economic, cultural, political and environmental factors, among others (Morrill & Dormitzer, 1979; Claval, 1998). These factors change diachronically and vary synchronically, which explains a higher or lower level of vulnerability, depending on the capacities of human groups to obtain food, use exosomatic energy, maintain water in quantity and quality as an element of life, and create conditions of inhabitability, among other things (Diamond, 2013).

Unlike previous stages, where human groups and their productive and reproductive activities were directly related to the reproduction cycles of nature, and yields where based on land fertility and the quality of soil, today obtaining productive inputs depends, to a larger extent, on the capacity to obtain resources not only from the surrounding region, but other more distant regions. This means taking ownership of the carrying capacities of rural (and urban) areas in other regions or countries, without taking into consideration (or paying for) the social, economic and environmental impact that such actions generate. But, before analyzing the changes that stem from a global economy, let's think about the idea of carrying capacity that existed twenty years ago. Thus, the viability and prosperity of a community or human agglomeration not only depend on the *natural endowments*[3] of our immediate environment or its carrying

1 Berry (p.8) identifies four types of roles (which I am paraphrasing here): 1) Reactive: a role where nothing is done until a problem appears or a dysfunctionality is perceived; 2) Predictive: a role where attempts are made to modify trends based on current identified trends; 3) Opportunistic: a situation similar to that of a private business that seeks favorable opportunities in terms of viability and lower risk; and 4) Strategic: a role that defines objectives based on an image of the future, and requires sufficient control and power to ensure that the inputs mobilized will produce the results desired.

2 See Champion, 2007; Parr, 2007.

3 As several pioneering regional economists affirmed. See Perloff and Wingo, 1964.

capacity, but on different elements such as the openness of its economy, its physical and functional proximity to the main innovation nodes, or its integration into different networks, among many other factors (Precedo, 2003).

In effect, the logic of population distribution and the location of economic activities in the territory should be the abundance of natural resources, and one would have to assume that the presence of, and access to, environmental resources and services would create advantages for certain settlements to thrive compared to those that do not have them.[4] However, the viability of a settlement or town also depends on aspects such as their attraction capacity, which is not only related to their size, but also to their location in relation to other settlements and transportation and communication networks (Geyer, 2002a:57; Aguilar and Graizbord, 2014), as well as their "power" and the development of their institutions (Acemoglu and Robinson, 2012; see chapters 2 and 5).[5]

Parallel to the process of distribution of the population and economic activities, demographic growth is coupled with an increase in the number and proportion of the population living in poverty, especially where economic growth is not enough to create jobs and accommodate the new workforce (which has been the case of Mexico for many decades). On the other hand, this growth and the physical expansion of these settlements result in an increase in the demand for public and private goods and services and, therefore, pressures on ecosystems and the immediate environment.

The following questions arise from the processes described in the previous paragraphs:

- What are the characteristics of the urbanization process in the early decades of the 21st century, and how is the demographic growth distributed in the territory?

- How do these dynamics exert pressure on resources and how will the different spaces be affected in the mid-term?

The answer to these questions leads to another more important question: What should be the role of domestic urban policy in the process of facing these challenges?

Pacione (2011:3) considered that the trends and growth patterns of cities have been affected by a process of transition into a global and eminently urban society. And he wondered if this urbanization process characterized by an unprecedented scale and growth can sustain a level of urban development like the one we have today, especially in developing countries, and also if the growing demands of urban populations, whose levels of income and consumption are higher compared to their rural origins, can be met.

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4 Water provision is, without a doubt, an example of that. In our country, however, that is not the case. See Graizbord, González and López, 2013.

5 As a result of the agglomeration diseconomies created in larger cities (Geyer, 2002b:73), middle-sized and small cities experience a trickle-down effect in the urbanization process, which reinvigorates their relative and absolute growth in the National Urban System as a whole and the regional context where they exist.

But also, and as a result of the above, the kind of impact these population concentrations have on local ecosystems and the global ecosystem (and vice versa), as well as the effects that global change has, or will have, in these agglomerations (Romero Lankao, 2008:5; Sánchez, *et al.*, 2008). On a global scale, there is certainty about climate change and the increase in the planet's average temperature but, at the same time, local and regional spatial differences only create more uncertainty, considering the specific impacts of these changes are little less than predictable, even though we know that *inaction will only lead to huge human and material costs* (Stern, 2007; Galindo, 2009; see last paragraph in Chapter 2 and Chapter 5).

This chapter is divided into six sections. Three of them deal with the relationship between population and resources, which are addressed from the perspective of natural capital. The fourth section is a fairly general but systematic overview of the efforts made by intergovernmental agencies and bodies since Stockholm, in 1972, to address anthropic effects on resources and the environment. The fifth section explores different dimensions of the "complex human interaction" with the environment, and the last one suggests the use of the *regional scale* to achieve sustainability.

## 1. The population-resources relationship

The recent call to hold an international discussion in Port Elizabeth, South Africa, in June of 2014, with the theme *Population and climate compatible development*, organized by Lead Southern and Eastern Africa and funded by UNFPA, starts with the following text:

> *The world' population grows at unprecedented rates. With a growth of 78 million inhabitants each year, we can expect the world population to reach 9 billion by 2050. Our ability to respond in the long-term to the needs of this population is severely compromised by unsustainable lifestyles and the impact of climate change on the natural resources of the planet and the possibilities for development, which poses a challenge to achieving sustainability.*
>
> *Understanding the complex network of interconnections between population, climate change and development is the key to develop innovative solutions that adapt to the changing world and strengthen the path toward a sustainable future.*

There are two key aspects to highlight in these paragraphs. First, the world's population volume is mentioned in quantitative terms, and attention is brought to the challenge of meeting the needs of this population in the long term (by 2050, the year in which the world's demographic growth is expected to stabilize), but this is only related to something difficult to analyze, that is, the "complex mesh of interconnections between population, climate change and development", no more and no less! Of course this is all about the relationship between population and resources (Weisman, 2014; Graizbord, 2006), as well as the way in which both categories have been addressed in the literature, beyond the Neo-Malthusian formula of I = PAT (impact = population x abundance x technology).[6] Second, no reference is made of the spatial dimension, without which it is almost useless to talk about these issues, because neither the population nor resources are homogeneously distributed on the Earth's surface.

6 This formula appears in Ehrlich and Holdren (1971). We should remember the Ehrlichs' book entitled The Population Bomb (1968), and the title they thought of originally: Population, resources, environment. See Ehrlich and Ehrlich (2009), which suggests a review of Malthus in the light of the world's population today.

Ignoring the "where" is not an omission exclusive of population scholars. For economists, spatial differentiation does not seem to have any importance either. The "where" is the *leitmotif* of geography, but what are the aspects that this science provides and highlights as fundamental for the analysis of the complex relationship between population and resources in the context of climate change and development?

To be fair, the following is another paragraph of that same document that suggests arguments that require a careful analysis:

> *The current debate about the relationships between population dynamics and climate change is often limited to the argument about size. This reflects an incomplete understanding of the causes and consequences of climate change.*
>
> *The relationship between population size and growth and the emission of greenhouse gases is more complex! It must be assessed in the context of broader development trends, including increases in consumption and urbanization levels.*

This quote states that the current debate about the links between population dynamics and climate change is limited to the issue of size. Instead, decision-makers often fail to consider environmental impacts as part of the population analysis. I cannot believe that, after the Erhlichs' call about the "demographic bomb", people still insist on this relationship in a simplistic manner, which seems to be the case here.[7] The truth is that, in the current context of climate change, as an environmental problem of the 21st century, a century where we could easily see temperatures never seen before on Earth since the last interglacial some 140,000 years ago, we can say that, today, our planet is quite a different place compared to what it was *"back in the day"*: before the industrial revolution. To begin with, as stated by Cowie (2007: 206): "back then there were not 6 billion humans, and rising, nor the population grew like it does today. Nor was the planetary landscape so managed or the global commons, both atmosphere and oceans, perturbed by human action".

The relationship, as the paragraph quoted continues, is a *complex* one, it must be *contextualized* in a broad development trend, and it must be related to demand and consumption, as well as to urbanization levels. Still, there is room to highlight the omission of an approach that fails to establish a distinction between *levels of aggregation* (*i.e.* the collective, the social vs. the individual, the personal decision, the individual or couple and the community, the global and the local, to mention just a few).[8] At no time can we accept that human reproduction is exclusively

7 Even an explicit text about population growth and the need to control it makes reference to the conceptual, methodological, political and public policy difficulties involved (see Wire, 2009). Even in the simple proportional relationship proposed by Ehrlich and Holdren (1971) between environmental impact and population (I=PAT), where the population volume is weighed by per capita consumption (wealth or income and consumption patterns, which are even culturally affected) and technology (energy inefficiency, or even efficiency), the implications are not easy to analyze. Of course, the idea is based on the logic that, quantitatively speaking, two similar persons could have an impact on the environment that is twice as much as just one of them, which seems reasonable, regardless of whether we admit the fact that the relationship is now more complex and multifactorial.

