Environment and Development

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CHAPTER 8

Environment and Development

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8.1 Introduction

Development is, clearly, not a neutral procedure. Despite the different concepts attributed to development over time [1], in the field of economics, development is related to increase in production of products and services within an economy. The basic indicator used for development is the gross domestic product, defined as "an aggregate measure of production equal to the sum of the gross values added of all resident, institutional units engaged in production (plus any taxes, and minus any subsidies, on products not included in the value of their outputs)" [2]. The undeniable relation between development and economic growth produces significant interactions between development and the environment, both physical and man-made. As Braudel [3] states: "The actual situation of a civilization depends, to a significant extent, on the advantages or disadvantages of its geographical space (surrounding environment)."

In a world functioning through free-market economies and in an era dominated by finance capital, the fact that economic growth is the main focus of development policies is inevitable. However, the rise of neoliberal ideas and policies coincided with the invigoration of environmental/ecological movements [4,5]. These movements contributed to awakening about increasing pollution problems, irrational use of natural resources, etc. Moreover, the intensifying inequalities between the developed and the developing world (reflected in major humanitarian disasters such as those in Africa between 1981 and 1984, when over a million people starved to death because of continuous draught) also aroused global concern. Hence, the leaders of the world were driven to adopt a new development paradigm, focused not only on economy. Sustainable development was introduced as a global priority in the so-called "Earth Summit," in Rio de Janeiro, in 1992. Then, in 2002 and 2012 most of the world's countries refreshed their commitments to achieve sustainability. Sustainable development consists of three pillars: economic development, social development, and environmental protection [6].

Indeed, sustainable development—even as a global ideological framework—comprised a major progressive step for the world. Various actions and measures in a wide variety of sectors have led to great improvements in the social and the environmental field. Nevertheless, a lot of great challenges still remain. Our world is a field of inequalities, while global environment is under constant threat. This is a major reason leading to criticism on sustainable development from various points of view. A usual accusation is that sustainable development has become a catch phrase rather than a factual motivation for action [7].

The objective of this chapter is to sum up the concept and implications of development and the related policies, at global level. By realizing a critical study of the extensive literature and data sets related to development, a concise "guide" to the basic trails of development is composed. It is aimed to provide the reader with views and information, which will make comprehensible the basic issues of development and its environmental and social implications. In this way, awareness about these important matters could be raised. Moreover, by presenting views doubting on current development strategies, we aim to strengthen critical approaches to these issues; this is a fundamental step toward the direction of creative change.

As far as the structure of this chapter is concerned, Section 8.2 deals with the notion of development and its evolution over time. Moreover, the dominant development strategy, that of sustainable development, is analyzed and concerns about it are put forward. In Section 8.3 implications between environment and development are analyzed. The analysis is supported by several case studies and some basic indicators reflecting the interactions between development/economic growth and the environment. Section 8.4 refers to the major issues of poverty, whose alleviation is the main target of all, major development policies. Some basic tools supporting development planning are presented in Section 8.5. In the same section, a synopsis of major, global policies regarding environment and development is made. In Section 8.6, alternative approaches to development are searched. General concerns and ethical issues are noticed and a theoretical framework of an alternative pathway to current development policies that of integrated, worth-living development is presented.

8.2 Conceptual Approaches to Development and Principles of Sustainable Development

"Development" is a contested concept, implying that it has meant different things from one historical situation to another and from one actor to another [8]. However, during the past century the word "development" has been used in numerous contexts because of its ability to guide thought and behavior [9]. As Rist [10] argues, the strength of development discourse comes of its power to seduce, in every sense of the term, to charm, to please, to fascinate, to set dreaming, but also to abuse, to turn away from the truth, to deceive.

Table 8.1: Meanings of Development Over Time [1].

Period	Perspectives	Meanings of Development
1800s	Classical political economy	Remedy for progress, catching up
1850>	Colonial economics	Resource management, trusteeship
1870>	Latecomers	Industrialization, catching up
1940>	Development economics	Economic growth—industrialization
1950>	Modernization theory	Growth, political and social modernization
1960>	Dependency theory	Accumulation—national, autocentric
1970>	Alternative development	Human flourishing
1980>	Human development	Capacitation, enlargement of people's choices
1980>	Neoliberalism	Economic growth, structural reform, deregulation, liberalization, privatization
1990>	Postdevelopment	Authoritarian engineering, disaster
2000	Millennium development goals	Structural reforms

What is actually the interpretation of the word "development"? It is a fact that there is no consensus of the scientific community on how the term can be understood. The various theories of development, the different sociopolitical and philosophical viewpoints, and perceptions highlight a series of concepts with an objective hypostasis, such as growth, development, movement, alteration, radical change, progress, management, reform, modernization, amendment/modification, transformation, action−reaction, which characterize the quantitative and qualitative figures of development [11]. In Table 8.1 the meanings of development over time can be seen.

Furthermore, Potter et al. and Gasper [12,13] citing Thomas [14] recognize a number of different usages of the word development in the development studies literature. These are worth noting here as they effectively expand upon a simple dictionary:

- development as a fundamental or structural change—for example, an increase in income,
- development as intervention and action, aimed at improvement, regardless of whether betterment is, in fact, actually achieved,
- development as improvement, with good as the outcome, and
- development as the platform for improvement—encompassing changes that will facilitate development in the future.

Moreover, Rokos [15] defines development as a new, improved dynamic balance between human relations and systems of land use, production, employment, consumption, and distribution, which aims at the optimal use of physical and socioeconomic resources, according to the average social consciousness of the citizens, the specific social dynamics, and the political will of authorities. Talmage [16] points out that development is an effective change process aimed toward positive impact that is facilitated through the efficient use of resources.

However, during the previous century Western perceptions about the world and history have created a broad trend, according to which development is associated with something positive, something desirable, regardless if development refers to societies, regions, or specific population groups. As highlighted by Schumacher [17], in every branch of modern thought, the concept of development plays a central role.

For many people, ideas of development are linked to concepts of modernity [18]. Some of them interpreted this diffusion of modernity as development and progress, while others connected it with the alienation of cultural practices, the destruction of habitat, and loss of quality of life. This is what Horkheimer and Adorno proposed in their work: *Dialectic of Enlightenment* [19], in which they argue that the logic behind the rationalism of the Enlightenment is logic of domination and oppression. The desire for dominance over nature meant domination over men and could only ultimately lead to "nightmarish situation of sovereignty over ourselves."

However, despite the reservations, development was the dominant ideology of the previous century. Describing this situation Wolfgang Sachs [20] notes: "Like a towering lighthouse guiding sailors towards the coast, development stood as the idea which oriented emerging nations in their journey through post-war history."

This lighthouse of development was created just after the World War II. Development became significant when the Western world confronted the new challenge of rebuilding countries, especially in Europe, a continent that had been shattered by war [21]. As Potter et al. [12] reported, many development theorists support that the modern era of development started with a speech made by President Truman in 1949, in which he employed the term "underdeveloped areas" to describe what was soon to be known as the Third World concluding with the duty of the West to bring development to such relatively underdeveloped countries and urging other countries to follow the Western development policy [20]. In this general context, the core meaning of development was catching up with the advanced industrialized countries [1].

The foregoing case has been a very useful mental tool for the United States. As a result, development prevailed as the one-dimensional economic development and in fact, as Rokos [22] pointed out, in its most vulgar version, that of growth. The classical equation that regurgitated ever since was:

$$\text{Development} = \text{Natural Resources} + \text{Capital} + \text{Labor}$$

This equation is marked, in the course of humanity, in boundary moments, by the "extreme" historical precedents of:

- colonialism, the plundering of our planet's natural and human reserves of dependence, underdevelopment, external debt, predatory lending in the form of assistance, and deficits of the "Third World" countries and poor countries in general,

- financial and economic "incentives" of tax exemptions and the rampant speculation of the investors and the usurious financial system, and
- exploitation of man by man, of immigrants, of women, and child labor, etc.

Under those circumstances, according to Willis [18], an idea of an impasse became increasingly common. In the 1960s and 1970s the contrasting approaches of modernization theories and dependency theories represented differing perspectives on development. However, the global economic problems of the 1980s and the awareness that in many senses existing development theories had not been translated into practical success led theorists to stop and think about what development was and how it could be achieved. While neoliberal thinking now dominates development policy-making, the post-1980s period has been associated with the recognition of much greater diversity within conceptions of development. This has included greater awareness of environmental concerns, gender equity, and grassroots approaches.

8.2.1 Sustainable Development

The concept and the term of "sustainability" expressed the concerns about the issues of development and environment. Although sustainability was not an unknown idea, it came up in the 1970s and 1980s. At international institutional levels, the main milestones in the growth of the concept of sustainable development are the UN Conference on the Human Environment (1972), the World Commission on Environment and Development (1987), the Summit on Environment and Development (1992), the Special Session of the UN for Environment and Development (1997), and the World Summit on Environment and Development (2002). The main feature of these international meetings was the attempt to link the aspirations of humanity. Sustainable Development, emphasizing on the most recent dual concerns on environment and development, is typical of such attempts.

With the Brundtland's Commission [23], the concept of Sustainable Development acquired international interest and became a keyword for politicians, decision makers, development actors, academics, and environmental groups. The goal of the World Commission was to identify practical ways to address environmental and development problems around the world. In particular:

- to reconsider the critical environmental and development issues and to formulate realistic proposals,
- to propose new forms of international cooperation on the issues that will influence policies and actions toward the necessary changes, and
- to improve the comprehension and commitment levels so that individuals, voluntary organizations, businesses, foundations, and governments act more intensively.

Thus, the commission supported an approach to the development that would take into consideration the relationship between the ecological, economic, social, and technological issues. This approach is called "sustainable development," defined as the kind of development that meets the needs of the present without compromising the ability of future generations to meet their needs [23].

According to this definition, sustainable development promises economic growth in its traditional sense of the increase of per capita income, in conjunction with reduction of poverty and social inequalities and on condition that natural resources will not be exhausted [24]. In other words, increasing the prosperity of the people should not be at the expense of the welfare of future generations. There are two key concepts in this definition:

- the concept of needs, especially the needs of the poorest of this world, in which priority should be given and
- the concept of limits, as set by the state/level of technology and social structures to the ability of the environment to satisfy both current and future needs.

The report recommends urgent action on key issues to ensure that development is sustainable. These are population and human resources, industry, food security, species and ecosystems, urban challenge, and energy. The meaning of sustainable development was then analyzed further, as evidenced by the issue of two more reports: "Caring for the Earth. A Strategy for Sustainable Living" [25] and "Agenda 21," the action plan adopted at the UN Summit in Rio in 1992.

Agenda 21 is a comprehensive program of actions that would have to initiate in 1992 and to continue during the 21st century by governments, UN agencies, development agencies, nongovernmental organizations, and the private sector. These actions relate to every field of human activity that has an effect on the environment and should be adopted at global and national level. In other words Agenda 21 defines the projects that are necessary to promote a prosperous, fair, and sustainable Earth.

Ten years after the Earth Summit in Rio de Janeiro, the heads of state and governments around the world committed themselves again in fighting against poverty and environmental protection at the Johannesburg Summit in 2002. The Johannesburg Summit produced results in three levels: (1) the Political Declaration, which is now referred to as the "Johannesburg Declaration on Sustainable Development," (2) the Johannesburg Plan of Implementation, and (3) "Type II nonnegotiated partnerships" between governments, enterprises, and NGO's. However, environmental policies remain very different among countries and largely dependent on the level of economic development and environmental awareness. The Johannesburg Summit results were rather scanty. Even though the adoption of the Declaration on Sustainable Development was finally accomplished, the General

Assembly, during the 57th Session, was limited to vague references on the results of the conference [26].

Meanwhile, the phrase sustainable development has been continually redefined. Aspects of government policy, business strategy, and even lifestyle decisions have been shaped around the concept. As Mawhinney [27] notes, sustainable development as a concept promises many things to many people. The implicit vagueness of the Brundtland Commission's definition along with transcendence, which is connected with the concept, has stimulated interest from different academic fields, which have attempted to interpret the meaning of sustainable development according to their field of knowledge. Blewitt [28] states that many people are coming to sustainable development with little understanding of the key issues and debates. Basiago [29] points out that sustainability is susceptible to varying interpretations by different disciplines. In biology, sustainability is connected with the interaction between human and natural systems.

The biological definition of sustainability concerns itself with the need to save natural capital on behalf of future generations, particularly the genetic diversity contained in plant and animal species, or "biodiversity." In economics, "sustainability" encompasses instruments to internalize the environmental costs of industrial activity in the economy by way of public intervention in private markets. In sociology, "sustainability" refers to the way: certain human interest groups make decisions over the use of natural resources, other groups are affected, and the equity issues that are raised. The urban definition of "sustainability" seeks to reduce notions of "sustainability" to the practical planning of regions, communities, and neighborhoods. The ethical definition of "sustainability" probes the domain where humans ponder whether they are a part of, or apart from, nature, and how this should guide moral choice.

It is a fact that the interpretation of the concept varies also in different cultural contexts, even if it expresses the same or different connotations. In English the term sustainable refers to a process the rate of which should be maintained. It is a dynamic, nonstatic concept, which introduces a long-term vision [30] cited in Ref. [31]. The term sustainable development takes different forms in different societies and environments and is the process by which societies are driven in a dynamic equilibrium condition called sustainability [32]. However, in practice, there are discrete, different interpretations of sustainability. Hopwood et al. [33] mapped different trends of thought on sustainable development, based on combining environmental and socioeconomic issues. They present three broad views on the nature of the changes, necessary in society's political and economic structures and human−environment relationships to achieve sustainable development: that it can be achieved within the present structures; that fundamental reform is necessary but without a full rupture with the existing arrangements; and that as the roots of the problems are the very economic and power structures of society, a radical transformation is needed.

Supporters of the status quo recognize the need for change but see neither the environment nor society as facing insuperable problems. Adjustments can be made without any fundamental changes to society, means of decision making, or power relations. This is the dominant view of governments and business, and supporters of the status quo are most likely to work within the corridors of power talking with decision makers in government and business. Development is identified with growth, and economic growth is seen as part of the solution. Those who take a reform approach accept that there are mounting problems, being critical of current policies of most businesses and governments and trends within society, but do not consider that a collapse in ecological or social systems is likely or that fundamental change is necessary. They generally do not locate the root of the problem in the nature of present society, but in imbalances and a lack of knowledge and information, and they remain confident that things can and will change to address these challenges. They generally accept that large shifts in policy and lifestyle, many very profound, will be needed at some point. The key is to persuade governments and international organizations, mainly by reasoned argument, to introduce the needed major reforms. They focus on technology, good science and information, modifications to the market, and reform of government.

Transformationists see mounting problems in the environment and/or society as rooted in fundamental features of society today and how humans interrelate and relate with the environment. They argue that a transformation of society and/or human relations with the environment is necessary to avoid a mounting crisis and even a possible future collapse. Reform is not enough, since many of the problems are viewed as being located within the very economic and power structures of society because they are not primarily concerned with human well-being or environmental sustainability. While some may use the established political structures and scientific arguments, they generally see a need for social and political action that involves those outside the centers of power such as indigenous groups, the poor and working class, and women. The transformationists include those who focus primarily on either the environment or the socioeconomic field and those who synthesize both.

8.2.2 The Political Dimension of Sustainability

Ambiguity is observed in the relationship between development and sustainability, as these concepts separately neither specify nor restrict the kind of relationship between them. For some scholars and, generally, all the national and international institutions, sustainability and sustainable development are used interchangeably, while for others, the two terms are not absolutely synonymous [34]. The flexibility of the concept has given rise to questions about what it is supposed to mean: sustainability of what, for whom, and why? [11,35].

Since the conclusion of the Brundtland Commission [23]—in itself something of a political compromise—the two competing notions of strong and weak sustainability have dominated the theoretical debate on sustainable development. Loosely speaking, strong sustainability argues that we must live within the environmental and ecological limits that the planet clearly has. Weak sustainability argues that humanity will replace the natural capital we have used and that we depend on, with human-made capital [36].

Parker et al. [37: 278] argue that, although the notion of sustainable development has done much to raise public debate and attention on environmental issues, many feel that it does not go far enough in challenging the practices that have led to environmental degradation. A "strong" view of sustainability would hold that economic growth is incompatible with the earth's finite resources. From this perspective, the notion of sustainable development is a contradiction in terms, a smoke screen used by government and business to pay lip service to environmental issues while maintaining their commitment to economic development. Devkota [38] citing Pearce and Barbier, Pearce and Atkinson, and Serafy [39,40,41] reports weak sustainability as a correct measurement of income, and hence, sustainability need not bother distinguishing between natural and other forms of capital.