8 A simple relationship between food production and the size of the world population can be found in the following data: While the total food production index went from 98 in 1978-80 to 122 ten years later, the per capita production in that same period increased from 100 to 104 (for both, 1979-81=100). Of course, in those regions with a larger demographic growth, per capita production declined, even though the total increased (see Chart 3.1 in Simmons, 1997:108, with WRI data from 1993).

inherent in the biological nature of the species. However, while the decision to have children is a personal matter for couples, reproduction and population growth are *social issues* and, in specific scales and contexts, they can be an issue of survival for the group or a public policy issue.[9]

The way in which population distribution, its structure or its composition by age or gender, migration and growth vary spatially speaking, relates to the nature of the places (the context of/on a given scale). Of course, the disciplinary boundary between geography and other sciences interested in these topics is vague, while the geographic approach focuses on the *scale* and the *spatial variations* of phenomena and variables. Just like the study of population cannot be isolated from the fundamentals of human ecology, it would also seem that it has not been able to detach itself from the two essays by Malthus about the economic principles of population (1798 and 1803).[10]

It is worth remembering that two are the ideas that serve as a basis for the argument and have "bothered" those interested in the study of the population so much: the fact that the population has a tendency to grow faster than the livelihoods at its reach, and also that the measures to control these differences can be "preventive" or "positive" in nature. The former refers to a tension between population and resources, and the latter refers to aspects related to social practices that affect mortality and fertility. Positive practices arise from phenomena beyond the control of individuals (such as wars, disease, poverty or food shortages), while preventive practices stem from moral (individual) or ethical (social) decisions related to sexual and reproductive practices.

Generally speaking, the anti-Malthusian reaction has followed three lines of thinking. The first one refers to the apparent confusion between the moral and the scientific (and even the Catholic Church has participated in it). The second has to do with poverty, and there is no assurance that Marx's position about the reasons that explain it as a result of the injustice of the social institutions of capitalism, and not as a result of population growth (which apparently has been possible precisely thanks to the Industrial Revolution), refers to the same, even though this criticism had a huge influence among the "populationists". The third main criticism is based on the empirical confirmation of the mistaken prediction in connection with the population growth dynamics[11] and the unforeseen power of technology to also geometrically drive the

9 We would have to analyze the demographic, and moral, logic behind China's Draconian measure to implement the "one-child" policy to reduce its population growth, which had an impact on individual freedoms and, as already seen, distorted the gender balance with different social and spatial effects (even psychological and from the standpoint of international migration).

10 The 1789 version is "Ensayo sobre el Principio de la Población", FCE, Mexico, 1951. In particular Chapter 2: The different ratio in which population and food increase - The necessary effects of these different ratios of increase - Oscillation produced by them in the condition of the lower classes of society - Reasons why this oscillation has not been so much observed as might be expected - Three propositions on which the general argument of the Essay depends -- The different states in which mankind have been known to exist proposed to be examined with reference to these three propositions. Available at: www.marxists.org/reference/subject/economics/malthus/.

11 Only in some cases. In the beginning, the quote does not necessarily confirm it is wrong to think about exponential growth. Even 200 years ago, it was really unthinkable that the Earth's human population would reach 9 billion. And even less that we would face thresholds in terms of globally available resources, nor that we could have a negative impact on the environmental services provided by nature, and a negative and anthropocentric impact on the climate of the planet.

world's food production capabilities.[12] From there the insistence that political issues, and not the shortage of food in this planet, are to blame for famines.[13]

Today, it would seem that population scholars should not have to bother with the apparently reactionary position of Malthus, who made his critics believe his arguments, a situation that hindered the development of demography as a science. Instead, we should consider his power of argumentation, which has persisted for so long and has led to a permanent debate that has already lasted for two centuries.[14]

In addition, we should look, with a different set of eyes, at the relationship between population, or the populations, and ecosystems, recognizing the finite nature of our planet and its resources, as well as the limited capacities of ecosystems to assimilate extractive practices or those that generate waste on the current scale, *i.e.*, its character as *spaceship Earth*.[15] There are other opinions that are also an important wake-up call in this population–environment relationship. In a best seller from 2009, Friedman (2015: 77-88) adopts another view on the demographic dynamics. "...[The] demographic explosion is coming to an end", he categorically

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12 To some extent, the truth is that, as affirmed by Daly (1977), in his eagerness to grow, "man has ceased to live within the annual solar budget and has become addicted to living off his capital of terrestrial stocks of low entropy (fossil fuels, minerals)."

13 Back in the 1980s, Kidron and Segal (1984) considered that not all the countries had secured their food production. Some countries in Africa are protected by their farming land and systems, but many suffer persistent draughts and, in general, the data showed that the food production per capita had dropped by more than 20% since the 1960s. In general, the countries in North America, Europe and Australia are the only ones with food security. However, the fact is that the "growing volatility of climate… will only worsen the pressure on over-specialized [commercial] crops" (Hawken, *et al.*, 1999: 197), a crop system characteristic of those countries. China and Russia are considered to have a minimum capacity, while Japan, for instance, has an extreme deficit. In fact, China is today the world's biggest cereal importer. The following quote from Brown (2004: 10-11) is quite enlightening: "Perhaps the largest agricultural setback in recent times has been the steep decline in the production of cereals in China since 1998. Ten years ago, in Who is going to feed China?, I projected that China's large grain production would peak and then decline. But I did not anticipate that it would drop by 50 million tons between 1998 and 2004".

14 Now that the discussion about climate change has shifted to the issue of adaptation, and it is well known that it will have severe impacts, first and foremost, on poor populations, regions and countries, we may have to subject Malthus "to a new trial and execution", as Irvine and Ponton (1988), members of the British Green Party, stated in his defense. Or maybe we should admit with them that "demographic pressure is not only a third world problem". (Reprinted in an abstract in Dobson, 1999: 66-67).

15 We owe this concept to Boulding (1996). Here, it is worth resorting to Daly (1977). This influential author, although not as much as he should be, presents, in one paragraph, a brief history of the human species on Earth, precisely talking about its growth: "As population grew, man needed more food and undertook the work necessary to produce it, employing draft animals to help. As population continued to grow man became more reluctant to share his food-producing land to grow fodder for draft animals. Instead, he began to feed tractors with fossil fuels and increased the ability of the land to support a larger population. Also, new products were produced and standards of individual consumption increased along with population, further increasing man's addiction to living off his terrestrial capital.. Some big problems emerge from this addiction... [Daly points to a fundamental one:] Whenever the net energy yield becomes zero (that is, it costs as much energy to mine a ton of coal as can be got from a ton of coal) then it becomes nonsensical to continue mining that energy source." (Reprinted as an abstract in Dobson, 1999: 162).

cally affirms. Based on UN projections (p.79), he shares the signals sent by current trends and explores the social impact on lifestyles and ways of living, highlighting women's role in this process and the changes they experience, both personally and socially.

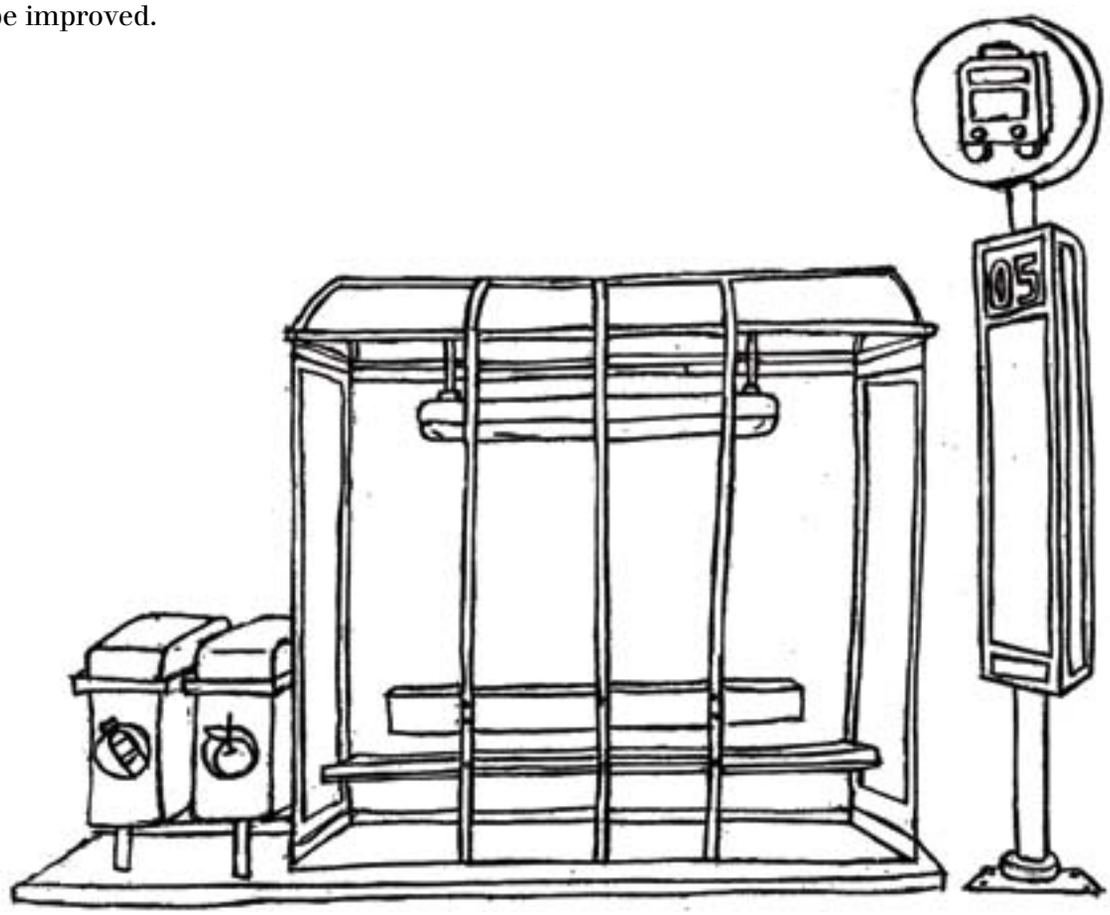
The following quote is noteworthy:

> *The crude reality is that a reduction in greenhouse gases requires a more limited general consumption of fossil energy.*
>
> *Therefore, the more population there is in the planet, the bigger the per capita decrease necessary to achieve safe emission levels.*

On his part, Zlotnik (2009:35) points to the sacrifice that the biggest consumers must make, but there are other important aspects in his argument:

> *Existing disparities in energy use stemming from sharp differences in per capita incomes add complexity to the argument, but do not invalidate the fact that current levels of population growth cannot be maintained over the long run without endangering the sustainability of the planet, particularly if standards of living are to be improved for a growing population.*

This would seem to be valid, even if we do not expect that the above-mentioned standards can be improved.