Strong sustainability considers natural capital as a provider of some functions that are not substitutable from the human-induced capital. These functions are highlighted by defining sustainability as a mortgage to the future generations of a stock of natural capital not less than that enjoyed by the present generation. Sustainability is expressed in terms of nondeclining natural capital. Contrary to this notion is the concept of mild sustainability. After the definition proposed by Pearce and Atkinson [40], an economy is considered sustainable if the saving rates are larger than the combined devaluation percentage of natural and human capital. In this sense, sustainability is equivalent to a nondecreasing total capital reserve. This is called weak sustainability, and it does not take any limitation of substitutability between natural and human capital. From the weak sustainability perspective, "an economy is considered to be sustainable if its savings rate is greater than the combined depreciation on natural and man-made capital" [42].

Verstegen and Hanekamp [43] by examining the different definitions of sustainable development indicated that all this controversy is defined by two different worldviews of Western society. According to the first theory, idealism expresses clear opposition to the prevailing politics. Under this worldview, economic growth cannot be continued because in less than 100 years the natural resources will be exhausted and the system will collapse. Even if the resources are not exhausted, the collapse will occur either from excessive pollution or overpopulation. Growth cannot be continued. Therefore, either it will be limited voluntarily or we are led to a system crash. This approach is characterized as pessimistic. Nevertheless, pessimism must be treated as a political tool in the search for "good society." Unlike idealism, the conformist perspective is the most optimistic. It does

not introduce a separation in relation to the past. It is the perspective of political and economic cohesion. The optimism in this approach is based on technological progress which can broaden the natural limits to the point that there are not any. Therefore, the population will continue to grow over the next 200 years with decreasing rate of increase but with increasing per capita income. The poorest people will greatly benefit by continuous economic growth through the development of new technologies. Both sides claim that the other strategy is impossible.

Eventually, sustainability "is a word that hides more than it reveals" [44]. Anyone can redefine the term and interpret it according to his purposes. Potter et al. [12] citing O'Riordan [45] argue that the concept of sustainable development can mean anything or everything you want. This may be unintentional or, worse, it can be utilized to "disguise" or to "green" socially or environmentally destructive activities. Kates et al. [46], despite this criticism, argue that each effort to determine sustainability is an important parameter in an ongoing dialogue on the concept of sustainability. "In fact, sustainable development owes a large part of its appeal, strength and creativity to the lack of clarity. These challenges of sustainable development are at least heterogeneous and complex as the diversity of human societies and natural ecosystems are, around the world" [46]. Hartman [47] reminds us that the ideas for sustainable development are inevitably controversial, since their supporters are of different values and interests and they wish to support different sets of ecological, environmental, and social relations. Cooperation among them is a challenge with insurmountable difficulties.

8.3 Economic Growth and Environmental Implications

8.3.1 Introductory Remarks

The air, water, and soil pollution; the desertification of large areas; and the greenhouse effect are some of the most serious environmental problems, nowadays. The need of investigating the causes but also finding solutions to these problems has been widely acknowledged.

The natural environment is a dynamic system, in which the following four functions interact: Firstly, it is a source of raw materials and resources. Secondly, it provides space for waste accumulation and storage. Thirdly, it constitutes an effective machine for the assimilative–regenerative processes with regard to chemically and biologically active wastes. Finally, it determines the health level and general quality of life for all organisms that live within it [48]. In this aspect, two key questions are raised nowadays, regarding the economic growth and environmental implications: Will continued economic growth bring ever greater harm to the Earth's environment? Or do increases in income and wealth sow the seeds for the amelioration of ecological problems?

The neoclassical economists interpreting the environmental problems either as cases of market imperfection and/or failure or as a consequence of market lack for natural resources. Therefore, they suggest a state interference in order policies, which will lead to the market refinement as well as to an effective and sustainable utilization of natural resources, to be established [49,50]. On the other hand, the majority of Marxists agree with the fact that pollution and natural resources depletion in modern capitalist societies are inextricably linked with the capitalist class process, ie, with the production and distribution of the surplus value [51,52].

8.3.2 Theories Based on Orthodox Economic Perspective

The neoclassical economic theory of environment and natural resources is based on (1) the notions of individual preferences and subjective assessment of the value of consumer goods and factors of production (ie, marginal utility, subjective cost), (2) the technology, and finally (3) the market mechanism, which allocates the limited resources to alternative uses in order for the individual choices to be satisfied. The concepts of external economies, as well as those of public and free goods, are central to the interpretation of the market mechanism failure to protect the environment and natural resources. Therefore, state regulation measures are proposed, in order to address market failures so as effective and sustainable use of natural resources and the environment to be achieved [53].

Specifically, according to the "orthodox economists" the ecological deterioration is presumed as a market failure. The market is unable to orient enterprises toward the proper use of environmental capital if the latter is not fully integrated into the market system through a rational price structure. The neoclassical environmental economists are inherently based on a three-step process. First, they analyze the environment in specific goods and services, which are separated from the biosphere in such a manner so that they are capable of transforming those into commodities. Subsequently, through the generation of supply and demand curves, an imputed value is attributed to goods and services, a fact that allows economists to determine the optimal level of environmental protection. Finally, market mechanisms and policies are designed either in order to change the values in existing markets or to create new markets [54–56]. In Box 8.1, there are some basic notes regarding the issue of determining the optimum level of environmental protection.

It is a fact that the neoclassical approach is based on the transformation of the environment into a set of goods. The explicit goal is to overcome market failures in the environmental field by creating alternate markets for environmental products. This particular approach considers that the environmental pollution occurs because the environment does not function according to the laws of economic supply and demand. The nature of this approach arises from an attempt to interpret the whole society and ecosystems in their entirety on the basis of the concept of market goods [56].

Box 8.1 Estimating the Optimal Level of Environmental Protection

Great attention is given to the demand curves generation, which are built based on the estimation of the willingness of consumers to pay. Given that there are no real markets for environmental goods willingness to pay is presumed in two ways.

Creative Pricing
According to this approach, consumer preferences are disclosed by the demand for goods and services which are directly related to an environmental good. For instance, consumer willingness to pay for a quiet neighborhood is estimated by comparing the prices among a house next to an airport and a similar residence which is located in a most tranquil area.

Contingent Valuation Method
In this case, hypothetical markets are built and the consumers are invited to indicate their preferences through a market survey. In these surveys, consumers are asked how much they would pay for a certain protection level of an environmental good.

Having determined—with the aforementioned approaches—the optimal level of environmental protection, the economists continue by resolving the issue of creating new markets. Typically, two approaches are used: (1) either taxes enforcement, which will increase the cost of causing environmental damage, or subsidization which will increase the benefit of environmental upgrades and (2) creation of new autonomous markets through state interventions (eg, tradable pollution permits).

A different approach which has been released since 1990, among the circles of environmental economists, is the notion that the natural tendency of the capitalist economy toward "dematerialization" is a key response to all the environmental problems. In particular, the increased energy efficiency and the development of the "new economy" in the developed capitalist economies decoupling economic growth from energy and materials use as well as from waste disposal, minimizing the environmental impacts of any further GDP growth. According to this view, in fact, no measures are necessary to reduce the environmental impact of growth. The continuous innovation as well as the market laws resolves the problem. Ideally political decisions should simply accelerate the trend toward "dematerialization" and ensure that the environment is integrated into an innovative economy, which is more knowledge oriented [57,58].

The aforementioned hypothesis is presented with terms of the environmental Kuznets curve (Fig. 8.1). The Environmental Kuznets Curve (EKC) is often used to describe the relationship between economic growth and environmental quality. It refers to the hypothesis of an inverted U-shaped relationship between economic output per capita and some measures of environmental quality. The shape of the curve can be explained as follows: As GDP per capita rises, so does environmental degradation. However, beyond a

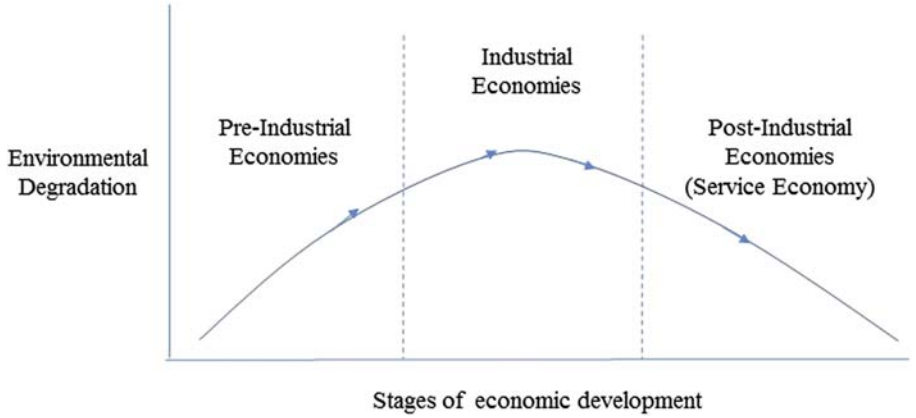

Figure 8.1
The environmental Kuznets curve [59].

certain point, increases in GDP per capita lead to reductions in environmental damage [59–61]. Specifically:

- at low incomes, pollution abatement is undesirable as individuals are better-off using their limited income to meet their basic consumption needs,
- once a certain level of income is achieved, individuals begin considering the trade-off between environmental quality and consumption, and environmental damage increases at a lower rate, and
- after a certain point, spending on abatement dominates as individuals prefer improvements in environmental quality over further consumption, and environmental quality begins to improve alongside economic growth.

8.3.3 Marxist Political Economy for the Dipole Economic Growth—Environmental Problems

The Eco Marxism—Eco Socialism constitutes an alternative critical view regarding nature's ownership under capitalism. This particular approach interprets the ecological degradation and environmental problems as issues inextricably linked to the economic, political, and ideological organization of capitalist societies.

The main feature of capitalism is that it is a self-expanding value system, in which the accumulation of economic surplus value should be realized in an ever-growing scale. Simultaneously, capitalism represents an expansion process which catalyzes all qualitative interactions converting them into quantitative, in terms of exchange value [62]. The general formula for capital, as explained by Marx, is the one where money is exchanged for a commodity (or the means of production of a commodity) which is then sold for money once again, this time at a profit. This procedure reflects the overarching objective

of capitalism which is the expansion of monetary value. It is obvious from the foregoing, the interminable expansion which characterizes this system. As noted by the conservative economist Schumpeter "capitalism is a process, the stagnant capitalism would be *contradictio in adjecto*" [63].

Given that under the capitalist production procedure the natural resources (1) constitute the fixed capital assets and (2) sustain human life, ie, ensure the existence and reproduction of the direct producers, whose labor consists the source of value and surplus value under capitalism, become obvious the negative environmental impacts of the aforementioned interminable procedure of economic growth [53]. Nevertheless, many orthodox economists adopt the aspect according to which the growth of the man-made capital value compensates for natural capital losses. However, according to the concept of "strict version of sustainability" the man-made capital cannot always replace the natural capital due to the fact that there is the notion of "the critical natural capital," ie, the natural capital, which is crucial for the biodiversity reservation [63]. Furthermore, despite the obvious link between the capitalist economic development and environmental degradation, there are economists who argue that increasing scarcity of natural resources will result into the market reorientation to the rationale of conservation. However, according to the radical ecologist Rudolf Bahro: "The rising cost of land was unable to suspend the cementation of space" [64].

Finally, it is worth mentioning the customary solution—for environmental problems—promoted by the capitalist economies. According to capitalist approach, switching technology in environmental friendly direction (ie, energy efficiency, replacing fossil fuels, recycling) constitutes a solution to the environmental problems. Nowadays the prevailing view is that everything has to be done in order on the one hand energy efficiency technologies to be promoted and on the other hand ecological practices to be introduced into the production process. Thereby, the economic growth without further environmental degradation is presumed. However, according to William Jevons, a known British economist, pioneer of neoclassical economic analysis, increased efficiency in the use of a natural resource leads to increased demand for this resource rather than decrease [65].

From the abovementioned definitions, it is clear that the capitalist economy aims exclusively to the expansion of profits and to an interminable economic growth through the extreme exploitation of all production factors. It is granted that this process is accompanied by the absorption of energy and materials and the disposal of an increasing number of wastes into the environment, leading to further environmental degradation.

Another indirect correlation between the capitalist economic organization and the environmental degradation has to do with the fact that the capitalist countries are inherently imperialistic. Modern theories of imperialism generally shared the view that the

slow economic growth, excessive inequality, and high levels of unemployment in developing countries result from the nonequal power relations between rich and poor countries [66]. Therefore, the economic problems of the least developed countries, particularly their indebtedness, make nature conservation to appear almost impossible. These countries, in order to acquire foreign currency so as to service their external debts, are trying to expand their exports and reduce imports. So these countries are intensifying the extraction of natural resources (eg, Amazon rainforests deforestation). Furthermore, poor countries, which are in a great need for funds, provide storage space for nuclear and toxic waste [67].

8.3.4 Three Case Studies

Japan: Minamata disease

Japan emerged from the World War II completely devastated. The rehabilitation and construction of the country was a vast unifying goal for the Japanese nation between 1950 and 1960. The rapid economic growth based on rapid industrialization resulted in widespread degradation of natural resources. Serious environmental problems became visible in the 1960s, when many diseases occurred because of the environmental degradation. Ui [68] provides a detailed chronicle of Minamata disease, which is related to intoxications from organic mercury wastes, generated by Chisso's company fertilizer factory. This disease spread to cities Kumamoto and Niigata and had, according to Japanese sources, 2239 casualties including 987 deaths.

Malaysia: the environmental mess of the Southeast Asia's "tiger" during 1970–80

Malaysia, as soon as political autonomy was granted in 1957, placed high priority on economic development. According to Sakarajasekaran [69], during 1971–73 the GDP growth rate registered 11% growth, compared to the planned objective of 6.8% growth, while the 1976–78 period showed a real GDP growth rate of 8.4%, compared to the average 8.2% real growth per annum anticipated for the 1976–80 period.[1] Nowadays, despite the Asian Financial Crisis in 1997, Malaysia's economy is one of the most competitive in Asia, ranking 6th in Asia and 20th in the world, higher than countries like Australia, France, and South Korea.

All these impressive achievements, as Hamzah Majid [70] since the year 1979 had mentioned, have been accompanied by detrimental effects on the natural environment. According to Goh Kim Chuan during the 21st year of independence, the government's priorities (ie, economic growth, social issues, etc.) left no space for environmental concerns. Moreover, it is a common phenomenon during national economies'

[1] According to: Treasury Economic Report (1978). Kuala Lumpur: Government Printers.

reconstruction period the natural resources to be considered vast and limitless and at the same time probable environmental consequences of development projects to be confronted as unnecessary distractions. As a result, considerable environmental deterioration in some localities and severe water pollution problems had occurred. Particularly indicative, for the tremendous environmental problems created due to Malaysian economic growth model through the years 1960–80, is the publication of Goh Kim Chuan [42].

Forest ecosystem damage

The effects of changing land use and logging activities have been diminishing forest acreage in Peninsular Malaysia. A survey of forest resources in the peninsula, in 1966, showed that about 9.1 million hectares out of the total land area of 13.2 million hectares were forested (primary forest cover), thus accounting for some 69% of the land.[2] In 1978 the percentage had decreased to 54.6% [71]. As far as the effects on rain forest animals are concerned, there had been no full study during the same period. Nevertheless, Chivers [72] estimated that 10,000 gibbons die each year due to loss of habitat.

Water pollution

Due to the mountainous terrain, as well as the high annual rainfall in Malaysia, there is an extensive network of rivers. During the 1970s Malaysia was the world's leading producer of natural rubber and at the same time the industrialization of the country had begun. According to Singh et al. [73] these industrial activities had resulted in the daily discharge of some 97 million liters of effluents into the rivers and streams. This volume of discharge was equivalent to a pollution load of 200 tonnes of biochemical oxygen demand (BOD) per day, which was equivalent to the organic pollution load from a population of about 4.5 million people. Another important source of water pollution was the effluents of oil palm factories. It had been estimated that for every tonne of effluent discharged from an oil palm factory, the BOD output is equivalent to that discharged from a population of 500 people. The total discharge from all oil palm mills in 1974 was estimated as a population equivalent of 8 million, and in 1978 it was estimated that the figure had doubled to almost 16 million population equivalent [74].

Air pollution

According to Goh [75], over half a million tonnes of air pollutants were released into the air over Peninsular Malaysia as a result of fuel combustion and burning of wood wastes in 1975.

[2] For further information, see: P.C. Lee, (1973). Multi-use management of West Malaysia's forest resources, In: *Biological resources and national development*, E. Soepadmo and K.C. Singh (eds). Kuala Lumpur: Malayan Nature Society.