## 2. Population and its environmental impact

The exponential population growth experienced in the last two hundred years, which we see as natural in a short-term vision, is not necessarily a typical phenomenon. We have seen the Mexican population double twice: from 25 to 50 and from 50 to 100 million in fifty years, between 1950 and 2000. Today, in spite of the ideology that affirmed that "to govern is to populate", which later changed to "responsible parenthood" and then to "small families live better", it is now possible for the current growth rate to guarantee, for the time being, that the population will not grow beyond 135-140 million, a number that will be reached by the middle of this century. The problems have more to do with distribution than growth, or at least that is the way it should be. But this is not the case in all the regions of the world. And neither would it be possible to think, in all of them, that a stabilized population will solve the environmental impact issue, because the dilemma lies in *restricting the consumption pattern*, which poses two types of problems: it is unfair for the *"newcomers"* (*i.e.* emerging countries: China, India), and inacceptable for the "rich" (*v.g.* developed countries: USA, Germany). Apparently, the dilemma in inescapable for mankind (Bauman, 2007: 35), because consumption has moved away from the *need* and, therefore, from *satisfaction* and even *wellbeing* (Offer, 2006: 279, 36).

The scenarios for the future population are based on the consideration of current growth rates, which have already declined, and also on the fact that higher income and education indicators result in lower fertility rates.[16] In this regard, populations in poor countries will have higher growth rates compared to the developed world, and the same will happen in rural regions, where children are some sort of insurance for the elderly. Another addition to the growth in the environmental impact related to the demographic dynamics is rural-urban migration, as well as that from poor to rich or industrialized countries. In both cases, this new location of the population that moves from rural to urban areas and/or often times also from poor to rich countries, implies an increase in the demand for drinking water and the use of exosomatic energy and therefore, impacts on the environmental footprint, given the differences in consumption patterns.

In summary, human ecology must be considered as part of the population analysis, that is:

*i. The way in which the population reflects the amount of biomass and, therefore, the impact the human population has on other species.* Food production for the world's current population, with such a big food demand, has led this activity to dominate biologically productive land in the temperate areas of the planet (Cowie, 2007: 327). The technology applied in this sector has led to a one-half reduction of the land area required. If we followed the agricultural practices we had 40-50 years ago (Ibid., Fig. 7.7, p.329), the problem of soil degradation would be solved.

16 In Spanish there is usually no distinction between the terms fecundidad (fecundity) and fertilidad (fertility). However, fecundidad refers to the number of descendants produced by an individual or couple, while fertilidad refers to the reproduction capacities of a population. The former is individual in nature, and the latter has to do with the collectivity.

ii. *The supply of energy related to the negative effects on the carbon cycle and other cycles that ensure life.* More than one half of global warming in recent decades can be attributed to anthropogenic CO2 emitted by burning fossil fuels. In the last 50 years, the global increase has been 350%. Over time, if nothing is done, there is a risk of affecting the thermodynamic balance of the biosphere (Cowie, 2007: 330-4). The other greenhouse gas is methane, whose emissions currently account for 15% of the total. In this case, there is also a direct relationship with the population, because it is generated in rice fields and cattle-breeding areas. Alternative sources of energy are currently more expensive than conventional ones or they are insufficiently developed, and their widespread use (wind, solar, geothermal, among others) will depend on the price and the availability or relative scarcity of oil and gas. Finally, deforestation generates emissions, while the opposite, the preservation of forests and jungles, which is still an incipient effort, allows for the capture of carbon.

iii. *Health, or the relationship with those species that affect humans.* Climate change affects human health through processes mediated by disturbances or the degradation of ecosystems. The interest in this relationship has shifted from the nineteenth-century concern to heat up rooms in homes and workplaces in the winter, or to cool them down during the hot summer in hot regions, but also the burning of wood inside precarious homes in rural areas, to a concern over the impact of climate changes on vulnerable populations, age groups (elderly people, children, women) and the indigenous population, which are generally associated with poverty. This impact occurs in several ways. It has effects related to the hydrologic cycle, which creates hydrometeorological events of a greater intensity or duration; it affects crops; increases the reach of pathogen vectors that affect humans and other species, and has an impact on the quantity and quality of water for human use, among many other consequences.

iv. *The availability of foods that have an impact on vegetable and animal species harvested by humans.* The world's food security increased in the last 3 to 4 decades of the last century, thanks to the mechanization of farms and the use of fertilizers and pesticides. Grain production (corn, wheat, rice) has multiplied by four, while the per capita consumption reached a plateau at approximately 300 kg/year since the 1980s (due to the world's population growth); meat production also multiplied by five, with an average consumption that went from 17 kg in 1950 to 39 kg in 2002; global annual fisheries production also multiplied by five during the second half of the 20th, but the average per capita consumption reached a plateau since the 1960s, at approximately 15-17.5 kg, despite the fact that the supply has grown since the 1980s due to the expansion of aquaculture, from 7 to 36 million tons in 2000 (Cowie, 2007: 360). However, average figures hide the differences between countries and also between income groups. But that has not been the case in certain regions or countries, mainly in Africa and Asia. The world's estimated 850 million inhabitants considered to be underfed or malnourished according to FAO (2004) are in India (25%), the countries in Sub-Saharan Africa (24%), Asia Pacific (19%), China (16%), Latin America (6%), North Africa (5%), and other countries (4%). And only 1% in developed countries (Cowie, 2007: Fig. 7.13, p. 373).

> In addition, farming practices have had a cost, and it cannot be said they are sustainable. They have generated erosion, toxic impacts and resistance to agrochemicals used. The consumption of seasonal agricultural products has changed, and the virtual energy component necessary for their production has increased, no less than the volume of water, a farming input essential for irrigation purposes (Cowie, 2007:368). The future does not look promising due to two factors: first, that most productive ecosystems are over-exploited and, second, that population growth and the culture of intensive use of fossil energy, but also agricultural practices, are not sustainable from the standpoint of food security (*Ibid*.: 370).

These considerations lead us to think that population growth, which will mainly occur in developing countries, will undoubtedly contribute to increase the emission of greenhouse gases (due to the generally inefficient use of fossil energy). During the 19th and 20th centuries, CO2 emissions were mainly generated by industrialized or developed countries, and very few by the less developed ones. By the end of the 20th century, and for at least half of this century, the situation has been reversed, considering that the population of developed countries is no longer growing, and in developing and recently industrialized countries there is a steady growth. We will have to wait for two changes to occur so that, before year 2100, we can see a reduction in population growth rates in the poorest countries: a reduction in infant mortality and an increase in life expectancy. (Friedman, 2015: 79-82). Therefore, it will be in the latter that emissions will grow to the point where, as a whole, they will account for more than one half of global emissions, which poses a scenario different from the one we have today in global negotiations around climate change and its mitigation. But there are two paradoxes: the demand for goods and services is generated in the former (if we exclude China and India), and it will be in the poor and developing countries where emissions will have bigger repercussions and more investments and efforts to adapt to the impacts expected will be required.

## 3. Resources or natural capital?[17]

It is said that the degradation experienced by the environment is the result of institutional flaws (Swanson, 1996: 4). The importance of institutional development comes from a seminal paper written by Hardin (1968), which led to a vast literature that questioned the "tragedy of the commons" or the hopeless tendency to exploit resources, mine them, when individuals or corporations have free access to them.[18] According to Ostrom (2000), there is a distinction between free access and common use resources. The latter achieve a level of sustainability through the development of institutions that express the organization of the social group that maintains them as communal property or agrees to their use based on cooperative principles. In the international scene, Young (1997) highlights the need and the options faced by mankind for the development of intergovernmental systems that protect free-access global goods such as the oceans, the atmosphere, the poles and, in general, the environmental services provided by nature.

If the goal is to sustain the production of goods and services indefinitely, it is necessary to think in terms of the concept of *natural capital*, that is, to accept the idea that we must use or *live off the interest and not touch the capital* (Gilpin, 1996: 206). However, this would also require the acceptance of the concept of "strong sustainability", which opposes the use of a different type of capital (physical, financial, human, etc.) to replace or complement natural capital. According to Hackett (2001: 335), strong sustainability optimizes the economy based on the ecologic and environmental capacity. The latter conditions the economic activity and not the other way around, which, in any event, would be far from being realistically acceptable. *There is, and if there is, what is the acceptable or middle point?* (Graizbord, 2006: 503).

If, as it was the case, regional development was based on *natural endowments*, and wealth was based on the *stock of resources*, the solution was to rationalize its use and, in this regard, yields depended on scarcity. The reader should note that here we are referring to a regional scale, and not necessarily to a city or metropolitan area. In other words, as we have insisted in other chapters, we understand the challenge of the sustainable city as a problem not limited to the urban sphere, as will be seen in the following paragraphs. Conventionally speaking, the goods and services produced by using resources that are depleted or become scarce can be replaced. However, in the analysis of natural resources (Neher, 1990: 84), these are valued for the ecologic benefits and the amenities they generate and, at the same time, for their exploitation. Thus, we consider the value of the *stock* and, at the same time, the value of the flows of goods they produce. The question then is: How can we strike a balance between the short-term benefits of the flow generated by the exploitation of the natural environment (which includes renewable and non-renewable resources) and the concomitant and long-lasting environmental damage of the *stock*?

In general terms, a resource is something that is directly or indirectly capable of meeting a human need. According to the economists, there are three categories: capital, work, and natural resources. Capital refers to the type of resource produced not for direct consumption, but rather for the purpose of creating or achieving a more efficient production process.

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17 For an extended version of this discussion, see Graizbord, 2006: 491-507.

18 The term "tragedy of the commons" may not be the best. Maybe it would be better to speak of the tragedy of "common resources" or, in more general terms, of the tragedy of "the common", which makes a clear reference to the concept of common property.

Work includes the physical and mental production capacities of men (as mankind) to carry out their activities and produce goods and services. Natural resources constitute the *stock* of live or inert materials that are found in the physical environment and have an identified potential use for human beings (Hussen, 2000: 4, cited in Graizbord, 2006: 501).

The science of economics considers that resources used for direct consumption experience changes, but are used as production factors, that is, as means to produce satisfactors. Of course, this notion is strictly anthropocentric, as stated by Hussen (2000: 4), which implies that they are not considered as having an intrinsic value or any value other than the economic value defined by human (and, therefore, commercial) needs. But in addition to that, resources are of interest for the economy simply because they are scarce. Finally, as production factors, resources are used combined and are, or can be, (according to Solow 1991, cited in Hussen, 2000: 5) replaceable. In other words, none of them is considered *by itself* as absolutely essential for the production of goods and services, which does not eliminate the fact they are scarce.

And this leads to some basic questions: What to do in order to meet the human needs of goods and services in in a world of scarcity? How to maximize the group of goods and services available at a given point in time? How can we justify the need to ration the limited resources? One answer is in (Hussen, 2000: 6-7):

*a.* Make decisions and define priorities: *choose*;

*b.* Consider the associated costs and, therefore, sacrifice something to obtain something else: *opportunity costs;*

*c. Minimize waste by using the best possible or available "technology": efficiency; and*

*d.* Reduce the conflict caused by the allocation and distribution of scarce resources, in which case the market system can be the means or mechanism for that: *social rules or institutions.*

But the stock of resources (renewable and non-renewable) does not guarantee life in the planet. The *environmental services provided by nature*, that is, the *natural capital*, is what guarantees sustainability. The idea that an economy can continue to function without natural capital is behind the notion of the discount rate and the effect technical progress can have on it. The notion of the discount rate refers to people's preferences for current consumption (benefit) compared to future consumption (benefit). Thus, people will be willing to substitute their current consumption (benefit) for future consumption (benefit), but only as long as they obtain a "premium" through a discount rate: sacrificing one peso of current consumption requires a compensation that exceeds the value of a peso of future consumption. Thus, future consumption is discounted at a certain discount rate that indicates the substitution of current consumption for consumption at a later date. The question is: Why is future discounted? The answer is because people are short-sighted or because the future is uncertain. An individual is more short-sighted and faces more uncertainty than society, and gives less importance to the future, so the matter becomes more social than ethical, because the decision affects the wellbeing of future generations. Thus, choosing or determining the discount rate is crucial: the bigger the uncertainty the higher the rate, but a lower or a low discount rate favors future generations. However, according

future generations. However, according to Hartwick-Solow, this is not a serious problem, because the effect of a positive discount rate may be affected by the technical progress growth rate and, therefore, it is not immoral or wrong to use a discount rate, especially if the premium is carefully used to maintain the sum or *stock* of the different types of capital (physical, human, environmental) constant.

There would be six possible reasons to think that this rule about sustainability, or optimal (*v.g.* efficient) inter-temporal route, has weak foundations (Hussen, 2000: 185-186):

*i.* It assumes that the capital generated by men and natural capital are substitutes when, in any event, they are *complementary;*

*ii. I*ntergenerational efficiency requires that all goods and services reflect *their social value.* However, it ignores or assumes that there is no difficulty in solving the distortions caused by externalities;

*iii.* Some economists argue that the idea of a positive discount rate is wrong and fails to take in consideration the wellbeing of future generations *in all of its dimensions* (Perrings, 1991, cited in Hussen, 2000: 186);

*iv.* The approach followed by this rule fails to explicitly consider the *scale*, that is, the size of the human economy in relation to natural ecosystems;

*v.* The economic process is conceptualized as something separated from environmental systems, without understanding the complex interactions that exist between both systems.

It also underestimates the fact that human activities can cause irreversible damages to the natural environment (and ecosystems); this, acknowledging that there is uncertainty about the risks that these effects can cause on life-supporting systems and the quality of human life. Thus, contrary to what Hartwick-Solow's approach suggests about sustainability (the probability of substitution and the role of technical progress), an economy as a system could hardly continue to operate without natural capital. At least that is the position of the strong approach of environmental economics.[19] And this means, on one hand, considering *intergenerational equity* and, on the other, maintaining natural capital constant; in other words, the preservation of natural resources and the relentless defense of environmental conditions.

19 Represented by Boulding (1996) and his idea of ecological boundaries; Georgescu-Roegen (1993) and his concept of energy as a limiting factor; and Daly (1996) and his steady-state economy approach.

With these principles, the rules or policy criteria should be the following (Hussen, 2000: 188):

*a.* The rate of exploitation of natural resources *should not exceed* their regeneration rate.

*b.* Waste emission (pollution) should be kept at or below the waste-absorptive capacity of the environment (ecosystem). However, there are persistent emissions whose rates *should be zero* since the ecosystem has no capacity to absorb them, or because the time it takes to absorb them is huge (*i.e.* DDT, radioactive substances, CFC, among others).

*c.* The extraction of non-renewable resources (fossil energy) should *be consistent* with the development of renewable substitutes. According to Hussen (2000: 188) this is the equivalent, paradoxically, of Hartwick's rule of substitution.

As can be inferred from the above, economic considerations are ignored and therefore, the usefulness of this approach to orient public policies may be limited, which leaves the sustainability issue unsolved! And here we can quote Hussen's question: Is sustainable development a helpful term or a vague and qualitatively void concept? But this also leads us to the (*intra and intergenerational*) equity vs. efficiency dilemma and the issue of the trade-off between both remains unsolved.

## 4. Some historical background

The concern over sustainable development is not new. In 1971, the Secretary of the United Nations Conference on the Human Environment requested a report on the "state of the planet". This report, entitled *One Earth*, was presented in Stockholm in 1972. Years later, in 1987, the World Commission on Environment and Development of the United Nations, led by Norwegian Dr. Gro Harlem Brundtland, presented the report Our Common Future. The importance of this document not only lied in the fact of launching the concept of *sustainable development* defined as *that development that meets the present needs without compromising the needs of future generations*, but its inclusion in all the UN programs, which became a precedent for the Earth Summit held in Rio de Janeiro in 1992.

In essence, sustainable development is a process of change where the exploitation of resources, the direction of investments, the orientation of technological development and institutional change must be in *harmony and promote* the current and future potential to meet present and future human needs. We are far from achieving this ideal, and far from solving the two issues implicit in the statement:

- The concept of *needs* implies focusing our attention on *poverty and inequality*, which are key to solving the issue of *intra- and intergenerational* justice;

- The idea of *future* means imposing *limits on current consumption*, and, consequently, on *environmental pressures* (here and now) to ensure that ecosystems and the global ecosystem maintain the ability to provide the environmental services required to guarantee meeting the needs of future generations, that is, the issue of *intergenerational justice*.

## 4.1. Environmental pressures

In 1992, with a widespread global awareness that human activities could endanger life on the planet, a second conference, "The Earth Summit", was held in Rio de Janeiro with the participation of representatives of almost all the countries in the world. At this summit, a guiding document called Agenda 21 was drafted together with recommendations for its implementation.[20] Ten years later, in 2002, a third meeting, "Rio+10", was held in in Johannesburg with the aim of assessing the achievements made in connection with the objectives of Agenda 21. And ten years later, in June 2012, the "Rio+20" meeting was held with the purpose of:

"…shaping an ambitious sustainable development framework to meet the needs of both people and planet, providing economic transformation and opportunity to lift people out of poverty, advancing social justice and protecting the environment".

A review of the resolution approved by the United Nations General Assembly (http://www.un.org/es/comun/docs/?symbol=A/RES/66/288) included in "The future we want" does not seem to leave anything out. It is important to stress the idea of a "green economy" that United Nations agencies such as UNEP (2011) have advocated as a growth model based on urban economies and, in the interest of this publication, a summary of the *recommendations* from the sustainable cities section is presented here:

20 The conceptual basis for the preparation of Agenda 21 came from resolution 44/228 of the United Nations General Assembly of December 22, 1989. As a result of negotiations of 172 nations at the Earth Summit held in Rio de Janeiro in June 1992, the drafting of Agenda 21 was agreed together with a global plan of action to promote sustainable development and the establishment of the Rio Declaration on Environment and Development. The topics addressed are divided into 40 extensive chapters under four main sections: a) Social and economic dimensions; b) Conservation and management of resources; c) Strengthening the role of social groups and d) Means for implementation. Available at: http://www.rolac.unep.mx/agenda21/esp/ag21inde.htm;http://www.un.org/spanish/conferences/cumbre&5.htm..

*i.* Encourage cities to promote economically, socially and environmentally sustainable societies.

*ii.* Promote sustainable development policies that support inclusive housing and social services; a safe and healthy living environment for all, particularly children, youth, women and the elderly and disabled; affordable and sustainable transport and energy; promotion, protection and restoration of safe and green urban spaces; safe and clean drinking water and sanitation; healthy air quality; generation of decent jobs; and improved urban planning and slum upgrading. We further support sustainable management of waste through the application of the 3Rs (reduce, reuse and recycle).

*iii.* Include disaster risk reduction, resilience and climate risks in urban planning.

*iv.* Achieve a balance between urban development and rural regions.