Among these, a share of 45% was derived from transportation, 28% from furnaces and power generators, and about 28% from the burning of wood and wood waste.

South Korea: the miracle of rapid economic growth

The air pollution level in Seoul is among the highest in the world. A study in the 1980s concluded that 67% of rainfall was highly acidic for its residents. Sulfur dioxide emissions in Seoul were found to be five times higher than those of Taiwan and eight times than that from Tokyo. In 1989, the government found out that the water into 10 factory purification plants contained heavy metals such as cadmium and manganese at a level twice the officially permitted limit. The use of herbicides has increased 26 times between 1970 and 1985. According to studies conducted in the mid-1970s, the use of fertilizers in Korean agriculture was six times higher than that in the United States and 13 times higher than the average global. Finally, Korea has one of the highest levels of diseases related to professional employment. In particular, 2.66 out of 11 people suffer from diseases related to their professional employment compared to 0.70 in Taiwan, 0.93 in Singapore, and 0.61 in Japan [76].

8.4 Quantifying the Interactions Between Development and Environment

As it has already been stated, nowadays, air pollution, degradation of soil and water quality, desertification, biodiversity loss, global warming, etc. have become major environmental problems. Irrespective of the approach, if one aims at examining the causes and interdependencies between environmental degradation and the development process, as they were presented above, it is imperative to select appropriate indicators, which will illustrate both the progression of degradation and the improvement of environmental resources.

Given the aims of this section, among the great variety of indicators, the indicators used for monitoring the Millennium Development Goals (MDGs) concerning the environmental sustainability will be delineated in this chapter. These indicators cover a wide area of environment—development implications and comprise a basis for understanding their quantitative dimension. In chapter "Urban Environment," a more detailed analysis of the content and progress of the MDGs is presented. It should be also noted that the procedure of selecting an indicator is not an unambiguous process. It depends on data availability, as well as on the particular conditions of the problem and/or the thematic area, which this indicator is intended to describe. Besides, according to Mavraki et al. [77], there is no acceptable set of environmental indicators, being able to be applied at every different analysis level. This fact has led to the development of many different indicators, according to the case under study.

The indicators used to reflect the progress of the MDGs in the field of environmental sustainability—and in our view are the appropriate ones to quantify the interactions between the development models and the environment—are:

- *Proportion of land area covered by forest:* Land use change, principally deforestation, is responsible for the release of large amounts of carbon into the atmosphere. Deforestation in 2005 was accounted for an estimated 17% of global greenhouse gases (GHG) emissions, more than the entire transport sector [78]. Most of this is generated in developing countries. In recent years deforestation in Brazil and Indonesia has produced over half of all GHG emissions associated with land use change. Forest cover continues to decrease on a global scale. Between 1990 and 2005 the global surface of forests was reduced by 1.3 million km^2. Latin America and the Caribbean lost 7% of their forest during this 15-year period and Sub-Saharan Africa lost 9% [79].
- *CO_2 emissions, total, per capita, and per GDP (PPP):* GHG emissions have continued to increase since 1990. Deforestation and fossil fuel consumption primarily produce CO_2, while agriculture and waste are the main source of methane and nitrous oxide emissions. For the very poorest countries most GHG emissions come from agriculture and land use changes. When emissions from land use change are included, the top 10 emitters account for the two-thirds of CO_2 emissions—including China, India, and Brazil. In general the amount of GHG emitted per capita is far higher in the developed than in the developing countries [80].
- *Proportion of fish stocks within safe biological limits:* Developing countries are highly dependent on marine and freshwater fisheries. Fish provide 2.6 billion people with over 20% of their protein intake. Two-thirds of world fisheries production comes from fish capture. Together China, Peru, Chile, Indonesia, and India accounted for 45% of inland and marine fish catches in 2008 [79]. The share of overexploited fish populations has increased the last 40 years from 10% to 25% [79] and the most commercially successful species are fully exploited.
- *Proportion of total water resources used:* UN Water estimated in 2007 that by 2025 two-thirds of the world's population could be under conditions of water stress, defined as 1.700 m^3/person/year, the threshold for meeting the water requirements for agriculture, industry, domestic purpose, and energy. The International Water Management Institute also recently assessed global environmental water needs. It went beyond traditional calculations which compare water withdrawals to mean annual runoff, measuring the water needs at a river basin level and finding the amount of water needed to maintain ecosystem functionality [81].
- *Proportion of terrestrial and marine areas protected:* Only 12% of the planet is under some form of protection: about 18 million square kilometers of protected land and over 3 million square kilometers of protected territorial waters. Protected areas are also often poorly managed and suffer from pollution, irresponsible tourism, etc. [82].

- *Proportion of species threatened with extinction:* Measuring the diversity of animals, plants, and other organisms is inherently very difficult. Some progress has been made by the World Wildlife Fund (WWF) which summarizes changes in populations of vertebrate species in its Living Planet Index (LPI). This index tracks over 3600 populations of 1313 vertebrate species [83]. The LPI indicates a downward trend since 1970 with no signs of recovery [79].

It is worth mentioning that as a part of an evaluation of progress toward environmental MDGs, the World Bank has assembled and compared measures of the quality of national environmental policy and institutions. One of these, the Environmental Performance Index (EPI) takes broadly accepted targets for a set of 25 environmental indicators regarding: air pollution, water resources, biodiversity, productive natural resources, and climate change and ranks countries on the basis of their performance relative to these. Using the scores from 149 countries the 2008 EPI revealed that lower-income countries generally lag behind higher-income countries [84].

8.5 Development and Poverty Alleviation

8.5.1 Background and Questions

Welfare and poverty

Economic growth and development are supposed to beget welfare and well-being. One way to define the latter is through the level of command or access to resources or commodities [85]. Poverty, on the other hand, is considered "as a condition involving critical shortages of those elements" [85: 16]. In this sense, poverty statistics are indicative of the status that has emerged by the implementation of the selected developmental strategies and practices. What is more, not only income-based indicators, but also other nonincome dimensions of well-being/poverty are harnessed and are recognized as vital [86]. As McGillivray [87: 1] points out, it appears that there is a convergence toward the fact "that well-being and poverty are multidimensional and, in particular, that no single uni-dimensional measure adequately captures the full gamut of well-being achievement." This seems to be particularly true since the poor, apart from having little money and face shortage of quantifiable resources, enter into a more general situation of vulnerability such as deprivation in nutrition, limited access to health and education services, sense of impotence, etc. [85].

There is a series of multidimensional conceptualizations and indicators regarding well-being and poverty. The best known well-being indicator having been developed by the United Nations Development Programme (UNDP) is that of Human Development Index (HDI). The latter is "a composite measure that includes indicators along three dimensions: life expectancy, educational attainment, and command over the resources

needed for a decent living" [88: 23]. But UNDP also publishes statistical data about poverty, attempting to approach it in a multifarious manner. The Multidimensional Poverty Index (MPI) constitutes such an indicator.

Poverty and hunger

Hunger is shaped by several factors, but poverty is deemed to be one of its most important determinants [89]. A large share of the income of poor households is spent on food—even for those engaged in farming; in extreme cases, though, very poor families are not even capable of buying and consuming "enough food to meet dietary requirements," a fact that "can have long-lasting impacts on labor productivity" and eventually lead to the hampering of development prospects [90: 74]. Moreover, hunger, like poverty, with which is closely related, is multidimensional [89]. More specifically, hunger—in the shape of both undernourishment and malnourishment—is approached by the concept of food insecurity.

So, in an attempt to overcome the drawbacks of hunger, food security is measured across its four dimensions, namely: availability, access, stability, and utilization [91]. As it is shown in practice, all of these dimensions matter and need to be considered in order to measure, estimate, and enhance food security. This is in particular true in cases where food insecurity in portrayed as solely an (economic/physical) access problem: yet, the relationship between food insecurity and access is not as straightforward as it is often assumed to be, given that other "exogenous" economic conditions and political or natural hazard events occasionally severely deteriorate the state of food security [90].

In any case, no matter which are the determinants of food insecurity, the latter "usually takes a huge toll on labour productivity, and thus perpetuates a vicious circle where food insecurity causes low labour productivity, low incomes and thus further food insecurity" [90: 68]. This vicious circle refers to what is called the "hunger trap" or the "agriculture–hunger–poverty nexus." It is essential that one understands that poverty is not only a determinant of hunger, but it also results from hunger. And the deeper insight of how these two injustices interconnect is a prerequisite in order to eradicate both [92]. As von Braun et al. [92] explicitly state:

> *Hunger, and the malnourishment that accompanies it, prevents poor people from escaping poverty because it diminishes their ability to learn, work, and care for themselves and their family members. If left unaddressed, hunger sets in motion an array of outcomes that perpetuates malnutrition, reduces the ability of adults to work and to give birth to healthy children, and erodes children's ability to learn and lead productive, healthy, and happy lives. This truncation of human development undermines a country's potential for economic development—for generations to come.*

Questions

In this respect, both poverty and hunger—being tightly intertwined—are shaping the welfare of a region or country, and thus, the level of development. So, what is the state of the world at the present time, in terms of welfare and development? In what ways have the given developmental strategies affected this worldwide state of affairs, or to what extent have some of the MDGs and World Food Summit (WFS) target been met? The answers can be partially derived by appealing to the pertinent UNDP statistics and their overall historical trends and geographic differentiations. Yet, a more comprehensive and illuminating image is to emerge by putting these figures and findings in the wider context and assessing them in a critical perspective.

8.5.2 Statistics and Analysis

Poverty

According to the most recent UNDP Reports, although there is a generic trend of progress in human development—in terms of HDI— there is also a great disparity across HDI group countries. More specifically, in 2012, the global average value of HDI was 0.694. The lowest in the rank was Sub-Saharan Africa with an HDI value of 0.475, followed by South Asia (0.558), while the group of countries of very high human development exhibited a value of 0.905 [88]. In 2013, the pertinent HDI values were 0.702 (globally), 0.502, 0.588, and 0.890, respectively [93]. Now, by examining the HDI trends for the periods of 1990−2000, 2000−08, and 2008−13 per region, it is shown that "[w]hile all regions are registering improvement, signs of a slowdown are emerging" [93: 33]. The same slowdown in growth is monitored in all four (low, medium, high, very high) human development groups [93]. These temporal changes in the slowdown are portrayed in Figs. 8.2 and 8.3.

Aside from this decreased growth, which is displayed by the utilization of the HDI, there are some significant findings pertaining to poverty indices. It is worth noticing that MPI has substituted HPI (Human Poverty Index), avoiding the latter's aggregate character and providing the more specific overlapping deprivations (health, education, living conditions) faced by households and individuals per geographic region, ethnic groups, etc. [94]. Now, by appealing to the MPI, it is revealed that the number of people who live in multidimensional poverty are much more than those who live on less than $1.25 a day (ie, than those below the extreme income poverty); more precisely, the former group is estimated to count about 1.56 billion people, whereas the latter comprises 1.14 billion people [88,95]. So, these MPI statistics do show in an empirical means that income alone cannot warrant a reliable estimator of poverty—something that the theoretical research has indicated as well. Another interesting finding is that the HDI group (low, medium, high) has to do something with this disparity: "The lower the HDI value, the larger the gap

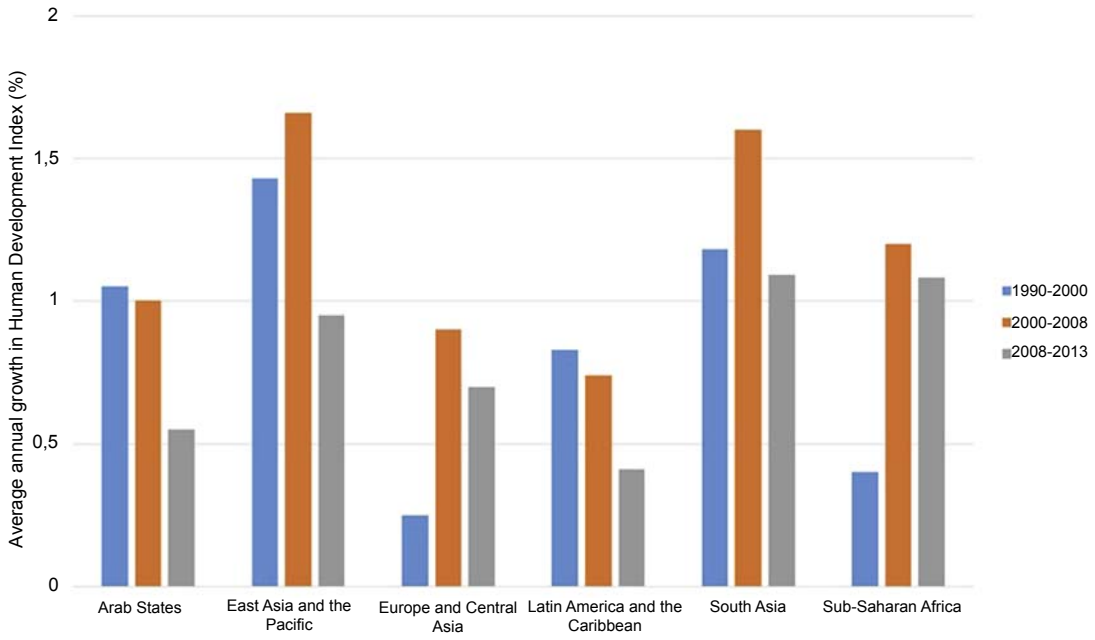

Figure 8.2
Trends of the Human Development Index from 1990 to 2013 per geographic region [93].

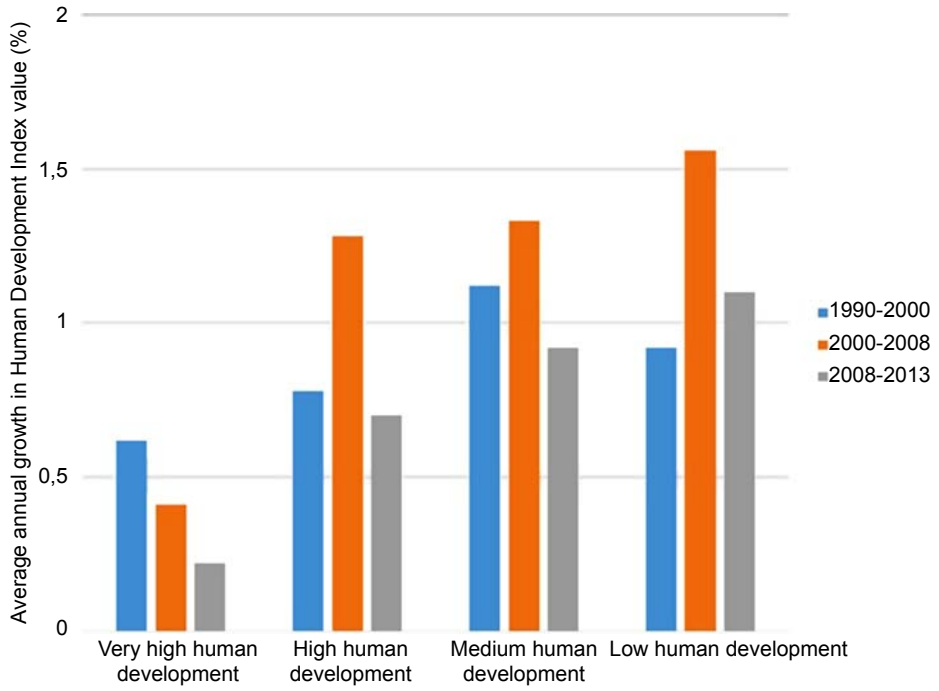

Figure 8.3
Trends of the Human Development Index from 1990 to 2013 for low, medium, high, and very high HDI groups of countries [93].