*v.* Increase the number of metropolitan regions, cities and towns that are implementing policies for sustainable urban planning and design in order to respond effectively to the expected growth of urban populations in the coming decades.

*vi.* In the case of urban planning, consider the involvement of multiple stakeholders, as well as the full use of information and sex-disaggregated data, including on demographic trends, income distribution and informal settlements.

*vii.* Improve municipal administrations so they can fulfill the important role of setting a vision for sustainable cities.

*viii.* Drive the planning of mixed-use areas, and encourage non-motorized mobility, including the promotion of pedestrian and cycling infrastructures.

*ix.* Promote partnerships among cities and communities, considering the important role they play in promoting sustainable development.

*x.* Strengthen cooperation mechanisms or platforms, partnership arrangements and other existing implementation tools to advance the coordinated implementation of the *Habitat Agenda*, with the active involvement of all relevant United Nations entities and with the overall aim of achieving sustainable urban development.

There is no doubt that this is a broad program that, among other aspects, in addition to the financial one, requires institutional development and the creation of management bodies that do not exist or that, if they do, require strengthening without delay.[21]

In the interim between Stockholm (1972) and *Rio*+20 (2012), international meetings on gender, population and habitat, among other things, were organized, and several global environmental agreements were reached. Thus, in the 1980s, and after confirming that the problems were far more serious than previously reported in *Stockholm*, scientific research revealed the presence of substances that deplete the ozone layer. People began to realize that biodiversity loss was occurring at an unusual pace; that species were being extinguishing at a rate never seen before, and that the accumulation of greenhouse gases (GHGs) could cause major changes in global climate, which could mean substantial changes in life on the planet.

It also became evident that the illegal trade of species posed a threat, which led to the signing of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES, 1973) and the Ramsar Convention (signed in 1971); the Vienna Convention (1983) and the Montreal Protocol (1987) for the elimination of substances that deplete the ozone layer, and it was understood, on a global level, that it was necessary to negotiate a new generation of international agreements related to biodiversity, climate change, the fight against desertification and droughts, and control of chemical contaminants.[22]

Despite these initiatives, over the course of the last three decades forests have disappeared at an unprecedented rate, the accumulation of greenhouse gases in the atmosphere has increased, air and water pollution has intensified, plant and animal species have disappeared, and vector-borne diseases of animal origin have grown explosively. Soil degradation has increased poverty and hunger and has led to the abandonment of the countryside in favor of cities. All this continues today (Melnick, McNeely and Kakabadse, 2005).

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21 In a report prepared for the Metropolitan Environmental Commission (Graizbord, et al. 2010: 89-96), several strategies and actions were proposed based on the following five dimensions, for the purpose of strengthening the institutional development of this metropolitan body and attempting to ensure the implementation of its environmental sustainability agenda: i. Metropolitan coordination; ii. Rationalization of powers; iii. Financial and administrative consolidation; iv. Relationships with other government agencies; and V. Dissemination of activities.

22 The Kyoto Protocol on climate change of the United Nations Framework Convention on Climate Change (UNFCCC), as well as an international agreement to reduce the emissions of six greenhouse gases that cause global warming: carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O), and three other fluorinated industrial gases: hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF6), by an approximate percentage of at least 5% over the 2008-2012 period, compared to 1990 emissions. This goal, of course, has not been fully met, and the differences between countries are striking. The Protocol was initially adopted on December 11, 1997, in Kyoto, Japan, but only came into force until February 16, 2005. By November 2009, 187 states had ratified the Protocol. However, the USA, the world's bigger emitter of greenhouse gases, did not ratify the Protocol. And now we are entering a post-Kyoto era, where a series of commitments have been made to undertake national efforts, based on each country's capacities, which will be formalized at the COP 20 to be held in Paris in December 2015.

## 4.2. Poverty

To date, several international initiatives have been launched (by the World Bank and ECLAC) to *link* environment to poverty and/or human development (UNDP, 2010). In September 2000, "at the dawn of the new millennium", the United Nations General Assembly promoted a strategy: the *Millennium Development Goals* (MDGs) for poverty reduction. The *Rio+20* resolution, which was already mentioned above, is related to poverty and multiple other issues such as health, food and education, among others. It also recognizes that, three years from the deadline to achieve the Millennium Development Goals (2015), while it is true that some progress has been made in terms of reducing poverty in some regions, this progress has been uneven, and in some countries the number of people living in poverty continues to grow, with women and children being the most affected groups, especially in the least developed countries (such as those in Africa).

It considers that the sustained, inclusive and equitable economic growth of developing countries is a prerequisite to eradicate poverty and hunger and achieve the Millennium Development Goals. In fact, the signatories recognize that, in order to eradicate poverty and address the root causes and challenges it involves, *integrated, coordinated and coherent strategies at all levels* are essential. And while it is true that in these proposals poverty is considered to be related not *only* to the income and consumption of individuals, but to key environmental factors (resources) and institutional development, the relationships between environment, poverty and resources have not been addressed appropriately.

A review of the way in which environmental issues have been approached in strategies to reduce poverty reveals the narrow view of public services and the use of resources; their focus on terrestrial ecosystems, ignoring the coastal and marine ecosystems; the omission of the causes of disasters; the exclusion of sectoral linkages beyond agricultural or forestry activities; the concern over the effects of sanitation and pollution on health, ignoring the links with water and vector-borne diseases; and the limited development of indicators to systematically monitor the links between poverty, [resources] and environment, among other important issues.

In any event, poverty, as well as environmental conditions and deterioration, do not manifest themselves in a homogeneous manner all throughout the world, nor between continents, let alone between and within countries.

## 5. Multiple and complex interrelationships

Population growth patterns have been approached from a broad geographic perspective that considers processes such as urbanization, industrialization and the use of resources (Johnston *et al.*, 2000: 600). Likewise, population is included in the spatial analysis based on a matrix of relationships between population, resources, location of activities, administrative structures, settlements of different sizes and economic-spatial functions, markets and central locations, institutions, and even values, motivations and social goals or objectives (Isard, 1960: 2). A more recent perspective that comes both from human (Simmons, 1997: 28-29) and physical geography (Gregory, 2000: 178) considers that the distribution and the "size" of the population are important to understand the reciprocal influence between environment and population, and between natural environment and culture: the way in which people affect the natural conditions of the ecosystems and the way in which the population is impacted by the changing environment.

As pointed out by Brown (1987: 19-20) "[historically], crop expansion has been closely related to population growth. In response to demographic pressures, farmers *moved from valley to valley and from continent to continent* [the italics are mine], gradually expanding the farming area. Today, one tenth [and at present almost one quarter] of the Earth's surface is cultivated, and the promising [border] settlements have almost completely disappeared". From this perspective, it is worth pointing to some implications of a world population that more than doubled in the last 50 years of the 20th century, from 2.5 to 6 billion, but took 10,000 years to go from 4 million to one billion after the Industrial Revolution.[23]. And had it not been for economic and technological changes, it would not have been able to survive and reproduce and, we must acknowledge, reach the levels of consumption that we have witnessed in some cases, but which are now as questionable as the size of the population.

Developments in the use of fossil fuels during the 19th and 20th centuries intensified food production, and the area of farming land expanded quickly. The demand for food and its relative satisfaction allowed millions of people to find ways to make a living linked to occupations in the industry (Simmons, 1997: 29), that is, in urban areas. But this growth has not been evenly distributed.

One first difference is the distinction between countryside and city or between urban and rural populations. Urban growth since the 1950s, at least in Mexico, and the unbelievable growth of African and Asian cities between 1990 and 2006 (as graphically illustrated by Thonke, 2010: 17 in a science magazine published by UN-HABITAT) show the displacement of the population problem in the world.[24] On the other hand, the current population growth of some regions and countries is negative, null or very slow. That is the case of countries in Europe and North America (and some in Latin America, such as Uruguay), while in others growth is accelerated, like in Africa, some Asian countries and the Middle East. One explanation is the uneven development of the *demographic transition* where, for different reasons, mortality and fertility rates have changed. But by the end of the 20th century, with a 1.68% annual rate, the world's population would double in 40 years.

23 Growth rates began to increase, especially at the onset of the 18th century (Simmons, 1997: 30).

24 Annual average growth rates of 7% or more are found in cities such as Fez in Morocco, (7.4%), Dire Dawa in Ethiopia (7.8%), Nakuru in Kenya (13.3) and Karaj in Iran (8%), or Guangzhou, Chongqing, Dongguan and Shenzhen in China (7.7%, 11.3%, 13.1% and 20.8%, respectively). Those cities with 7% rates would double their population in less than ten years, seven years in those with rates of approximately 10%, and five or three years in those that maintain rates of 13% or more. In Latin America, middle-sized or large cities such as Port au Prince (before the 2010 earthquake), Maracaibo, Ciudad Juarez and Tijuana, or Santa Cruz in Bolivia, have average annual rates of 4-5%, which are still very high.

And without underestimating historicist or economic explanations, it is worth noting that, when it comes to explaining these differences, culture is as important as figures (Simmons, 1997: 34).[25]

The regions and countries with high growth rates are the poorest, where the average income is declining. Biomass is the main source of energy. In addition, in those economies with high average incomes, the use of fossil energy is really high and continues to increase with the consequent environmental impact, in such a way that differences in material levels between rich and poor countries or regions of the world have clear consequences for the relationships between population and environment.

The complexity of the population-environment interaction in a context of spatial diversity, different types and quantities of resources and cultural multiplicity, leads us to think about the need to see the world, and our own place, differently compared to the conventional paradigm. As stated by Simmons (1997: 41), it is necessary to:

*i.* Include biophysical, socioeconomic, historical and political factors in our analytical framework;

*ii.* Simultaneously consider different processes at different spatial and temporal scales (local and global, fast and slow, short, medium and long term);

*iii.* Discuss the structural changes in natural and human systems that neither follow linear paths nor are kept in balance;

*iv.* Compare the count of measurable phenomena with those that cannot be quantitatively measured and, therefore, require not only numerical basis judgments, but judgments based on ethical criteria.