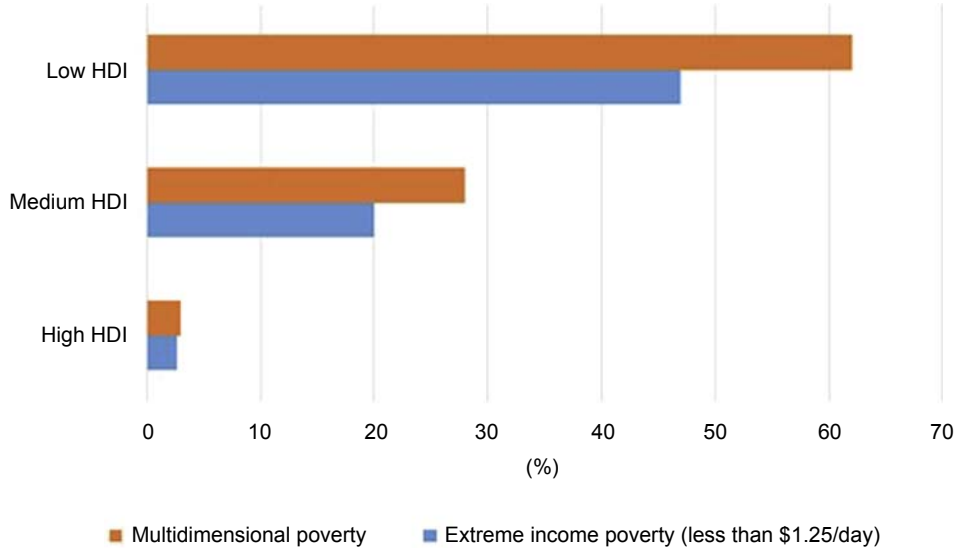

Figure 8.4
Trends of the Human Development Index (HDI) from 1990 to 2013 for low, medium, high, and very high HDI groups of countries [88].

between income poverty and multi-dimensional poverty" (data refer to 2002–11) [88: 29] (Fig. 8.4). This arises to be consistent with the fact that the countries with higher HDI—and not solely higher Gross National Income (GNI) per capita—have the socioeconomic structures, are "equipped" with the appropriate institutions, and provide the social services that can mitigate/"alleviate" the multidimensional poverty. As a consequence—aside from the apparent fact that both types of poverty are dramatically lower in high-HDI countries than those of the low-HDI countries—the multidimensional poverty of high-HDI countries is slightly higher than their poverty income in absolute figures since the income does not play such a decisive role in countries with developed social services. Although this explanation seems rather plausible, one should consider that both types of poverty apply to a percentage of less than 5% of the total population of the high-HDI countries, so the consideration of this gap in relative terms may have some importance as well.

Hunger

The hunger statistics show that about 870 million people were undernourished around the world in 2010–12; 852 million of these people were residing in developing countries, comprising the 15% of the total population of these countries [90]. In 2011–13, the respective population numbers were 842 and 827 million people [96]. From 1990 to 1992, the proportion of chronically hunger people has declined from 23.5% to 14.3% in 2011–13 and to 13.5% in 2012–14 for the developing countries [91,96].

Despite this conspicuous reduction of the number of undernourished people during the past two and a half decades, there are several aspects of this decline that, if examined properly, do not offer so promising an image for the development of the posterity and all of the regions/countries worldwide. To elucidate, the progress in the undernourishment has been slowed down during the past decade in comparison to that had taken place in the 1990s [96]. Furthermore, this progress in the percentage of undernourished people is not that impressive in absolute numbers [91,96]. Besides, the geographical distribution of the current status of hunger is not that promising as well. According to FAO's 2014 Hunger Map [97], large regional disparities do not seem to be bridged: The chronically hungry people reside almost exclusively in developing countries; about one-quarter of the Sub-Saharan people are undernourished at the present time, while in Southern Asia the chronically hungry people are more than half a billion; contrariwise, only Latin America and South-Eastern Asia are those subregions that display some very significant amelioration in the status of undernourishment.

8.5.3 Millennium Development and World Food Summit Goals and Targets

Therefore, at this point we return to some of the initial questions: where are we with respect to United Nations standards and goals?

On the one hand, UN MDG 1 is about eradicating extreme poverty and hunger and tow sub-goals (targets) refer directly to the subject of this section:

- Target 1-a. "Halve, between 1990 and 2015, the proportion of people whose income is less than $1 a day" and
- Target 1-c. "Halve, between 1990 and 2015, the proportion of people who suffer from hunger."

On the other, the goal or target set by the 1996 World Food Summit (WFS) was "… to eradicate hunger in all countries, with an immediate view to reducing the number of undernourished people to half their present level no later than 2015."

Regarding the 1-a target, according to the UNDP [96], "[t]he extreme poverty rate has been halved, but major challenges remain." More specifically, the accomplishment of this goal is mainly attributed to the success of some of the most populous countries such as China, Brazil, and India to significantly reduce the number of their extremely poor people (China's, Brazil's, and India's poor people percentage declined from 60.2% to 13.1%, from 17.2% to 6.1%, and from 49.4% to 32.7%, respectively). In addition, in 2010, the vast majority (nearly two-thirds) of the extremely poor people reside in five countries (India (33%), China (13%), Nigeria (9%), Bangladesh (5%), and the Democratic Republic of the Congo (5%)) [96].

As for the 1-c target, "halving the proportion of undernourished people by 2015 is within reach" [91], "but major efforts are needed to achieve the hunger target globally by 2015" [96: 12]. Given the sharp geographical discrepancies in the prevalence of undernourishment, these efforts should be intensified in Sub-Saharan Africa and Southern and Western Asia [97]. Yet, whereas this goal appears achievable globally, the World Food Summit target of halving the number of undernourished people by 2015 cannot be accomplished by 2015 [91].

A general comment about these goals is that poverty and possibly chronic hunger reduction are attainable in relative terms. Yet, when it comes to their mitigation in absolute terms, they remain stubbornly high—especially in the case of undernourishment [90].

8.5.4 Notes on Rural Poverty

Generally, an area is characterized as rural, when it is located outside urban centers. Stricter, technical definitions of rural areas vary. In order to facilitate development policies, the European Union defines rural areas according to population density. According to this definition, when the population density of an area is below 300 inhabitants per square kilometers, this area is considered as rural [98]. In the United States, the Department of Agriculture Economic Research Services is based for its studies on counties, which are considered as rural when they include a combination of open countryside, rural towns with fewer than 2500 inhabitants and urban areas with less than 50,000 people. According to the World Bank (data based on national statistical offices and UN estimations for the year 2013[3]), at global level 3.34 billion people live in rural areas. This corresponds to a 47% share of the planet's population. The share has fallen by 5% since 2003 and by 9% since 1993, showing a continuous trend to urbanization. Rural areas of the world do not have homogenous characteristics.

A special case among rural areas is that of mountainous areas. Mountains cover about 25% of the earth's surface, and 12% of the human population are there. Mountains are considered particularly important for the planet [99]:

- They are the "water towers" of the world—about 50% of the global population depends on them for freshwater.
- They include fragile ecosystems rich in biodiversity due to remoteness and variety of climatic conditions.
- They are reserves of energy and mineral resources.
- They are islands of cultural diversity.

[3] Data available at the online database of the World Bank: http://data.worldbank.org/indicator/SP.RUR.TOTL/countries.

Table 8.2: Percentage of Rural People Living in Extreme Poverty in Various Regions of the World [100].

Region	Percentage of Rural Population in Extreme Poverty Conditions (%)
East Asia	12
South Asia	50
Southeast Asia	8
Sub-Saharan Africa	30
North Africa and Middle East	<1
Latin America	1

Despite their importance and magnificence, mountain areas, in particular, and rural areas, in general, encounter severe poverty problems. Rural populations are considered the world's poorest and most disadvantaged. According to the International Fund for Agricultural Development (IFAD) [100], the largest segment of the world's poor are the 1-billion people living in rural areas, who are not able to cover their basic needs. In total, about 1.4 billion people around the world live in extreme poverty condition. So, more than the two-thirds of the world's population living in extreme poverty are inhabitants of rural areas. In Table 8.2, data related to rural population living in extreme poverty conditions are summarized. South Asia (mainly India) and Sub-Saharan Africa are the regions most exposed to extreme poverty. Generally, extreme poverty is defined as the situation, where a person lives with less than 1.25$ per day.

In 1990, more than half of the rural population (54%) in developing countries lived with less than 1.25$ a day and so, considered as extreme poor. By 2010 this share had dropped to 35%. This is, undoubtedly, an important step toward poverty eradication. High rates of economic growth in East Asia, and particularly in China, account for much of the decline in the rates of extreme poverty. However, the majority of people of rural areas, who were left-off living in extreme poverty, do not enjoy high living standards. Low income, food insecurity, insufficient infrastructure, analphabetism, and other negative factors still remain a threat for the rural areas of developing countries. The following characteristic statement of an African woman gives in a disarming manner the dimensions of poverty.

> *[Poverty] means the person is stuck. You cannot go anywhere or do anything to get out of the situation. You are not in a mood to rejoice, you can get rough with your children. You fear the future.*
>
> *Abibatou Goudiaby, female, 21 years, Senegal*[4]

[4] The words of Abibatou Goudiaby have been retrieved by http://www.un.org/en/globalissues/briefingpapers/ruralpov/quotes.shtml.

The problems faced by rural populations can be intensified under the influence of phenomena such as desertification and land degradation. It is estimated that about 1 billion people in the world are affected by land degradation, which mainly arises when fragile land is overexploited, in order to cover the demands of an expanding population. Excessive human activity leads also to desertification, which is additionally enhanced by climate change. Not only the growing need for food, but also the need for fuel lead to land degradation and desertification. People without access to energy services are obliged to consume biomass, in order to cook and warm their dwellings. This is an important factor of pressure to forest ecosystems. The major global challenge of climate change has also great effects on rural populations. In the case of people in semiarid and arid regions, as well as in mountain areas, agriculture takes place under marginal conditions. Hence, small changes in temperature and precipitation have great, direct impact on it. Taking into account that agriculture is the main means of survival for rural people, such changes could have dramatic effects.

The strong dependency of rural populations on the environmental conditions for their survival shows that there is a definite necessity for sustainable approaches to development in these areas. People facing extreme poverty conditions and suffering from chronic hunger are forced to struggle for their survival. This leads to adopting practices which ignore the environmental concerns, such as the already mentioned forest degradation for obtaining fuel, "slash-and-burn" agricultural techniques, overexploitation of water resources, etc. The environmental impact of poverty is partly due to the lack of economic resources and the inaccessibility to technological means and know-how. Therefore, apart from direct humanitarian aid, there is a dire necessity for integrated programs that will provide rural, poor communities with the appropriate means and knowledge, in order to escape from this vicious circle and become able to cover their essential needs without further environmental degradation. The environmental problems of the developing countries may be attributed—to some extent—to inequalities sustained by the dominant global economic policies. Hence, there is a moral obligation from the part of the "developed North" toward the "developing South" in the direction of diffusing resources, good practices, and policies.

As far as mountainous areas are concerned, according to the Food and Agriculture Organization (FAO), over 35% of their population faces food insecurity. Moreover, mountain populations are exposed to natural hazards (especially landslides and earthquakes); they face marginalization and do not have access to basic services. High-altitude areas have a series of specific characteristics (cold climate, limited space for agriculture, great distance from major urban and commercial centers, etc.), which require specialized approaches—mountain-specific strategies—for mountain development. Besides, since 1992 through a special chapter in Agenda 21 the need for sustainable mountain development was highlighted.

8.5.5 Lack of Access to Energy—Energy Poverty

Taking into account the great importance of energy services for modern societies, based on technology, in this subsection, some essential facts related to problems in energy supply and energy poverty are mentioned.

Living standards are closely related to energy sufficiency. There are approaches which connect social development itself with energy consumption. For instance, it is claimed that civilization is the figment of progress in machine manufacturing and intensive energy consumption [101]. According to the United Nations Development Programme, in order to ensure a satisfactory level of development, it is necessary not only to ensure sufficient quantities of energy, but also good quality of energy. In other words, households need to be at the higher steps of the "energy ladder" and be able to use electricity and/or fine liquid or gaseous fuels [102]. According to Reddy [103] the impact of energy on human development is related to the end-uses of energy and the tasks, which energy puts through. This explains the high importance that is attributed to access to electricity, since it has a multitude of end-uses: lighting, cooking, pumping, heating, cooling, etc. Reddy [103] also shows that in developing countries, small investments in the energy sector could produce dramatic improvements in the Human Development Index (HDI). With an increase of 100 W/person in electrical energy supply (a small fraction of the average electricity use in the industrialized countries), a radical improvement in quality of life could be achieved [104,105]. Energy consumption is not only related to quality of life improvement and poverty alleviation, but also with economic development. It is recognized that access to energy and, particularly, electrical energy is crucial for achieving the MDGs [106].

Despite the wide recognition of the importance of energy for development, globally, over 1.3 billion people live without access to electricity and 2.8 billion people without clean cooking facilities [107]. More than 95% of these people are either in sub-Saharan Africa or developing Asia and 84% are in rural areas, according to the International Energy Agency (IEA) [108]. At global level, the electrification rate is 80.5%, while in the world's rural areas this percentage is only 68%. More detailed data about access to electricity are given in Table 8.3. Between 1990 and 2010 the percentage of the world's population without access to electricity and clean cooking facilities has fallen by about 7%. However, in a period of 20 years this improvement is not particularly satisfying. Hence, the problem of lack of access to energy remains worrying and efforts for overcoming it should be intensified.

Even among developed countries, problems in energy supply are increasing. It is estimated that between 50 million and 125 million people in Europe do not have the possibility for adequate coverage of their energy needs [109]. Inadequate access to energy services is generally described either as energy or fuel poverty. Energy poverty is usually used for

Table 8.3: Access to Electricity in 2009 [108].

	Population Without Electricity (Millions)	Electrification Rate (%)	Urban Electrification Rate (%)	Rural Electrification Rate (%)
Africa	587	41.8	68.8	25.0
North Africa	2	99.0	99.6	98.4
Sub-Saharan Africa	585	30.5	59.9	14.2
Developing Asia	675	81.0	94.0	73.2
China and East Asia	182	90.8	96.4	86.4
South Asia	493	68.5	89.5	59.9
Middle East	21	89.0	98.5	71.8
Latin America	31	93.2	98.8	73.6
Developing countries	1314	74.7	90.6	63.2
World	1317	80.5	93.7	68.0

delineating problems related to dealing with energy services in the home, whereas fuel poverty is more often used for referring to the insufficient coverage of heating needs [110]. The concept of fuel poverty has not been defined yet with sufficient clarity. The United Kingdom is a country, which has adopted an official definition, legitimized in 1998. Under this definition, a household is considered to be fuel poor, when it has to spend more than 10% of its income on all domestic energy use, including appliance and heating. Apart from the United Kingdom, France, Slovakia, and Ireland have attempted to define the issue of energy poverty. The European Union through the European Economic and Social Committee (EESC) states the necessity of forming a common, general definition for energy poverty and establishing common indicators for it. This is the first step toward establishing integrated strategies for alleviating this important social problem. It is proposed that the definition given by the EESC in 2011 ("the difficulty or inability to ensure adequate heating in the dwelling and to have access to other essential energy services at a reasonable price") could be a basis for developing a common general definition of the problem.

Energy poverty—understood as inadequate coverage of energy needs—is, obviously, different than the total absence of energy services and its impacts are less severe. However, it still demands special attention. As shown in Table 8.4 [111], people at the risk of poverty in Europe are highly exposed to fuel poverty, too. In Table 8.4 three indices related to fuel poverty are used, namely arrears on utility bills, inability to keep the residence warm, and problems in the house attributed to inadequate heating. Energy supply problems seem to be acute in Central, Eastern, and Mediterranean EU countries, especially in Bulgaria, Hungary, Greece, and Cyprus, while in northern European countries the situation is far better. In Europe, as a whole, about 1 out of 10 people are considered to be energy poor and one-fourth of low-income people are energy poor. These facts,

Table 8.4: Percentage of People at the Risk of Poverty Affected by Fuel Poverty in European Countries [111].

Country	Arrears on Utility Bills (%)	Inability to Keep Home Adequately Warm (%)	Dwellings With Leakages and Damp Walls (%)	Country	Arrears on Utility Bills (%)	Inability to Keep Home Adequately Warm (%)	Dwellings With Leakages and Damp Walls (%)
Bulgaria	50.7	70.0	29.5	Estonia	20.0	9.6	30.3
Hungary	58.8	33.9	53.0	Belgium	14.0	18.8	26.2
Greece	54.4	47.6	21.0	Ireland	27.5	12.5	16.2
Latvia	39.5	35.1	43.3	France	17.8	15.2	22.1
Cyprus	25.9	50.6	34.6	Czech Republic	19.4	15.3	20.0
Slovenia	37.5	17.3	46.1	Spain	17.9	18.2	17.9
Italy	24.5	44.1	30.1	Slovakia	18.3	13.6	19.7
Romania	41.5	25.4	30.0	Netherlands	8.6	8.7	27.4
Lithuania	22.8	38.2	28.6	Germany	8.6	14.8	21.0
Portugal	14.5	43.0	28.4	Denmark	5.5	7.1	25.3
Croatia	40.9	21.8	19.9	Luxembourg	6.6	2.2	28.9
Poland	30.1	27.6	20.0	Austria	11.3	7.7	15.2
Malta	19.4	32.1	12.4	Finland	13.7	3.8	8.6
United Kingdom	20.3	19.4	21.4	Sweden	10.3	3.5	11.0

taking into account, the generally high living standards in Europe, show that there should be no complacency about the problem.

Insufficient energy supply poses serious threats for human health; inadequate heating increases winter mortality; and inability to use safe fuel (either for heating or for cooking) downgrades indoor air quality. Between 30% and 50% of excess winter mortality is attributed specifically to housing conditions and inadequate heating [112]. A special index (EWDI—Excess Winter Deaths Index) is used for monitoring winter mortality. This index indicates if the expected deaths in the winter are higher than in the rest of the year and is considered to be closely related to energy efficiency of houses and sufficient heating [111]. In Malta, Spain, and Portugal, in the period 2011−12, EWDI was over 30%. Even in Germany, EWDI exceeded 10% in the same time period. The World Health Organization considers indoor air pollution as one of the top 10 health risks, at a global level [113]. Furthermore, another aggravating factor for human health is time and effort to procure fuel, especially in cases of high dependency on firewood, like in sub-Saharan Africa. Mostly women, in rural sub-Saharan regions, have to carry about 20 kg of wood for an average distance of 5 km every day [114]. The abovementioned facts constitute additional causes for international mobilization toward alleviating problems in energy supply.

8.6 Development Policies and Useful Tools for development Planning

8.6.1 A Synopsis of Major International Policies

The fight against poverty is, probably, the most important target of international development policy, as it has already been noticed. Poverty alleviation is an essential step in the direction of defending the humanity's dignity and it is the prerequisite for creating development perspectives for the "damned of the earth," which now number about a billion, when speaking about extreme poverty. The United Nations through the MDGs gives the tone of international policies/actions against poverty, hunger, disease, and child mortality. In 2002 the Millennium Project was commissioned by the UN Secretary-General, aiming at the development of a concrete action plan for the world to achieve the eight MDGs, which are related to confronting poverty, hunger, and disease. The MDGs were set out in 2000, by the historical Millennium Summit of the UN. In this summit, leaders of a large number of nations adopted the UN Millennium Declaration that committed the nations to reduce poverty and set out certain targets, with a deadline of 2015. The MDGs and their basic context, in the form of 18 targets, are summarized below:

- Goal 1: Eradicate Extreme Hunger and Poverty
  - Target 1: Halve, between 1990 and 2015, the proportion of people whose income is less than $1 a day
  - Target 2: Halve, between 1990 and 2015, the proportion of people who suffer from hunger

- Goal 2: Achieve Universal Primary Education
  - Target 3: Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling
- Goal 3: Promote Gender Equality and Empower Women
  - Target 4: Eliminate gender disparity in primary and secondary education, preferably by 2005, and in all levels of education no later than 2015
- Goal 4: Reduce Child Mortality
  - Target 5: Reduce by two-thirds, between 1990 and 2015, the under-five mortality rate
- Goal 5: Improve Maternal Health
  - Target 6: Reduce by three-quarters, between 1990 and 2015, the maternal mortality ratio
- Goal 6: Combat HIV/AIDS, Malaria, and Other Diseases
  - Target 7: Have halted by 2015 and begun to reverse the spread of HIV/AIDS
  - Target 8: Have halted by 2015 and begun to reverse the incidence of malaria and other major diseases
- Goal 7: Ensure Environmental Sustainability
  - Target 9: Integrate the principles of sustainable development into country policies and programs and reverse the loss of environmental resources
  - Target 10: Halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation
  - Target 11: Have achieved by 2020 a significant improvement in the lives of at least 100 million slum dwellers
- Goal 8: Develop a Global Partnership for Development
  - Target 12: Develop further an open, rule-based, predictable, nondiscriminatory trading and financial system (includes a commitment to good governance, development, and poverty reduction both nationally and internationally)
  - Target 13: Address the special needs of the least developed countries (includes tariff- and quota-free access for least developed countries exports, enhanced program of debt relief for heavily indebted poor countries (HIPCs) and cancellation of official bilateral debt, and more generous official development assistance for countries committed to poverty reduction)
  - Target 14: Address the special needs of landlocked developing countries and small island developing states (through the Program of Action for the Sustainable Development of Small Island Developing States and 22nd General Assembly provisions)
  - Target 15: Deal comprehensively with the debt problems of developing countries through national and international measures in order to make debt sustainable in the long term
  - Target 16: In cooperation with developing countries, develop and implement strategies for decent and productive work for youth

- Target 17: In cooperation with pharmaceutical companies, provide access to affordable essential drugs in developing countries
- Target 18: In cooperation with the private sector, make available the benefits of new technologies, especially information and communications technologies

In 2008 a high-level event took place at the UN Headquarters. Governments, foundations, businesses, and civil society groups refreshed the efforts toward the achievement of the MDGs and announced new commitments in order to meet the targets. An amount of about $16 billion was agreed to be provided, in order to reach the MDGs, according to the announcements of the UN. Then, in 2010, another UN Summit focused on the MDGs adopted a global action plan for maintaining the course toward achieving the targets, especially the antipoverty ones. The action plan included also new commitments for women's and children's health and other initiatives. For accelerating progress related to women's and children's health, the states and the organizations that took part in the Summit allocated over $40 billion for 5 years. Arriving mid-2015, the following general deduction could be put forward: At global level, significant progress in achieving many of the MDGs has been made. However, great disparities across and even within countries are observed. It should not be overlooked that people pulled through extreme poverty and hunger still do not enjoy satisfying living conditions and so, the potential for making more progress is great. In Table 8.5, it has been attempted to gather the progress toward achieving the MDGs by combining the relevant reports [96,115]. It has been tried to keep the targets in their initial form (despite some changes made since their initial adoption), in order to be able to follow the whole course.

As far as Goal 8, is concerned, only Target 18 has been included in the Table as it has easily measurable results. Some key points regarding the some other targets of Goal 8 are summarized below [96]:

- Target 12: Great percentages of developing countries' exports enter the developing world duty free.
- Target 13: Not satisfactory financial aid is provided by the developed countries to the developing world.
- Target 15: Significant progress has been made but there are still various countries with very highly indebted.

In 1999, the income of the richest 5% of the world's population was 114 times higher than the income of the poorest 5% [116]. Between 1998 and 2008 the richest 1% of the world's population saw their real income increased by 60%. During the same period the incomes of the poorest 5% remained the same [117]. These facts show that we live in a world of raising inequalities. While the wealth of a small proportion of people steadily increases, the efforts for improving the living conditions of billions of people in the developing world have not been successfully completed. Almost 30 years after the publication of the

Table 8.5: Progress Over the Millennium Development Goals (MDGs) [96,115].

MDGs	Targets	Overall Progress	Regional Progress						
			Northern Africa	Sub-Saharan Africa	East Asia	South Asia	Southeast Asia	Central Asia/ Caucasus	Latin America
Goal 1	Target 1 Halve extreme poverty	Achieved Still great numbers of extreme poor	Achieved Low poverty	Not achieved Very high poverty	Achieved Moderate poverty	Achieved Very high poverty	Achieved Moderate poverty	Achieved Low poverty	Achieved Low poverty
	Target 2 Halve the proportion of people suffering from hunger	Not achieved Slower rates of hunger reduction than in the 1990s	Achieved Low hunger	Not achieved High hunger	Achieved Moderate hunger	Not achieved High hunger	Achieved Moderate hunger	Achieved Moderate hunger	Achieved Moderate hunger
Goal 2	Target 3 Achieve access of all children to primary education	Not achieved Important progress, still 10% of children in developing countries have no access	Achieved High enrollment	Not achieved Moderate enrollment	Not achieved High enrollment	Achieved High enrollment	Not achieved High enrollment	Not achieved High enrollment	Not achieved High enrollment
Goal 3	Target 4 Eliminate gender disparity in primary and secondary education	Achieved Progress should be made in some regions	Achieved Close to parity	Not achieved Close to parity	Achieved Parity	Achieved Parity	Achieved Parity	Achieved Parity	Achieved Parity
Goal 4	Target 5 Reduce by two-thirds the under-five mortality rate	Not achieved The rate has been halved. Accelerating pace in reducing child mortality	Achieved Low mortality	Not achieved High mortality	Achieved Low mortality	Not achieved Moderate Mortality	Achieved Low mortality	Achieved Low mortality	Achieved Low mortality

Continued

Table 8.5: Progress Over the Millennium Development Goals (MDGs) [96,115].—cont'd

			Regional Progress						
MDGs	**Targets**	**Overall Progress**	**Northern Africa**	**Sub-Saharan Africa**	**East Asia**	**South Asia**	**Southeast Asia**	**Central Asia/ Caucasus**	**Latin America**
Goal 5	Target 6 Reduce by three-quarters the maternal mortality ratio	Not achieved The ratio has fallen by 45%. In developing region 14 times higher maternal mortality than in developed	Not achieved Low mortality	Not achieved Very high mortality	Achieved Low mortality	Not achieved Moderate mortality	Not achieved Moderate mortality	Achieved Low mortality	Not achieved Low mortality
Goal 6	Target 7 Halt and reverse the spread of HIV/AIDS	Partially achieved The number of new infections has declined. Still great numbers of infections and alarmingly high levels of insufficient knowledge about HIV	Not achieved Low incidence	Achieved High incidence	Not achieved Low incidence	Achieved Low incidence	Not achieved Low incidence	Not achieved Low incidence	Achieved Low incidence
	Target 8 Halt and reverse the spread of malaria and tuberculosis	Partially achieved Millions of people still do not have access to public health programs	Not achieved Low mortality	Not achieved Moderate mortality	Achieved Low mortality	Achieved Moderate mortality	Achieved Moderate mortality	Achieved Low mortality	Achieved Low mortality

Goal 7	Target 9 Integrate the principles of sustainable development into country policies	Not achieved Apart from the elimination of the use of ozone depletion substances, other crucial factors regarding environmental sustainability need great efforts to be achieved. CO_2 emissions present increase, renewable water sources become more and more scarce							
	Target 10 Halve the proportion of people without sustainable access to safe drinking water	Achieved Not all people gained access to water have access to safe water	Achieved High coverage	Not achieved Low coverage	Achieved High coverage	Achieved High coverage	Achieved Moderate coverage	Not achieved Moderate coverage	Achieved High coverage
	Target 11 Significant improvement in the lives of at least 100 million slum dwellers	Not achieved The number of slum dwellers is increasing due to accelerating urbanization	Achieved Moderate percentage of slum dwellers	Not achieved Very high percentage of slum dwellers	Achieved Moderate percentage of slum dwellers	Achieved High percentage of slum dwellers	Achieved High percentage of slum dwellers	-	Not achieved Moderate percentage of slum dwellers
Goal 8	Target 18 Increase the users of the Internet	Achieved Great increase in the Internet users. Need to expand the use in certain areas	Achieved High usage	Not achieved Moderate usage	Achieved High usage	Not achieved Moderate usage	Achieved High usage	Achieved High usage	Achieved High usage

historic document "Our common future" by the World Commission on Environment and Development, fundamental issues for the world's welfare remain pending. The MDGs should be fully achieved and without delay more efforts should be made for ensuring better perspectives, especially for people in the developing world. Otherwise, the famous aphorism of Karl Marx, "The rich get richer and the poor get poorer," will continue haunting humanity.

In 2010 the High-level Plenary Meeting of the General Assembly on the MDGs requested the Secretary-General to start processing the creation of a post-2015 development agenda. The Secretary-General established the UN System Task Team on the Post-2015 UN Development Agenda. This team brings together the efforts of more than 60 UN agencies and international organizations, in order to reach a set of sustainable development targets. The Task Team issued a first report to the Secretary-General in May 2012 regarding the post-2015 development agenda. In this report it is noted that the central challenge should be ensuring that globalization becomes a positive force for all the world's peoples. Some more detailed recommendations are summarized below [118]:

- The goals and targets of the post-2015 development agenda should be concrete and precise. This was the strength of the MDG framework. The MDGs should be reorganized according to four key dimensions: (1) inclusive social development, (2) inclusive economic development, (3) environmental sustainability, (4) peace and security.
- High level of policy coherence at the global, regional, national, and subnational levels will be required. There are no solutions, which fit to all cases. Hence, the post-2015 development agenda should include and encourage national policy design, as well as adaptation to local settings, under the overall vision and its principles.
- It is too early to define concrete goals and targets for the post-2015 UN development agenda. Various processes will need to be completed first. The outcome of and follow-up to the Rio+20 Conference on Sustainable Development will provide critical guidance.

The acceleration of progress toward the MDGs and the creation of a new global alliance, through the post-2015 development agenda, including more drastic measures for global development, are absolutely necessary for improving the current condition of our world. Toward this direction, courageous political decisions, sufficient financial resources, and integrated approaches to the global problems and challenges are required. Without radical changes in the global priorities, progress toward improving peoples' lives would always be deficient.

As already discussed, the vast majority of the world's poor live in rural areas. Great numbers of rural people in the developing world live under unbearable conditions and do not have access to basic services. The Food and Agriculture Organization (FAO) of the UN is the major international body which coordinates policies for rural populations.

According to the relevant Website: "Achieving food security for all is at the heart of FAO's efforts—to make sure people have regular access to enough high-quality food to lead active, healthy lives." The basic strategic framework of FAO, as well as the major dimensions of action, is included in Table 8.6 [119]. The strategic framework of FAO is implemented through regional programs/initiatives, which are coordinated by regional offices. In partnership with regional organizations, it is attempted to raise political commitment for specialized, country-level actions, in order to improve the capacities of governments and stakeholders. FAO creates and shares information about food, agriculture, and natural resources. Additionally, it plays a connector role, since it works with different partners and so, dialogue is facilitated. The programs run by the organization have the general aim of turning knowledge into action. Therefore, depending on the needs of its region and according to the strategic framework, certain actions are implemented. The programs implemented by FAO are funded both by the member countries (at a percentage of 41% in 2014) and by voluntary contributions (at a percentage of 59% in 2014). For 2014−15 the total budget of the organization is $2.4 billion. FAO and its actions have played a major role in making progress toward the achievement of the MDGs, especially in the fields of poverty and hunger alleviation.

Table 8.6: The Strategic Aims of FAO and Their Basic Specification [119].

Strategic Framework of the Food and Agriculture Organization (FAO)	
Eliminate hunger, food insecurity, and malnutrition	• **Policies, programmes, and legal frameworks**: Development of policies and legal framework with strong focus on hunger and malnutrition. • **Human and financial resources**: Efforts toward greater commitment and allocation of human and financial resources to support the implementation of policies. • **Governance, coordination mechanisms, and partnerships**: Creation of perspectives for stronger and more inclusive coordination across sectors and stakeholders. • **Evidence-based decision making**: Support to effective decision making, at the basis of food security information systems, enhanced tracking and mapping of actions, and improved impact assessment.
Make agriculture, forestry, and fisheries more productive and sustainable	• **Support practices that increase sustainable agricultural productivity**: Development of good practices, which increase productivity and save resources and share with decision makers. • **Provide information to support the transition to sustainable agriculture**: Gathering and share of information, development and sharing of analytical tools aiming at increasing productivity, and sustainable use of resources in agricultural systems.

Continued

Table 8.6: The Strategic Aims of FAO and Their Basic Specification [119].—cont'd

Strategic Framework of the Food and Agriculture Organization (FAO)	
	• **Promote the transition to sustainable agriculture**: Help to countries, in order to evaluate the effectiveness of their strategies for sustainable agriculture. Supporting the development of policies and legal framework, which underpin the transition to sustainable agriculture. • **Advocate the adoption of international policies for productive and sustainable agriculture**: Urge countries to adhere to international agreements, which promote productive and sustainable agriculture. Support to the implementation of national laws.
Reduce rural poverty	• **Improve opportunities for access to decent employment**: Improving the design of rural economic diversification policies, in order to promote decent work creation. Skills training for rural workers. Assistance in the application of international labor standards, ensuring occupational safety and health. • **Improve social protection systems**: Support synergies between social protection measures and food security. Support the development of national programs on social protection of the rural poor. Strengthen current social protection programmes for increasing their efficiency. • **Empower the rural poor gaining access to resources and services**: Strengthen rural organizations, including co-operatives. Improvement of rural infrastructure. Improvement of access of the poor to natural resources.
Enable inclusive and efficient agricultural and food systems	• **Improve the inclusiveness and efficiency of food systems**: Help governments to support the sustainable development of food systems and regulate plant and animal health, as well as food quality and safety. Documentation about food lost and waste and work on reducing it. • **Help strengthen public—private collaboration to improve smallholder agriculture**: Engagement of the food industry and nonprofit organizations in supporting smallholder farmers. Facilitation of investment increase in strengthening the food sector. Support governments to cooperate more effectively with the private sector. • **Improve the inclusiveness and efficiency of markets**: Gather and share information on market access and development. Strengthen financial mechanisms to support the growth of agriculture and food industries.
Increase the resilience of livelihoods to threats and crises	• **Help countries govern risks and crises**: Help countries develop strategies and plans for reducing and managing risks. Advocating for the mobilization of resources toward risk reduction for agriculture, food, and nutrition.