25 In general, culture is some sort of social fabric that encompasses the different forms and expressions of a given society. Therefore, customs, practices, ways of being, rituals, types of clothing and behavior standards are aspects included in culture. Rules should also be explicitly added. With the contribution of anthropology, culture should include: material goods, symbolic goods (*i.e.* ideas), institutions (*e.g.*, in the sense of channels through which power circulates: school, family, government), customs, habits and laws. Thus, we can affirm that every society has a culture, and every culture is put into practice by the people that relate to each other. All societies have a culture expressed in them, in response to which we can say that *society equals culture*. They are the two sides of the same coin. Culture is the collective production of a universe of meanings in constant change. Culture cannot be seen as something appropriable. It is a collective production of a universe of meanings transmitted from one generation to another. In the Latin originally spoken in Rome, culture originally meant "the tilling of land". Available at: (http://www.monografias.com/trabajos13/quentend/quentend.shtml#ixzz3hWTaIYCd; http://www.monografias.com/trabajos13/quentend/quentend.shtml#ixzz3hWSEhKYx;http://definicion.de/cultura/#ixzz3hWQhD4g6

## *5.1. Time and space*

It is a fact that human activities have produced measurable changes in most biogeochemical cycles.[26] Changes occur in timescales that do not correspond to those in these cycles, in such a way that they have affected climate, the ozone layer in the stratosphere, soils and, therefore, food production and mineral contents in oceans, such as phosphor used in fertilizers, which allows for higher rates of photosynthesis by marine plankton, affecting their ability to sequester carbon from the atmosphere. The positive interaction between the different cycles allows human action to accelerate the changes (Simmons, 1997: 87-97), to the extent that some of them affect ecosystems or landscapes on local or regional scales and in short time frames, which often hides their overall and long-term impact.

Another aspect that stems from human action are the levels of *resource appropriation* that affect the functioning of ecosystems and have, both in per capita and overall terms, different local impacts in the *short-term* and *global* impacts in the *longer-term*.[27] Another one is that of inequity in the use of resources in consumptive and non-consumptive terms.[28] The contrast in per capita terms is obvious but, on the aggregated global scale, that is no longer the case in absolute terms, affecting both the levels of provision of materials and waste disposal. Even in the case of the non-material use of the resources or services provided by nature in recreational and tourist activities, the current practice shows levels of manipulation that jeopardize the stability of environments and ecosystems (Simmons, 1997: 105).[29]

But what is the *appropriate* level of analysis? Open systems (such as spatial units: regions, cities, metropolitan areas) are characterized by flows that cross their borders or political-administrative boundaries, which are often ill-defined (or defined by historical reasons that are no longer relevant) but crucial if one attempts to analyze the dynamics of growth in the territory based on this relationship between economy and environmental system or natural environment (Isard, 1972, cited in Braat and Steetskamp, 1991: 270).[30]

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26 Within the planetary "noosphere", the energy of the sun that enters and flows through the different systems, such as the aquatic system, allows for the creation of cycles, such as the hydrologic cycle. Other chemical elements present in living or inert matter allow this energy to flow and recycle, constituting biogeochemical cycles that make life possible on the planet. Among the most important ones are the carbon and nitrogen cycles. In sufficiently large magnitudes, human activity has modified part of these cycles, creating problems for different life forms and even the human species (Butcher et al, 1992, cited in Simmons, 1997: 87).

27 China has become the world's largest CO2 emitter, even though its increasing per capita level is not among the highest in the group of industrialized or developing countries. However, its largest cities, like Beijing and Shanghai, have reached higher per capita emissions than many European cities or New York and San Francisco, for example.

28 In simple terms, the non-consumptive use of a resource is one that does not alter its volume or quality. The examples in the case of water would include those uses that take advantage of its flow: hydropower, watermills or navigation. In contrast, when the use of the resource does alter its volume or quality, its use is consumptive.

29 Finitude or limits to their exploitation (Turvey, 1954) and the need to regulate their use were already recognized in the 1950s with the collapse of fisheries. That is where the debate around common use resources began (Gordon, 1954). However, the original formalization of the dynamics of populations is something we owe to Lotka (1925).

30 The capital of an economy is its inventory of real assets that produce goods or services in the future. Isard formalized the relationship between economy and environment for regional development.

In the context of development sustainability, *time* involves inter-temporal negotiations, intergenerational equity and long-term planning, where the horizon is arbitrarily defined as a convenient time in the future or is considered as qualitatively infinite. *Space*, on the other hand, in the range of the biosphere, considers global, regional or continental, national and regional systems. The determinants of these spatial boundaries adopt three forms: the physical properties of a system (*natural endowments*); the self-imposed limits (*institutional development*) and the technological level (*the complementation or factor substitution capacity*).

In this analytical framework, proposed by Braat and Steetskamp (1991), it is possible to unconditionally accept the idea of living in a "healthy" planet and inherit it to future generations, but it is not easy to decide how to distribute the benefits and burdens internationally, inter-regionally or locally (Elster, 1992).[31] In order to illustrate the difficulties faced in the design of environmental policy as a result of the spatial and sectoral (and temporary) interdependencies of the different elements and factors, we include the following proposal from Braat and Steetskamp (269-288 1991) of a set of *strategies for the development of a region* (conceived as an open system):

*a.* Shifting from local (*exploitation of resources*) to external resources *(import primary products).*

*b.* Using renewable fuel resources up to a limit (*extinction*) and replace them with alternative external fuel resources.

*c.* Providing space (*location*) and supplies (*water and energy*) for those activities that import primary products and export intermediate or final consumption goods.

*d.* Shift the use of a renewable resource from one function to another: forests for timber, for pulp, for outdoor recreation, even offering or applying subsidies to support this *functional transformation*.

*e.* Shift from *extensive-grazing* uses to *intensive-feedlot* uses in livestock farming (and perhaps in agricultural production, using hydroponics, for example).

31 The integration of the costs of exploiting resources and nature, in general, and the benefits of protecting it is a complicated issue. According to Peskin (1991: 179), the conventional system of national economic accounts has deficiencies in:

*i.* The way of measuring economic and social performance;

*ii.* It is inconsistent when it comes to dealing with wealth and ignores variables that might explain economic activities; and

*iii.* It has not developed a reliable accounting system that takes into account or properly identifies the environmental expenditure/benefit.

## *5.2. Urbanization*

We have entered the *urban world* and we live in the urban century (Kourtit et al, 2015: 4.). What do these statements mean? The authors highlight three different eras:

1. Despite all the negative opinions about cities, it is a fact that the evolution that has taken place over the last two centuries has led the population to move in the direction of urban agglomerations;

2. The pace of the urbanization movement and process has accelerated in unprecedented ways, to the extent that, by the middle of this century, 75% of the world population will be urban, compared to 10-20% two centuries ago;

3. The current urban model dictates changes in transportation, accessibility and connectivity for the city inhabitants. The *urbanite* leads his economic activities, life and personal work, in his family and in society, in a way we could have never imagined three decades ago (not to mention the beginning of the second half of the 20th century).

Today, population growth means *urbanization*. It is all about growth and urban concentration and, at present, all (or almost all) of the urban growth occurs in developing countries. An analysis of urban growth trends in the developing world reveals that environmental problems are expressed on *different geographic scales*, but also that they are *cross-cutting* and touch upon economic and social aspects, including cultural and political ones (see the Introduction and Chapters 1 and 2).[32]

A clear example of the above in almost all the cities of the Third World, as pointed out by Pacione (2011: 17), is that of contaminated water and urban riverbeds, which look more like drainage ditches. Floods, water shortages and the contamination of shallow water and aquifers pose a threat to the urban population in general and vulnerable groups in particular. Thus, the main requirements to solve urban environmental problems are the *provision of drinking water and wastewater disposal and treatment*, with the aim of fighting the effects of pathogens that raise morbidity and mortality levels (Pacione, 2011: 19), a situation that has a negative impact on productivity and the quality of life in general.

The fact of considering this variable, which runs across scales and sectors, would seem justified when it comes to thinking about a *territorialization* of public policy. In effect, one problem faced by public management or decision-making processes is that of *allocating (to whom, when, how and where) the benefits and burdens* of every action, in order to reduce unfair effects (Elster, 1992). Therefore, regionalizing, based on the availability of a vital resource (such as water), is justified because the decisions in connection with our economic and social (*who*) future (*when*), which are currently sectoral and geographically fragmented (*how*), affect the ecosystems in which we live (*where*) and vice versa. With a spatially *degraded* hydrologic system, limits will be imposed on the capacity to make informed decisions about the future of the economy and society in general.

32 Se toman ideas desarrolladas por Graizbord, González, López y Corona (2014), presentadas en una reunión de la Somede (http://xiireuniondemografica.ibero.mx/programa.html) de las que se publicó solo el resumen (http://xiireuniondemografica.ibero.mx/pdf/resumen_corto/15.1.2.pdf).

Since the end of the first decade of this century, the process has shifted to megaregions as the new scale (Faludi, 2009), although that trend is older than that in functional terms. Let us remember the discovery of Gottmann (1961) in the 1950s about the "megalopolis of the northeastern seaboard of the United States". Contant and Nie (2009) suggest a new *planning approach*, where the *megaregion* is a new concept in the field of urban and regional planning. A *megaregion* can be defined as a *multidimensional* space, where the links of networks among cities, metropolitan areas and rural areas are structured, that is characterized by a set of interconnected activities, with common resources, a cultural identity and economic opportunities. In this regard, Contant and Nie(2009: 15) raise the following question: Can the *megaregion* be a useful construct to understand, plan and solve the challenges of the 21st century?