Table 8.6: The Strategic Aims of FAO and Their Basic Specification [119].—cont'd

Strategic Framework of the Food and Agriculture Organization (FAO)	
	• **Help countries watch to safeguard**: Development and share of mechanisms that monitor and warn about hazards and risks. Help countries prevent and mitigate risks. Development of strategies that reduce the impact of disasters. Help countries to make their agricultural systems withstand and recover from crises. • **Support countries to prepare and response**: Provide assistance so that humanitarian action protects the livelihoods of vulnerable farmers, fishers, herders, etc. during emergencies. Help toward ensuring that disaster response plans are coordinated at all levels.

As it was described in Section 8.5, the development perspectives of great shares of the world's population are downgraded, due to lack of access to energy and, especially, electricity. The UN Secretary-General, Ban Ki-Moon, has stated:

> *Energy is the golden thread that connects economic growth, social equity, and environmental sustainability […]. Widespread energy poverty condemns billions to darkness, to ill health, to missed opportunities. Energy poverty is a threat to the achievement of the Millennium Development Goals. It is inequitable and unsustainable. Children cannot study in the dark. Girls and women cannot learn or be productive when they spend hours a day collecting firewood. Businesses and economies cannot grow without power. We must find a way to end energy poverty.*

The UN Secretary-General, in cooperation with the President of the World Bank, introduced an initiative called "Sustainable Energy for All" in 2011. This global initiative has three main pillars:

- providing universal access to modern energy services,
- doubling the global rate of improvement in energy efficiency, and
- doubling the share of renewable energy in the global energy mix.

It is aimed to meet the aforementioned targets by 2030.

In support of the initiative, the UN Foundation created a global Energy Access Practitioner Network, which has 2000 members in 170 countries. The Network focuses on removing market barriers to the delivery of energy services through the adoption of new technologies and innovative financial and business models. The UN Foundation is also collaborating with a series of public and private sector partners, in order to facilitate the initiative. As far as the steps toward achieving each goal are concerned, in Table 8.7 , the recommended actions are summarized. As it can be seen in Table 8.7, the first stage of the "Sustainable Energy for All" initiative is the creation of a robust data platform, which

Table 8.7: Areas of Action for Each Goal of the "Sustainable Energy for All" Initiative for Improvement of Global Energy Databases.

	Recommended Targeting of Effort Over Next 5 Years
Energy access	Improve energy questionnaires for global networks of household surveys
	Pilot country-level surveys to provide more precise measures of access to electricity and clean cooking
	Develop suitable access measures for heating
Energy efficiency	Integrate data systems on energy use and associated output measures
	Strengthen country capacity to collect data on sectoral intensities
	Improve data on physical activity drivers
	Improve data on energy efficiency targets, policies, and investments
Renewable energy	Improve data and definitions for bio-energy and sustainability
	Capture renewable energy used in distributed generation
	Capture renewable energy used off-grid and in microgrids
	Promote a more harmonized approach to target setting

will have the capability of monitoring global progress toward the specific objectives. Household surveys are the main source of data for energy access and national energy balances the basic tool for monitoring renewable energy use and progress in energy efficiency. Until now, it has been made possible to monitor between 126 and 181 countries, depending on the indicator. This corresponds to coverage of 96–98% of the world's population, a rather satisfying achievement.

Through the extensive monitoring framework, the establishment of certain quantitative targets for the initiative was made possible. These targets are listed in Table 8.8. Actual global investments in the areas covered by the initiative's objectives were estimated at about $400 billion in 2010. The additional necessary investments for achieving the

Table 8.8: Specific Targets of the "Sustainable Energy for All" Initiative.

	Objective 1		Objective 2	Objective 3
	Universal access to modern energy services		Doubling global rate of improvement of energy efficiency	Doubling share of renewable energy in global energy mix
Proxy indicator	Percentage of population with electricity access	Percentage of population with primary reliance on nonsolid fuels	Rate of improvement in energy efficiency	Renewable energy share in TFEC
Reference 1990	76	47	−1.3	16.6
Starting point 2010	83	59		18.0
Objective for 2030	100	100	−2.6	36.0

objectives are considered to be at least $600–800 billion per year. The access to energy-related expenses count for about 15% of the incremental costs. The greatest share of the expenses is attributed to energy efficiency and renewable energy. Box 8.2 contains an interesting successful example of a small-scale intervention for providing rural communities with green energy.

Within the developed world, lack of access to electricity is, practically, not a problem. Nevertheless, energy poverty, insufficient coverage of energy needs, becomes an intensifying issue. Action against energy poverty can be characterized as fragmentary, until now. For instance, some member states of the European Union proceeded to the adoption of national policies for alleviating energy poverty. Italy, Spain, and Greece have introduced low electricity tariffs for vulnerable customers. In Sweden, the social protection system undertakes the coverage of unpaid energy bills by customers with economic problems [120]. It can be claimed that better-coordinated actions should be adopted against energy poverty, aiming at protecting vulnerable citizens and avoid negative impacts on human health and the environment, caused by insufficient access to energy services.

Box 8.2 Successful Case Study of Action Toward Supplying Rural Areas in Peru With Energy

Successful example for sustainable energy supply: Micro-hydro revolving fund in Peru
"Practical Action"* has been using Inter-America Development Bank (IDB) funds in Peru since 1994, in order to implement a "Revolving Fund" of soft loans. The fund combined with technical assistance aims at constructing micro-hydro power plants in isolated rural areas. The fund consists of a financial model based on loans subsidized with technical assistance for individual clients (microrural entrepreneurs). It covers the installation of new systems, as well as the rehabilitation and/or repair of existing systems.

The amount of loans ranges from US $10,000 to $50,000, with an interest rate of 10%. The payback period is 1–5 years, and the grace period varies, depending on the client's situation. The types of guarantee vary according to the status of the client, collective or individual. In the case of collective clients, a positive cash flow should be demonstrated. In the case of individual clients, they must give collaterals for an amount equivalent to or greater than 30% of the loan received. The electromechanical equipment may form part of the guarantee.

To date, this model has allowed the conclusion of 22 loan contracts, amounting about $800 million, in total. The loans have enabled an additional installed capacity of over 1.5 MW to be put into operation in remote areas, which has provided 15,000 rural inhabitants with energy.

* Practical Action is an international organization was founded by radical economist and philosopher E.F. Schumacher over 45 years ago. It tries to use low cost, appropriate, small-scale development solutions for supporting people in helping themselves.

The MDGs include targets related to environmental sustainability. The content of the MDGs, themselves, show the strong interactions between environment and development. Apart from sufficient food, income, and decent housing conditions, good living standards require a clean, safe, and pleasing environment. Therefore, global efforts for protecting the environment and corresponding to major challenges, such as climate change, are absolutely necessary for ensuring a viable future for humanity. Unfortunately, there are major indices showing that we are, at global level, far away from a pathway respectful to the environment. For instance the world's average CO_2 emissions per capita were 14% higher in 2011 than in 1990 [121]. Despite the overall reduction in deforestation rates, in Latin America about 4 million hectares of forests are lost every year [122]. The depletion rates of the world's water reserves have not stopped increasing since 1960 [123]. Therefore, global concern about environmental issues should be intensified and international policies have to be more fruitful.

The global environmental agenda is set by the United Nations Environment Programme (UNEP), which can be characterized as the leading global environmental authority. UNEP focuses on the following thematic priorities, which contain particular goals. In Table 8.9 the thematic priorities of UNEP and their goals are listed. For each thematic priority global, regional and national programs are coordinated by UNEP, in order to achieve the specific targets. The activities of UNEP are concentrated on the developing world.

Table 8.9: Thematic Priorities and Goals of UNEP.

Priorities of UNEP	
Climate change	• **Adaptation to climate change**: Countries are helped to reduce their vulnerability and use ecosystem services to build natural resilience. • **Mitigating climate change**: Support in making sound policy, technology, and investments that lead to GHG emission reductions, with a focus on renewable energy sources and energy efficiency. • **Reducing emissions from deforestation**: Incentives for developing countries to reduce emission from forested lands. • Enhancing knowledge and communication.
Disasters and conflicts	• **Disaster risk reduction**: Prevention and reduction of the impacts of natural hazards on vulnerable communities and countries through sustainable natural resource management. • **Assessment**: UNEP conducts field-based scientific assessments to identify the environmental risks to human health, livelihoods, and security following conflicts, disasters, and industrial accidents. • **Recovery**: In the aftermath of a crisis, implementation of environmental recovery programmes through field-based project offices to support long-term stability and sustainable development. • **Cooperation for peacebuilding**: It is aimed to use environmental cooperation to transform the risks of conflict over resources into opportunities for peace.

Table 8.9: Thematic Priorities and Goals of UNEP.—cont'd

Priorities of UNEP	
Ecosystem management	• **Making the case**: Promotion of the ecosystem management approach and explanation of its advantages for development. • **Restoration and management**: UNEP develops and tests tools and methodologies for national governments and regions to restore and manage ecosystems. • **Development and investment**: Providing help to national governments, in order to integrate ecosystem services into development planning and investment decisions.
Environmental governance	• **Sound science for decision making**: Reviewing global environmental trends and emerging issues and bringing these findings to policy forums. • **International cooperation**: UNEP helps countries cooperate to achieve agreed environmental priorities and supports efforts to implement new international environmental laws and standards. • **National development planning**: Promoting integration of environmental sustainability into regional and national development policies. • **International policy setting and technical assistance**: UNEP works with countries and other stakeholders to strengthen their laws and institutions, helping them achieve environmental goals, targets, and objectives.
Chemicals and waste	• **Scientific assessments**: Global assessments of the environmental impacts of harmful substances and awareness raising. • **Legal instruments**: UNEP assists governments to develop appropriate policy and control systems for harmful substances. • **National implementation**: UNEP provides the tools, methodologies, and technical assistance to help countries design, finance, and implement national programs, which improve assessment and management of harmful substances and hazardous waste. • **Monitoring and evaluation**: Promotion of best practice for monitoring and evaluating the progress of national programmes.
Resource efficiency	• **Assessing critical trends**: Assessments and reports on trends in how resources are extracted, processed, consumed, and disposed of. • **Building capacity for policy action**: Work with partners from government, city authorities, and the research community to develop policy tools and instruments that lead to more resource-efficient societies. • **Seizing investment opportunities**: UNEP forges expert networks and industry partnerships. These collaborations help small and large businesses adopt resource-efficient technologies. • **Stimulating demand for resource-efficient goods and services**: UNEP develops consumer and procurer information tools, market incentives, and public—private initiatives to promote sustainable lifestyles and value chains.

Apart from the general directions given by UNEP and the relevant projects, there are numerous regional and national policies for the environment. In the United States, the Environmental Protection Agency (EPA) is a major organization which aims at protecting the environment and health of citizens. EPA develops and enforces regulations on environmental issues, gives grants for implementing environmental programs, and studies environmental issues through a big network of laboratories and monitoring stations. EPA is activated to the whole range of environmental issues, namely: Air, Chemicals and Toxics, Climate Change, Emergencies, Greener Living, Health and Safety, Land and Cleanup, Pesticides, Waste, Water. EPA receives generous funding and this is a major cause for the high impact of its activities and its global reputation. In 2014 the EPA's costs of operation were $8.5 billion [124]. It should be noted that the budget of UNEP for the same year was $630 million. The mission of the two organizations is different. However, taking into account that UNEP coordinates environmental programs worldwide, the great difference in the budgets is an indicator of the particularly heterogeneous exercise of environmental policy among the world.

Finally, it is worth mentioning a central policy of the European Union, aiming at confronting climate change. This is the well-known "climate and energy package 2020," which contains the "20-20-20" target setting three objectives for 2020:

- a 20% reduction in EU GHG emissions from 1990 levels,
- raising the share of EU energy consumption produced from renewable resources to 20%, and
- a 20% improvement in the EU's energy efficiency.

Although the "20-20-20" target is based on the will for environmental protection and climate change alleviation, it is a typical example of environment—development interactions. More specifically, all EU member states, according to the 2009/28/EC Directive, were obliged to set binding national targets for raising the share of renewables in their energy consumption. Obviously, a great amount of investments is needed, in order to achieve these targets and hence, the climate and energy package has strong implications on development across the European Union.

It seems that Europe has been particularly successful in parts of its environmental policy—compared to other regions of the world—and the "20-20-20" has played a positive role toward this success. Between 1995 and 2011, the European Union has been the only region globally that achieved reduction of CO_2 emissions, at a percentage of 5%. The overall share of renewables in 2012 within the the European Union was 14.1%, compared to 6% in 1997 [125].

The strong environment and development interactions may affect the EU policies after 2020. Ambitious targets have been set by the the European Union for 2030, such as

increasing the share of renewable to 27% and achieving 30% energy savings. However, recession/crisis phenomena are still present within the the European Union and they, de facto, set restrictions in environmentally friendly strategies, which demand high investment costs.

8.6.2 Tools for Supporting Environment/Development Issues and Policies

Environmental Impact Assessment

The multifariousness of the environment—perceived as a whole—has already been noted. Furthermore, the inevitability of the human action(s) and intervention within this multidimensional environment has also been clearly discussed. That is, the developmental process, involving human activities, projects, and works, is viewed as an inescapable necessity.

However, this necessity—being attributed to the development-related activities—is not to be accompanied by the potential adverse environmental implications that these activities entail. One kind of dealing with this situation is through some means of preestimating these implications. The pertinent history goes back to the enactment of the National Environmental Policy Act of 1969,[5] where the newly created tool (then) of *Environmental Impact Assessment* (*EIA*) was envisioned to be of use for federal agencies with the aim of integrating the socioeconomic aspects of development with environmental concerns [126]. Since then, "EIA systems have been set up worldwide and become a powerful environmental safeguard in the project planning process" [127]. In the context of the European Union, the EIA has been introduced with the European Union Directive (85/337/EEC) on Environmental Impact Assessments[6] and has been amended through time (eg, Directive 2011/92/EU).

In a rather generic definition, EIA is "the process of identifying the environmental consequences of human activities, before those activities begin" [128: 1]. More specifically, EIA's main focus is to anticipate the important consequences from proposed projects on biophysical (soils, flora, fauna, etc.), built (settlements, infrastructures, etc.), socioeconomic (education, health care, recreation services, etc.), and cultural systems (art, beliefs, etc.). A much more detailed definition is furnished by Lawrence ([129: 7]—different levels of bullet/indentation added by the authors) [129], whereby EIA is treated as:

"a systematic process of:

- Determining and managing (identifying, describing, measuring, predicting, interpreting, integrating, communicating, involving and controlling) the

[5] National Environmental Policy Act, 42 United States Code Sections 4321–4370.

[6] Council Directive 85/337/EEC on the Assessment of the Effects of Certain Public and Private Projects on the Environment (1985-06-27) from Eur-Lex. Available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31985L0337:EN:HTML.

- Potential (or real) impacts (direct and indirect, individual and cumulating, likelihood of occurrence) of
  - Proposed or existing human actions (projects, plans, programs, legislation, activities) and their alternatives on the
    - Environment (physical, chemical, biological, ecological, human health, cultural, social, economic, built and interrelations)"

In practice, there are several key stages involved in the EIA process: from the initial stages of Project Preparation, Screening and Scoping—to the Environmental Studies, Review of Adequacy of the Environmental Information, Consideration of the Environmental Information by the Competent Authority before Making Development Consent Decision, the Announcement of Decision and the Post-Decision Monitoring (to mention only some of these stages) [130].

Yet, despite the formalities suggested and the considerable attention that it appears to be given to the environmental consequences that emerge from various proposed human actions, projects, etc., the EIA is not a panacea. There are several caveats compromising the reliability and scientific adequacy of the EIA process. Wright et al. [131] stress out the fact that the limited time for the completion of EIAs to meet legislative deadlines, the cost-reduction strategies, and a lack of impartiality degrade the results of the process. In such an approach—which is usually far from being scientifically rigorous—a habitual treatment of topics of the utmost importance is favored and cultivated, "perpetuating previous misconceptions and analytical flaws"; instances of negligence of nonlethal/nonsignificant environmental impacts, along with instances of dismissal of the cumulative effects that nonsignificant impacts may induce are indicative of the frivolous and, from time to time, opportunistic character of the EIAs [131: 72]. Although one could assert that such problems occur only in practice, the way our socioeconomic systems are structured—promoting the call for rapid and inexpensive solutions—makes it plausible to claim that these problems shift even toward the very core of the EIA process. The major pitfall here is the false sense of security and of environmental safeguarding that the abiding by the legislative imperatives and completion of EIAs entail. Since our security and well-being is conditioned to a great extent by the health of our environment [132], the naïve reliance on (socially constructed) conventions which do not intend to describe the actual environmental conditions in a genuinely scientific manner is deemed at least insufficient. The acknowledgment that "financial constraints are real logistical challenges and that workloads are continually increasing" along with the revealing of "ever-more complex relationships between human activities and their consequences […] and the impact on animals, species or habitats" [131: 75] does not justify or legitimize an easy way-out, that is adjusting EIAs to our own desires.