As affirmed by Higgins and Savoie (1997: 3), societies and their economies cannot be understood without an analysis of the *interdependence* and the *overlap* between space, time, economic structure and society. As a matter of fact, countries and national economies *are interrelated sets of spaces* (regions), each of them with their own economic, social, political and power structures. Therefore, the explanation of their performance (economic, social and political) will vary, to a large extent, due to the degree in which these spaces (regions) are integrated as national economic, social, political and administrative systems. When the performance of the group is not satisfactory, an intervention is required in these (regional or local) spaces, and not only on the macro and microeconomic levels of the economy. In this regard, the regional economy makes an attempt to rely on the scale of megaregions to include development, policy and regional planning assessments and analyses, all of which turns it into an integrating factor or a catalyst of social sciences in general. That is how it was suggested by Isard in 1960, when he proposed his *Methods of Regional Analysis*, the first textbook in this area of knowledge, also known as *regional science*.

According to Higgins and Savoie (op. cit.: 5-6), space has been traditionally seen from four different perspectives:

*a.* The first considers, implicitly or explicitly, that (*geographic*) *space is homogeneous*, but recognizes that there may be a set of spaces or geographical areas with different *endowments*, physical and human, which creates opportunities for geographic specialization, according to absolute or comparative advantages. From here the theory of international and interregional trade (see Krugman and Obstfeld, 1995).

*b.* The second fails to consider the friction of distance, because it assumes a *costless and instantaneous mobility of all the factors of production*, but recognizes that the different resource endowments of regions and specialization as the basis for regional trade also entail a cost to cover the "distance" that separates these spaces. Therefore (even though analytical parsimony is affected), transportation costs and limited mobility must be taken into account. These considerations appear in the theory of yields of rural (Von Thünen, 1966) and urban land (from Alonso, 1964; Mills, 1967).

*c.* According to the third perspective, the *uneven distribution of resources and population* requires making decisions as to what activities will be carried out, how and where. Proximity to markets and to resources, as well as production and transportation costs, will be considerations in these decisions (Weber, 1909). Today, access to information and technological developments are also elements that add to the determinants of population distribution and the location of productive activities (Norton, 2000). That is the basis for the *location theory* (Krugman, 1996), including the *central place theory* (Christaller, 1966; Lösch, 1954), and the rules about the city size (Richardson, 1973; Henderson, 1974) and *hierarchy in urban systems* (Berry, 1970).

*d.* The *boundaries of political-administrative units and borders* define spatial units such as nation states, states, provinces, municipalities and districts. According to this fourth perspective, these barriers affect decision-making processes in the areas of trade, monetary, fiscal, price, wage and salary and land use policies, among others. And these differences are precisely what leads to the analysis of policies in *subnational or supranational spaces* (like the European Union), although the specific analysis of cultural, social or political (and even environmental) differences has not been sufficiently developed on the different scales, from the local to the global.[33]

## *5.3. The local and the global*

These extreme scales represent analytical approaches of regional economics or two aspects of the development or evolution of the "new economic geography" (Fujita et al., 1999: 3). In the first case, we are talking about a methodological aspect within the discipline related to the definition of "place"; in the second case, we are talking, on one hand, about the result of the explicit consideration of technological changes and, on the other, the economic growth possible with the expansion of the world capitalist system (Wallerstein, 1974), which have transformed the market and modified the man-nature relationship, that is, the value of natural resources and their economic use by society.

On the *local* scale, Harvey (1996: 207-209) affirms that, depending on their economic, social and political forms of organization, as well as their specific environmental circumstances, different societies have produced particular ideas about *space* and *time*. And while it is considered that both concepts are social constructs, there is still a lot of confusion in the debate. Thus, it is accepted that space and time are shaped through *social relationships and*

33 Taylor (2013) recently argued about the need to write History (capitalized) not on the basis on nation states (*i.e. artificial* homogeneous areas), but through *cities* (as concentrations of dynamic flows of goods, services, ideas, values, knowledge), such as Athens, Rome, Babylon, Tenochtitlan, Amsterdam, Paris, New York, Tokyo and Shanghai, among many others. This author, precisely leads the GaWC group, which was created in 1998 to promote the study of the *world's system of cities as nodes of a global network* of exchange of goods and knowledge (ideas): *"Thus instead of the traditional stuff on the rise and fall of empires – narratives of war and peace between great powers – I have been focusing on how cities are implicated in the huge advancements humans have made since such settlements first appeared many millennia ago.... Cities are revealed as being world-changing loci, with an innovative capacity that will be vital in producing a resilient global society necessary to carry us safely through the 21st century..."* Available at: http://elgarblog.com/2013/01/23/cities-are-extraordinary-by-peter-taylor/.

*practices*, even though it is often said that they occur in a *pre-fabricated* space-time frame, like the latter was a continent of the former. In fact, it is not clear that space and time can be dealt with as separate qualities in the analysis of our being or in the attempts to explain how the world works in general. Formally speaking, however, both time and space are dealt with separately as explanatory variables, but also as dependent variables (Giddens, 1990; Crosby, 1997).[34] According to Harvey, the concepts of space and time are fundamental to almost everything we think and do, including how we see the world around us and how we theorize about it.[35]

Harvey makes an attempt to find responses through an extensive and impressive review of existing literature in disciplines such as history, geography and anthropology. The latter two disciplines have some limitations for the regional analysis. In synthesis, it can be said that anthropologists have conducted their studies about particular societies or human groups in certain places, but in doing so they have not put enough emphasis on the analysis of the physical environment that sustains a particular social group, and with which it interacts, nor have they shown any interest in comparing or looking for similarities between one group/place and another. Physical geographers, on the other hand, are more aware of the physical environment, but underestimate the social and cultural structures and the political and administrative framework that characterize the social group and define its interactions or relationships with the environment.

According to Harvey (*op. cit.*: 208-209), the concepts of space and time provide the reference for us to adopt a spot, to define our situation and position with regard to what happens around us or in the rest of the world. Thus, he affirms, space and time cannot be discussed without invoking the term *place*. There is, Harvey continues, a countless number of words (*i.e.* surroundings, locality, location, local, neighborhood, district, region, territory) that describe the *generic* qualities of the place. Other terms (*i.e.* city, town, village, megalopolis, etc.) designate particular types of places, and some others (*i.e.* home, nucleus, community, nation) evoke strong connotations of place, so it would be difficult to talk about one without the other. But the term *place* also has broad metaphorical meanings ("the place of art in social life," "our place in society", "the place of man in the universe") that psychologically make us feel that we belong to something and are recognized by others. Or else, they allow for the expression of norms to locate people, events and things in the "right" place or the subversion of those norms by defining new places: "in the outskirts", "along the border", through which one can then give an opinion or take action. This profusion of meanings and ambiguity, Harvey (*op. cit.*: 118) affirms, can be useful to explain the processes of "socio-ecological" change that affect:

*i.* The environment in which we live (air, water, land and landscapes);

*ii.* The ecosystem that supports life in general [and the environmental services it provides]; and

*iii.* The quantity and quality of the stock of natural resources (renewable and non-renewable) that allow for the development of human activity.

34 Also as analytical categories.

35 Somehow, methodologically speaking, spatial statistics integrates space and time into some of its techniques, such as the spatial-temporal correlation: Anselin, 2005. Some examples of its application in Mexican cities can be found in Garrocho and Campos, 2015a.

### *5.4. Globalization*

On the other end, we have the global scale, where human life occurs on the planet. Global changes affect the local in a *spatial-temporal continuum*. Thus, the "socio-ecological" link identified by Harvey raises an analytical interest in globalization processes.[36] Regardless of the ideological-cultural, economic (Sklair, 1991. Chapter 5) or psychological impacts it has on the lifestyle and quality of living of individuals in their immediate environment (on the local), globalization jeopardizes global environmental resources and services and, therefore, this begs the question of whether the scale achieved by human activities and production processes today is consistent with the desire to make human existence on Earth sustainable and viable, or with the need to secure it without reaching unacceptable consequences (Heal, 2000: 169).

## 6. The regional, or is sustainability possible here and now?

The reader should note that the question in the heading of these conclusions is far from the questions raised by *The Limits to Growth* team in 1972, to wit: What would happen if population growth remains out of control? And, yet, it somehow resembles the additional questions raised: What will happen if growth in the world's population continues unchecked? What will be the environmental consequences if economic growth continues at its current pace? What can be done to ensure a human economy that provides sufficiently for all and that also fits within the physical limits of the Earth? That question was then defined with respect to the scale, but also with respect to intra and intergenerational equity (*today and tomorrow*), with the phrase "sufficiently for all" (Meadows *et al.*, 1972: 19).

To put the discussion in context and explore regional demographic changes, as well as changes in human activities from the perspective of economic geography, it would be worth summarizing the "real life" factors that, according to Higgins and Savoie (1997: 7-10), *have not been systematically considered*, either by the approaches of neoclassical economics or the different Marxist schools of thought:

1. *All societies or social groups live in particular places.* Cultures are defined in terms of space, a fact that has not been explicitly recognized by regional economists.

2. *These spaces are almost always smaller geographically than a nation state*. No country can be considered as sufficiently homogeneous to be studied as a single society or culture.[37]

3. *Groups of interest coexist in most countries*. They differ among themselves and sometimes express themselves in a conflictive manner and occupy different social and political spaces.

36 This last topic, the interaction with the environment, affects the basic principles of the two main traditional branches of both physical and human geography and aims to bring them together. See, for example, the physical geography book by Gregory (2000), which consistently addresses the aspect of human activities and their mutual impact with the biophysical and biogeochemical elements of ecosystems.

37 Perhaps with the exception of a few very small nation states, such as the Vatican, Monaco, Grenada, Malta, Liechtenstein or San Marino, among others.

4. *Economic and social interests* of particular societies in particular spaces are closely tied to the dominance of economic values and therefore, to the structure of the economy. Thus, a commonality of interests arises when people live in the same place and work in the same activity or sector.

5. People develop stronger *loyalties* to the "place" than to the activity or sector in which they work. Knowing how to behave in that environment creates a pull in most of the people who live in it. This means that mobility could never be costless, instantaneous or painless, even if transportation were free, or if appropriate infrastructure and equipment exist in a different place. This fact should be taken into consideration in the calculation of the impact of certain policies (such as those of "jobs for workers" or "workers to work" [or social housing]) on the welfare of a particular society.[38]

6. Most people do not think of welfare in terms of nation states. Their national pride changes if they live in a retarded space (region) [environment], if they (or their families) are unemployed, ill-housed, impoverished or have deficient or inexistent public municipal services, and are unable to get education and health services. Thus, the criterion should be that of public policies aimed at much smaller spaces [areas] than the nation state.

7. As a result of a combination of *market failure and public policy failure*, the market does not work well, as the theory suggests. There is no assurance that a rise in the national income of a particular group, sector or region will produce social wellbeing. Thus, the criterion should be that of *ad hoc* policies with measures that are appropriate to each case.

8. *The harmony of interests* is not automatic and unlimited in a national economy or society. If a group or sector of the economy is prosperous, it can increase its consumption, but if the supply is inefficient and highly protected (like it was during the era of industrialization as a result of import substitution), then there will be sectors or groups that will oppose this protectionist scheme and will demand an openness that will not necessarily benefit all.

9. These conflicts tend to be translated into *spatial terms*. Depending on the differences in competitive capacities, some sectors or regions will be better prepared than others to face challenges and seize opportunities. Thus, there will be winning and losing sectors, regions and social groups.

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38 The reader is encouraged to imagine the violent and "empty" environment of housing developments 30 to 50 kilometers away from the nearest town where the market, school, church, health center, or workplace are located. Developments like this have been built in recent decades in Mexico in the context of an irresponsible housing policy, to say the least, designed to serve the interests of real estate capitals and developers (refer to Chapter 2).

10. There is also an *overlap between the structure of the national economy and regional development*. Changes in the occupational and industrial structure go, or may have gone, hand-in-hand with regional development. However, that development does not occur in all regions at the same time, nor in all sectors. Today, the fluidity in the location of the world's economic activities makes changes faster and more unpredictable within a country, and these changes affect regional space more differently than economic sectors. The same happens with the diffusion of innovations, because it is not possible to explain what is going on in the country without knowing what is going on in its regions or cities. One example of that is the dynamics proposed in Geyer and Kontuly´s (1993) model of "differentiated urbanization".

11. There cannot be a trade-off between an equitable policy for regional development and a policy for the efficiency of the national or urban economy, because there are strong *complementarities* between the two. In fact:

    a. Countries with a high per capita income tend to have small regional disparities, while those with a low per capita income tend to have large disparities between their regions and cities;

    b. Countries with large inter-regional and inter-urban inequalities tend to have high inflation rates and unfavorable unemployment rates, while those with small gaps between regions and cities tend to have a favorable combination of inflation and development;

    c. Slow-growth regions tend to have higher economic fluctuations, with shorter growth periods and longer depressions than high-growth regions, which tend to have greater stability with long growth periods.

That is it on Higgins and Savoie. The point here is if, as they say, "regional convergence is achieved with sustained growth rates over long periods", although they also argue that "there is no evidence of a general movement toward *equilibrium* in a free market economy in the sense of regional balance…".

The experience in the evaluation of regional policies developed by Higgins and Savoie at the time is addressed by Fujita *et al.*, (2001: 9) with "two helpful questions" that, I might add, are also *still valid* for purposes of this discussion:

1. When is a spatial *concentration* of economic activity sustainable? In other words, in what conditions can the advantages obtained from agglomeration economies be sufficient to maintain concentration?; and

2. When is a systemic equilibrium without spatial concentration [or dispersion] unstable? In other words, under what conditions do small differences among locations snowball into larger differences, causing the symmetric equilibrium between two identical locations to break?

This is a technical-analytical level that we cannot address here, although there are multiple reasons to consider it in the context of a *sustainable urban development* policy. In fact, we would have to point to two tendencies in this regard: the possibility (although remote) of finding successful cities in depressed regions with degraded resources, and vice versa; and the impossibility for a general policy to have harmonic and successful results in all cities or in all regions. Therefore, we would have to wonder if the *green economy* initiative and model that takes into consideration the opportunities offered by cities (UNEP, 2011) will be enough to offset these tendencies, or if it is necessary to take into consideration the interrelationships we have discussed throughout this book.[39]

The discussion about the differences or inequalities in economic development between countries and regions in the context of a globalized economy is addressed in the model of "endogenous growth" or "new growth theory", where technological innovation is endogenously determined by public and private sector investments in the economic system, and is not exogenous to the system, as assumed in the conventional theory. In other words, if investments in human capital and innovation by the public and private sectors are appropriate, then it is possible for an economy to attain a constant and sustained growth rate in output and consumption (Barbier, 1999: 127).

The original question is: why is it that the long-term economic growth rates of poor countries as a whole do not converge with those of rich countries? The answer is straightforward: "Poor countries fail to achieve high growth rates because they *fail to generate or use new technological ideas* to reap greater economic opportunities" (Barbier, *op Cit*.: 126.). According to Romer (cited in Barbier, *op. cit*.: 127), they fail to do so because "the feature that will increasingly differentiate one geographic area [city, region or country] from another will be the quality *of public institutions*." (Diamond, 2013; see Chapter 2). Those with more competent and effective mechanisms to support collective interests, especially those related to the production of new ideas, will be more successful, in such a way that the difficulties faced by poor countries in the process of achieving the wellbeing of their populations can be attributed to "the flaws of the politicians" and weak institutions (Acemoglu and Robinson, 2012). In fact, the literature reports that, with relatively low levels of initial physical and human capital, national efforts are less effective in reducing poverty and responding to economic growth (Datt and Ravillon, cited in Pernia and Quising, 2003: 14).

But this is not the whole story: "In many poor economies the depletion and degradation of natural resources -such as crop lands, forests, fresh water and fisheries- contribute to this institutional instability and disruption. Resource scarcities can cause social conflicts that disrupt the institutional and policy environment necessary for producing and using new ideas and for absorbing useful knowledge from the rest of the world" (Barbier, *op cit*.: 128; see Chapter 5) -or traditional communities!, we might add-, which means that scarcity may not necessarily limit economic growth, but can have an indirect negative effect on the *innovation potential*.

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39 "Cities can provide essential services, including health and education, at lower *per capita* costs thanks to the savings of scale yields. Savings can also be achieved in the development of vital infrastructure such as housing, water, sanitation and transportation. In addition, urbanization can reduce energy consumption, particularly in the areas of transportation and housing; and create interactive spaces that expand the cultural exchange and scope. Achieving these benefits requires proactive planning to address future demographic changes." A powerful argument in favor large cities is, without a doubt, that of Glaeser (2012).

However, endogenous growth theories have failed to address the contribution of natural resources to economic welfare or the role of innovations to overcome resource scarcity, although some economists like Stiglitz (1974), for example, or economists in the fields of environmental and ecological economics, have explored the effects scarce resources have on economic growth (Neher, 1990). To do this, they use $Q = KLRert$ type neoclassical growth models, that is, the aggregated product $Q$ as a function of the physical capital stock $K$, labor force $L$, and resource input $R$, with r being the constant rate of technological progress in a given period $t$.

The results of these analyses are optimistic and conclusive (even with high population growth and a limited supply of natural resources): resources can effectively increase in such a way that a sufficient allocation of human capital to innovation ensures that, in the long-term, the depletion of resources can be postponed indefinitely, and it is possible to reach an endogenous growth rate to sustain, and even increase indefinitely, a certain *per capita* consumption (see Chapter 3). However, according to Barbier (op. cit.: 132), we can consider two scenarios in the case of countries or regions that maintain a high rate of resource exploitation:

*i.* One where the long-term innovation rate surpasses any resource scarcity adverse effects, in such a way that net innovation is positive; and

*ii.* Another where the long-term effects resulting from resource scarcity can affect innovations, that is, disrupt social and technical innovation to the extent of annulling it (which could, but does not necessarily mean, the collapse of the economy).

The economies (national and regional) trapped in this second scenario would be behind those that do not face resource scarcity or those that manage to overcome the barriers to innovation. And that reason is enough to:

*i.* Stop and reverse exploitation; and

*ii.* Accelerate the implementation of the agreements reached last July in Addis Ababa, Ethiopia, during the *Third International Conference on Financing for Development* (http://www.un.org/esa/ffd/ffd3/conference.html), where attempts were made to find the formula to transfer resources (from environmental debtors) to the most vulnerable, who will inevitably experience the relentless effects of climate change.[40]

*40 Declaration of agreements:*
*i. Assessing the progress made in the implementation of the Monterrey Consensus and the Doha Declaration and identifying obstacles and constraints encountered in the achievement of the goals and objectives agreed therein, as well as actions and initiatives to overcome these constraints;*
*ii. Addressing new and emerging issues, including in the context of the recent multilateral efforts to promote international development cooperation:*
** The current evolving development cooperation landscape;*
** The interrelationship of all sources of development finance;*
** The synergies between financing objectives across the three dimensions of sustainable development; and*
*iii .The need to support the United Nations development agenda beyond 2015, reinvigorating and strengthening the financing for development follow-up process. Can we expect results without delay?*