Remote sensing for environmental applications

The abundant, multifarious, and extremely variable—temporally and spatially—physical, chemical, biological, and human components of the Earth's environment involve highly complex interactions and feedbacks, rendering our environment a highly dynamic system [133]. Managing the entirety of the biophysical and human environment requires, at first, the inventorying of a variety of elements that constitute it. Yet, the vastness and the inconstancy of these elements call for methods and techniques that enable us to acquire information about the cover of the Earth surface without being in direct contact with it.

Toward this direction, *Remote Sensing* can be of significant aid. As Jensen [134] states: "Remote Sensing is the art and science of obtaining information about an object without being in direct physical contact with the object" and it "can be used to measure and monitor important biophysical characteristics and human activities on Earth." Typically, the electromagnetic radiation carries the input information in the Remote Sensing system, while the output information of such a system can be either an image directly representing the scene being viewed, or it can occur by further analysis and interpretation [135]. In practice, this information acquired by Remote Sensing methods provide us with several capabilities which range from: (1) observation and identification of natural features or patterns, (2) analysis and measurement of various biological and physical variables, (3) mapping the geographic location, spatial extent, and distributions of physical features and of biophysical variables, (4) monitoring of how these mapped features and variables vary over time (and space), up to the (5) support of decision making by resorting to all the previous capabilities [136].

The previously mentioned capabilities encompass various aspects of the biophysical environment such as vegetation and soil cover, geologic composition and structure, water surfaces' and hydrology's characteristics, etc., but they also extend to the human or built environment. In the following, we refer to some of the Remote Sensing applications which typically harness satellite imagery and address issues pertaining to these various aspects of the environment.[7]

Managing the natural/biophysical environment

There are several Remote Sensing applications pertaining to the management of the natural (biotic and abiotic) environment:

Biotic Environment: Remote sensing methods are often utilized to furnish spatial, temporal, and thematic information about living organisms. This information can range from the detection of large mammals' occurrence to the identification of larger features

[7] It should be noted that we refer only to aspects of the environment located *on* the Earth's Surface. Thus, we do not include the observation of what is above its surface (eg, clouds, aerosols, etc.).

habitat types, land covers, and landscape patterns [136]. Knowledge about vegetation species, spatial patterns, and modifications in phenological cycles can be derived by several vegetation indices/transformation processes and landscape ecology metrics based on remote sensing inputs and digital image analyses [134,137]. Spatial patterning quantification in landscapes and especially in forests has been a core matter of much of ecological, forestry, and management-related research, while "the technological and conceptual advances in remote sensing have shaped the way landscape ecologists […] conduct research," ie, "using landscape metrics or landscape pattern indices" [138: 174]. Moreover, applications regarding the more generic issue of managing the biological diversity "include land cover and land use change, grassland conditions, oil-spill cleanup, wildfire fighting, monitoring of fire scars in tropical forests, postfire recovery, and changes in fragmentation patterns" [136: 9]. In an even more generic sense, as Franklin [139: 1] states, Remote Sensing has been developed as a foundation for a transdisciplinary approach to biodiversity and wildlife management and this new approach relies "on the capability to derive multispectral views of environment at multiple spatial and temporal scales, which are readily integrated with other forms of data, including Global Positioning Systems (GPS) and Geographical Information Systems (GIS)" in order to produce suitable models and visualizations and ultimately "explore solutions to previously intractable environmental science and management problems."

Aquatic Environment: Another important domain of Remote Sense applications for environmental management refers to water. Needless to offer an argumentation, information about its quality, quantity, extent, and geographic distribution is vital. Water (or hydrologic) parameters can be collected via in situ point measurements, but, typically, they cannot afford statistically significant distribution geovisualizations because these point measurements are usually sparse and insufficient to infer regional geographic patterns [140]. According to Jensen [134], the most important hydrologic parameters or variables pertain mainly to the: surface extent of water bodies, water (biochemical) components, water-surface temperature, water depth, snow and ice-surface cover, cloud cover, precipitation and water vapor—and it is hard to obtain regional information about these crucial variables by means of in situ point observations. However, by harnessing the merits of Remote Sensing, it is possible to map river channel morphology and in-stream habitat [141], to identify "spatial–temporal patterns of snow cover across large areas in inaccessible terrain, providing useful information on a critical component of the hydrological cycle" [142] or to detect changes in wetlands using time-series vegetation indices derived from multitemporal satellite imagery [143]—to mention only a few out of a multitude of applications for inland water observation and monitoring. Besides, the investigation of the oceans' dynamic processes—ie, the study of their changes in terms of their biological, chemical, and physical properties and in terms of the oceans' interactions

the atmosphere, cryosphere, and land—can be now realized on a global level by dint of the utilization of satellite Remote Sensing methods [144].

Rocks and Soils: The soil, geological, and geomorphological aspects of the environment of an area significantly affect the properties of the latter. Remote sensing methods can be employed to identify the "chemical composition of rocks and minerals that are on the Earth's surface and not completely covered by dense vegetation" [134: 507]. More recent papers cover the literature review on geological remote sensing approaches, satellite imagery selection, and applications [145] or suggest methods for the enhanced detection of lithological and hydrothermal alteration patterns and regional mineral exploration [146]. Moreover, the spatial structure or the 3D features of "the Earth's surface formed by natural processes" [134: 529] that is, geomorphology and landforms, respectively, can be extracted, classified, and mapped by means of Remote Sensing and GIS methods/techniques [147,148]. Remotely sensed images can also aid in measuring the soil properties and in soil mapping in an essential means—as well as in landform mapping [149]. Notwithstanding the "theoretical" importance and value of registering such kind of information, lithological/geological, landform/geomorphological, and soil mapping do have many practical bearings that are able to affect entities other than the nonliving ones, ie, living organisms and the humans. For instance, Bocco et al. [150,151] have explored the contribution of geomorphologic mapping resulting from the integrated Remote Sensing/GIS approaches in enabling/enhancing natural resource management and in ameliorating land use planning in developing countries.

Actually, the majority of the applications of Remote Sensing for all the previous domains can and usually has further implications on the human environment, and, specifically, on people. However, there are some applications that focus directly in observing and monitoring the built environment.

Managing the human/built environment

Urban Growth and Sprawl: One of the most essential issues relating to the built environment is the delineation of its spatial extent and the registering of its development—through time. The study of urban growth is subsumed in the subdiscipline of urban geography and its main focus is on cities and towns and on how they expand in physical and demographic terms [152]. Gatrell and Jensen [153] stress out the significance and effectiveness of the Remote Sensing methods in exhibiting the interactions between people and their urban environments. More precisely, assets of greatly relying on Remote Sensing are the rapidity of image acquiring over extended areas, the capability of getting large multitemporal data sets, the advancements in digital processing and analysis, and the potential of integration with GIS, etc. [154]. In a more specific sense, Donnay et al. [155: 7]

ascribe to the Remote Sensing the task of "detection, identification, and analysis of urban features" in order to produce data sets pertaining to:

1. "the location and extent of urban areas;
2. the nature and spatial distribution of different land use categories within urban areas;
3. the primary transportation networks and related infrastructure;
4. various census-related statistics and socio-economic indicators;
5. the 3-D structure of urban areas for telecommunications (inter-visibility) and Environmental Impact Assessment (EIA) studies; and
6. the ability to monitor changes in these features over time."

In practice, Remote Sensing data enable us to detect and measure features related to the land use/land cover and morphology of the urban area [152,156,157]. Elements pertaining to the land use/land cover are "'urban' pixels that form the basis of many remote sensing analyses consist typically of developed and impervious surfaces (pixels) that include built structures, concrete, asphalt, runways, and buildings" [152: 4], whereas features related to the morphology refer to parameters such as shape, density, and texture [156,157]. Yet, since urban areas may also encompass a multitude of nonimpervious, nonbuilt pixels such as parklands and urban forests while at the same time may rule out developments concerning other land-uses [158], and because of the distinct and complex spatial structures and functions in urban areas, Bhatta [152] labels the latter as urban ecosystems or landscapes. In this respect, an urban ecosystem or landscape can be seen to "integrate physical, social, economic, ecological, environmental, infrastructure and institutional subsystems [while] urban growth and sprawl is an outcome of change in performance/functioning of these subsystems" [152: 6].

Therefore, maybe the most significant advantage of Remote Sensing data in urban applications is the monitoring of urban development "[…] to determine the type, amount, and location of land conversion," especially in cases "of rapid land-use changes where the updating of information is tedious and time-consuming via traditional surveying and mapping approaches." [152: 51]. Another very important technical issue in urban Remote Sensing is the spatial resolution of the image data [159]. In this perspective, major advances in both the temporal and the spatial resolution of satellite imagery (large time-series of images and image resolutions of less than 1 m respectively) over the last years, now furnish a high potential in the management of the built environment.

The pertinent literature teams with research studies regarding the utilization of Remote Sensing to monitor urban expansion and land-use changes [160–162]. The study of the urban expansion is a matter of high significance by itself. Nonetheless, there are specific cases where this expansion is so rapid and "irregular"—leading to the encroachment of large proportions of farmland and forest, traffic problems, and other environmental

problems [152]. The geospatial patterns accompanying urban development "out of control" are deemed as urban sprawl [163]. The harnessing of Remote Sensing data and the implementation of respective methods and techniques do can and should aid in managing this special issue of sprawling which entangles a multitude of detrimental environmental effects for the urban landscape.

Enhancing (Human) Livelihoods by Managing the Nonhuman Environment: There are some other domains where Remote Sensing can contribute indirectly to the human well-being and development. In the previous sections, the issues of poverty and hunger have been addressed as being closely intertwined with human development. Food security and famine, in particular, are dimensions that have long ago been considered: Since 1986, the US Agency for International Development (USAID) has developed and promoted the Famine Early Warning System (FEWS) "to provide information on food security of communities in semi-arid regions so that such a widespread catastrophe does not occur again" [164: 3]. Granted that (governmental) strategies and policies of early and proper intervention can facilitate the detachment of the linkage between the climate extremes and famine [165], it is vital that we employ methods of acquiring and processing relevant data and information in handy manners.

"The development of remote sensing systems to monitor environmental conditions has offered for the first time a way to monitor current climate variations over entire continents for very little expense" [164: 4]. This development has occurred in a variety of ways, enhancing its potential to support agricultural management, thus allowing "a more accurate analysis and interpretation of the Remote Sensing data in terms of: type of crop, soil type, state of growth, and presence of disease" [166]. It should be noticed, though, that the elements and phenomena pertaining to the state and the evolution of agriculture, food security, and famine are multifarious and are interrelated in intricate means. Valuable information about environmental conditions, in general, can be gained through the combination of remotely sensed data and other data types for estimating the impacts on the agriculture-related issues and farmer's livelihoods [167]. More specifically, "[s]igns of imminent famine can be identified by combining remotely sensed data, precipitation data, and surface water data to characterize and model hazards threatening vulnerable livelihoods" [167: 18].

As mentioned above, field-based hydrological data are point-based and dispersed, not being able to provide sufficient regionalized information. Similarly, hydrometeorological data are sparsely distributed in space and are not capable of furnishing information in (near) real time and, thus, of effectively predicting famine, but, fortunately, "[r]emotely sensed data, combined with numerical modeling and GIS, are important tools for FEWS NET" [167: 18]. For instance, the research paper of Ratnasari and Kusumawardani [168] focuses on how food insecurity can be estimated in spatial terms through (1) remotely

sensed image manipulation—approximating crop failure potential level and the erosion potential—and (2) GIS utilization—determining the erosion potential due to rainfall and slope that can be obtained from spatial interpolation of point-based measurements regarding rainfall and elevation.

GIS integration for environmental applications

Thus far, it has occurred that Geographical Information Systems are closely associated with Remote Sensing in addressing various environmental issues. There are several definitions for GISs; yet, according to a relatively broad one, a GIS is an integrated system of effective capture, storage, retrieval, processing, analysis, and visualization of information pertaining to affairs that are inherently geographical, depending on the specified requirements of various users [169–171]. In this respect, it appears that GIS serves in incorporating Remote Sensing data, methods, and techniques—when it comes to environmental applications. Since Remote sensing is a tool extracting valuable information about geographic objects, entities, or areas, it provides a type of information that "functions in harmony with other spatial data-collection techniques or tools of the mapping sciences, including cartography and GIS" [152: 10]. In other words, remotely sensed data afford "thematic and metric information" (about diversified domains of interest—soils, geomorphology, hydrology, land cover, etc.)—"making it ready for input into GIS" [135: 9].

Such theses regarding integration have been endorsed in an even stronger and explicit means by Rokos [172: 151]: "the most appropriate methods and techniques for the systematic, holistic and dynamic observation and monitoring of the global changes are those that can integrate the capabilities of the Remote Sensing and of the Land and Environment Information Systems." In order to "read" the environment as a holistic, global system, one needs to adapt models—abstractions or simplifications of the reality—that furnish insights about both its biophysical and socioeconomic dimensions [171,173,174]. Now, by fusing GISs and Remote Sensing in the context of environmental modeling, Skidmore [171: 5] cites some examples of applications, including:

> *monitoring of deforestation, agro-ecological zonation, ozone layer depletion, food early warning systems, monitoring of large atmospheric-oceanic anomalies such as El Nino, climate and weather prediction, ocean mapping and monitoring, wetland degradation, vegetation mapping, soil mapping, natural disaster and hazard assessment and mapping, and land cover maps.*

Recent literature further endorses such kind of integration by dint of its being rather necessary and suitable both in theory and in practice [168,175,176]. In any case, one should bear in mind the multiple benefits of Remote Sensing for environmental applications—as demonstrated in the previous sections. Yet, it is the GISs' analytical

capacity that enables the decision making, planning, and management in environmental-related issues [171].

8.7 Alternative Concepts and Pathways

8.7.1 Ethical–Philosophical Issues

The present section is not dedicated to advocate a certain ethical/moral thesis, or even to outline and evaluate such kind of theses. However, when it comes to the election and/or the assessment of development approaches and strategies, it appears more than necessary to draw upon crucial issues of environmental ethics and philosophy.

Future generations

The modern concept of sustainable development stems from the UN Brundtland Report. In the latter, it has been explicitly stated that "[h]umanity has the ability to make development sustainable—to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs" [23: 8]. Through this definition, the issue of future generations arises. In other words, the crucial question emerges: Do we have *any* obligations to the posterity with reference to our development strategies and their subsequent long-term environmental impacts? Moreover, of what kind are these obligations (if we have any) toward them and, thereof, should we regulate our actions and steer our options taking into consideration the needs and desires of the future generations?

There is a widespread assumption whereby the advancement of science and technology is propelling progress in a manner that future generations will benefit. Yet, this assumption according to which one need not worry about the posterity is faulty and problematic since current trends of success (eg, in terms of productivity and of food availability) are to be abated in the future (eg, due to the forthcoming shortage of freshwater and land degradation) [177]. Therefore, granted that there are some absolute resource-based limits to the progress and to its capacity to sustain the needs of future generations, this technological optimist perspective is shown to fail. Even worse (for the technological optimist), just "[b]ecause of advances in science and technology, the current generation may bear a greater burden of moral responsibility toward its successors than that of any previous generation" [178: 444]. In this respect, progress by itself not only does not resolve the core matter of the sustainability—delivering us from the burden of weighing our present choices—but it does further charge us with the grave moral responsibility of caring for our successors. As Partridge [179] puts it, the state of both being able to predict the future outcomes and having the capacity to affect them set us to the position of being morally responsible.

But things are getting more complicated when one is wondering *what* our obligations to future generations are. Certainly, concerns about intragenerational equity and our obligations to the today's world's poor in specific "are [important] issues in the environmental ethics, because our reaction to nutritional needs in an expanding human population affects the total impact of human beings on the environment" [180: 11]. Herein, we take for granted such obligations to our contemporaries. Yet, contrary to the ordinary belief that our responsibilities to them is analogous to the responsibilities to future generations, philosophers "recognize that future persons have a moral, epistemological, and even ontological status that is radically different from the status of our contemporaries" [181: 444]. The future persons' contingent existence, their potential (active/passive) rights, and the nonreciprocal relationship between us and them are indicative of this different status [181]. Nevertheless, this stark discrepancy in their status should not pose insurmountable barriers in coming up with strategies that have a practical bearing. For instance, Partridge, and Callicott and Frodeman [181,182] propose some policy guidelines for sustainable future such as: "Leaving 'Enough and as Good,'" "Do No Harm," and "Doing Well by Doing Good."

Responsibilities to nonhumans

So far, the interest of assessing the environmental ethics has been on the well-being of our contemporaries or of future generations. Yet, aside from considering the impacts/benefits on human beings from environmental degradation/conservation, which is concentrating on *anthropocentric concerns*, there are also *nonanthropocentric concerns* involved in the domain of environmental ethics. The latter concerns are "about nonhuman lives and live forms for their sake rather than for our own" [180: 13]. Traditionally, ethics "was focusing on the obligations of humans to other humans, because until now it was deemed that only human beings and the granting of their interests have an inherent (intrinsic) value" [180: 38]—while other living and nonliving entities have only an utilitarian value. But an expanding shift appears to have been/be taking place regarding the spatiotemporal boundaries of ethics. As Nash [181] theorizes, ethics has been historically evolved from merely attending to the individual interests toward encompassing the whole human race at the present time; according to his hypothesis, this ethical perspective is to be broadened even to the point of integrating all the living and nonliving things, ultimately enveloping the universe as a whole.

Irrespective of how extreme such a perspective may (seem to) be, certain criteria are required for a being or entity to be included in the "ethical/moral community," ie, to be morally considerable. As it can be reasonably presumed, the criteria for such moral considerability "are multiple, complex, and sometimes intensely disputable" [183: 42]. One criterion for moral considerability is the existence of benefit or interest (eg, welfare) for an entity [182]. Another criterion is that of complexity—in terms of the level/degree of the organization of matter. Now, humans clearly satisfy both criteria. But, to tell that living

beings other than humans are excluded from having interests because these nonhuman interests differ from the human ones equals to the adoption of a sheer anthropocentric, or the *basic human chauvinism*, principle [183,184]. So, in a rather broad sense, animals and plants might be said to satisfy these two criteria, albeit, in more strict terms, this is not the case for the latter, owing to the fact that they do not have desires, intentionality, and self-consciousness [183,185]. However, the argument whereby intentionality is not a prerequisite for the existence of interest or benefit—eg, "a tree […] can see its 'interest' for continuing and unencumbered existence to be satisfied" [183: 43]—can be extrapolated to nonliving entities of nature like rocks, mountains, rivers, and stalactites [186]. Such entities can be alleged to promote "their own good" by dint of organizing and structuring the matter that are consisted of, but the case of ascribing to the organization of organic/biological matter a higher moral status than to the structuring of inorganic materials can be condemned as a kind of biological chauvinism or bio-chauvinism [187]. A milder version for assigning an intrinsic value to nonhuman entities is related to the line of reasoning that they are potentially morally (or aesthetically) considerable, simply because they exist [188,189].

Further remarks

Even from this elementary examination of these two (human and nonhuman) dimensions of the environment, the difficulty and the perplexity of deciding about our moral obligation toward the posterity and the nonhuman entities is apparent. Certainly, there is a series of environmental ethics' issues, but Papadimitriou [190] subsumes them under four basic conceptual dualisms that arise in the pertinent domain, namely: anthropocentricism versus nonanthropocentricism, instrumental versus intrinsic values, individualistic versus holistic perspectives, and shallow/deep ecology. As for the first case of dualism, it is pointed out that one cannot just discard nonanthropocentric concerns neither in principle, nor in practice. However, it is worth noticing that, as Norton [191] suggests, it may not be necessary to embrace altogether the intrinsic value of the environment in a venture to preserve it as a whole. In this sense, it might be possible for the human race to live in harmonic coexistence with the rest of the nature without adopting a biocentric perspective, but by merely being compelled to conform to the ideal of harmonic coexistence through proper social structuring and mechanisms [183,194].

This weak version of anthropocentrism does not comply with deep ecological principles; nonetheless, it is in line with more holistic approaches. The WCED's declarations for intra- and intergenerational equity strategies have emerged within the stream of weak anthropocentrism. Yet, the problem of environmental ethics remains both in principle and in practice. How can we ensure the respect toward the environment in a holistic manner merely by means of socially oriented coercion, that is, without appealing to the intrinsic value of nonhuman entities (including the intrinsic value that is possibly derived by their

interrelations) and to a more radical reformation of the human conscience and behavior based on the awareness of the fundamental unity between the self and the nature? Could it be that it is solely the standard Judeo-Christian tradition and Western ethical theory that have promoted this "human chauvinism" [186,192], or that our very (human) nature urges us to conceive the rest of our environment as inferior to ourselves, shaping behaviors that may incur destruction and annihilation? As it seems, such clear-cut distinctions cannot grasp the multifariousness of the matter, albeit there are historical cases that can verify the former or the latter ends of this "moral gamut."

These crucial moral-philosophical questions comprise the departing point for the rest of this section. In the remainder, we proceed with the critical evaluation of the dominant political and socioeconomic structuring and patterns that are intermingled with the current status and trends for the policies regarding the relationship between environment and development. Moreover, we adduce and describe some alternative concepts and pathways in an attempt to put forward alternative development strategies which may be beneficiary for the rest of humanity, the posterity, and the environment as a whole.

8.7.2 An Alternative Development Paradigm

In this final section the framework of an alternative development paradigm, as well as a proposed planning methodology according to it are presented.

There are many ways to categorize development thinking through time. Potter et al. [12: 82] suggested here that four major approaches to the examination of development theory can be recognized. The four approaches are:

- the classical—traditional approach,
- the historical—empirical approach,
- the radical—political economy—dependency approach, and
- alternative and bottom-up approaches.

Development theories and strategies have been many and varied, with new approaches generally being added alongside existing ones. Classical and neoclassical economic approaches generally stress the need for unrestrained, polarized growth and of letting the market decide for itself. Neoliberalism as a generic development paradigm stems from the New Right and emphasizes what is seen as the continuing need for market liberalization and for the economy to be market- and performance-driven. Historical models give a normative impression of the degree to which in the past, since mercantilism and colonialism, development has been highly uneven and spatially polarized. Both dependency (radical) approaches and alternative/another development can be seen as direct critiques of modernization theory. Thus, the economic growth paradigm of the 1950s was challenged by socialist and environmentally oriented paradigms in the 1960s and 1970s, respectively [12].

While much alternative development thinking makes a diffuse impression, this has gradually been giving way to a sharper and more assertive positioning on account of several trends [1: 89]:

- The enormous growth of NGOs in numbers and influence generates a growing demand for strategy and, therefore, theory.
- The importance of environmental concerns and sustainability has weakened the economic growth paradigm and given boost to alternative and ecological economics.
- The glaring failure of several development decades further unsettles the mainstream paradigm of growth.
- The growing challenges to the Bretton Woods institutions lead to the question of whether these criticisms are merely procedural and institutional (for more participation and democratization) or whether they involve fundamentally different principles.

Based on the previous approaches, a country is considered "developed" even if it has an increasingly large percentage of citizens living below poverty line, unemployed, underemployed, and marginalized; even if the quality of social services, education health, and security is constantly degrading; even if the private interests gradually replace even the most obvious government responsibilities; whether insecurity, alienation, racism, xenophobia, nationalism in its most hideous form, prostitution, drugs, crime, and interweaving economic and political interests grow bigger; even if ignorance, illiteracy, inequality of any type, and the progressive decline of the multidimensional educational and cultural aspect of education in a one-dimensional technical–vocational training and retraining are getting more and more alarming.

Many scientists, economists, sociologists, biologists, engineers, philosophers have tried and are currently attempting to challenge this approach from different perspectives, directly or indirectly, through their noninstitutional works, without having managed to establish a coherent alternative theory on development. Thus, it appears as a sine qua non priority the need of forming a mutually acceptable interdisciplinary and integrated theory for development, which is keeping up with the multidimensional and comprehensive nature of physical and socioeconomic reality [11]. The challenge is to define a development mode that not only combines social needs, economic needs, and environmental needs, but also gives a meaning to the lives of the individuals in a society [193]. In this context, Rokos' proposal perceives development as "a 'better' balance of social and human relations and land use systems, of production, employment, distribution and consumption, according to the values and choices of the forces in power as these coexist combatant and interact at the natural environment, each time according to the particular social dynamic and average social consciousness" [11].

Rokos [11] considers that development can only be an organic "whole" of the multidimensional and complex relations; interactions and interdependencies of economic,

social, political, cultural, and technical/technological energetics; and efforts to achieve this evaluative/axiological "better" balance that is different each time for people and societies. Thus, the objective concept of the "whole" of development cannot be fragmented in the particularism of the thematic/sectoral forms (economic, agricultural, industrial, etc.), ignoring the impact of their activities on the natural (ie, biophysical) environment and the political, social, and cultural field. It cannot be contained in a certain room, in a state, or a region, ignoring what this means for the broader international and planetary surrounding. The organic "whole" of development cannot be restricted in the time limits of a small or large, one-dimensional or multidimensional, national or supernational planning or project; neither sustainable development can be characterized as integrated because of the partiality of its conception since its main foundation is economic competitiveness and sustainability of companies.

That is why Rokos [11] envisions a Worth-Living Integrated Development (WID), namely that kind of development which exists simultaneously and over time at global, supernational, national, regional, and local level, in economy, society, policy, culture, and technology. This kind of development only exists in dialectical harmony and always with respect toward humanity, its age-old noble values, and the "whole" of the natural and cultural environment, in which man fits peacefully and creatively as integral but not as the dominant part. Integrated Development can only exist:

- when citizens of the world understand and believe that development cannot be only "economic" or even state centric, partially centric, Eurocentric, or bank centric, but concerns all aspects of life and is their duty and responsibility to take their lives into their own hands and fight for it,
- when citizens understand that economy, society, and politics have no value without morality, and
- when they take the actual share of responsibility for the present state of things, as actors, accomplices, or just spectators of events of a truncated social, economic, and political democracy.

WID should be always in dialectical harmony and with respect toward human beings and their natural and cultural environment, in which they behave as their integral parts and not as owners, "investors," and exploiters [11,194]. And, of course, WID presupposes respect and equality among human beings. And this is the radical difference between sustainable and Worth-living Integrated Development, since the supporters of sustainable development are, in the best case, used for the fiercest exploitation of human beings by other human beings, in the name of progress and neoliberal globalization in the era of the absolute dominance of rapacious markets [195].

The alternative way for a WID involves the principles of interdisciplinary and integrated approach, study, research, analysis, and treatment of the objectively

complex and multidimensional environmental and development problems in their political, cultural, economic, technical/technological dimension. This requires as instruments a common code of communication, of sciences, of perceptions, beliefs and ideas, and also a free, emancipated consultation, documentation, acceptance, agreement, and commitment on the way to a WID as a way-out of the total, global, and multidimensional crisis. This alternative path is based on the conscious, sensitive, responsible, active citizens (producers, creators, workers, scientists, professionals) and their freely coordinated collectives, to their cooperatives and collective initiatives, partnerships and actions: of social solidarity, of integrated land consolidations, integrated production units, standardization, processing, distribution, and exchange of local products of certified quality and institutions of free education, culture, research, and technology in constant collaboration with universities and institutes of technology.

Consequently, Rokos [196] has developed an interdisciplinary and holistic methodology concerning development in accordance with the philosophy, principles, and values of WID. The processes and phases of actions needed in the proposed methodology follow the steps listed below:

- Stakeholders of local development initiatives should document, agree, and accept in an interdisciplinary and holistic way the principles, values, goals, actions, and practices of WID as the optimum choice. The core of the methodological approach is the definition of the purpose, philosophy, principles, and values of development theory, in a dialectical relation with the quantities and qualities of the elements constituting natural and socioeconomic reality, as well as with the relevant problems, the real potentials, and objective constraints. The purpose of development, according to Rokos [196] should be the simultaneous—in space and time—appropriate economic, social, political, cultural, and technical/technological development, which will be performed in a dialectical harmony with human, as the latter is historically, peacefully, and creatively integrated to natural and cultural environment, as an organic and integral part and not as a master, owner, or exploiter.
- The necessary Integrated Surveys research and studies of the natural and socioeconomic reality of a region and the systematic monitoring of its changes through time should be conducted. The research should also take into account the dynamics of the multidimensional relationships, interdependences, and interactions between nature and society. The right choice of parameters that determine the economic, social, political, cultural, technical/technological, and natural reality of the study area should be made. Furthermore the adequate methods for recording and monitoring should be applied. The more accurate, real, and reliable the data are, the more valid and safely documented the development policies can be. These basic studies should be organically combined and

supplemented with specific on-site sampling corollaries, researches, and scrutiny, evaluating at the same time local people's indigenous expertise and wisdom.

- The elements/data that constitute the natural and socioeconomic reality of the area should be properly analyzed, evaluating and studying the quantities, qualities, and dialectical relations of the real problems, the objective potentials (perspectives), and constraints for Integrated Development. Proposals for thoroughly carried out researches and studies concerning specific areas or natural resources, confrontation of special issues, as well as the analysis of possible financing sources should be documented.
- Alternative scenarios for Integrated Development of the specific region should be formulated and documented. These scenarios should utilize the certain conditions of reality, confront problems according to local constraints and perspectives, specifying basic development directions—axes (ie, guidelines). They should also have a specific spatial reference and take into account the perceptions, desires, and suggestions of the stakeholders, residents, and emigrants, investigating not only the possible financing sources, but also the availability of the latter to take action and responsibilities, to contribute in a positive way in all levels for the realization of each scenario. The interdisciplinary evaluation of advantages and disadvantages for each scenario as well as between the different scenarios is also required.
- Predicting and evaluating the balance of positive and negative elements of each scenario. Choosing the optimum scenario, according to the purpose of development research, the time frame for their implementation, the social acceptance of individual actions, the constraints, internal and external, which multidimensionally affect the implementation of each scenario,
- The balance between positive and negative elements of each scenario for the Integrated Development of the region should be evaluated and then the optimum scenario should be chosen. This step should take into account the purpose of the research, the time frame for the implementation, social acceptance of individual actions, and internal or external objective constraints (intraregional, interregional, national, European, and international). All of the above factors can and will definitely affect in a multidimensional way, the sizes and qualities as well as the implementation of the outcomes of each scenario.
- Implementation of the optimum Integrated Development scenario for the region, constant monitoring, and feedback. This step includes the integration of all the positive elements from other alternative scenarios in the optimum scenario, constant monitoring and scrutiny of the implementation as well as realization of possible problems, investigation of sizes and qualities, evaluation of their importance, and finally taking over the right feedback initiatives through collective participatory processes.

8.7.3 Alternative Pathways in Practice

It is not easy to find successful cases of development based on alternative approaches in a world dominated by the markets. "Alternative islets" cannot easily be expanded to a wider geographical space without major social changes and/or changes in the productive processes. However, studying them is useful and can enhance the dialogue for overcoming the problems of the current, global development policies.

Energy cooperatives: sustainable energy solution in Costa Rica

Energy cooperatives in Costa Rica (a country with very high shares of renewable energy by the way) mainly focus on rural electrification. Rural electrification in the country is advanced, with over 98% of the nation's population having access to electric power. This is something exceptional for Central America. This achievement related in particular to the cooperatives which have been active since the 1960s. Four cooperatives (Coopelesca, Coope Alfaro Ruiz, Coope Guanacaste, and Coopesantos) operate in the rural regions. The primary objective of these cooperatives is to achieve levels of rural electrification in accordance with the requirements of the law on the participation of rural electrification cooperatives. The four cooperatives are completely self-sustaining and create a surplus on their operations. They are also continually expanding their scope and range of consumer services, for example, into telecommunications, by reinvesting the surplus. The cooperative model in energy production is a very good alternative example for overcoming energy poverty in the developed world. Three of the country's electricity cooperatives—Coopelesca, Coope Guanacaste, and Coopesantos—jointly own a wind farm. A federation of energy cooperatives, Conelectricas R.L., was established in 1989 and is involved on behalf of its members in power generation investment and operations, strategic services and policy advocacy, and various technical services. The energy cooperatives of Costa Rica supply energy to 150,000 customers in rural areas, a really great number. The profit-driven energy companies in a liberalized energy market are rarely interested/involved in rural electrification, since opportunities for profit are found mainly in urban and industrialized areas. In contrast to this situation, cooperative schemes can form the solution for rural electrification.

Marinaleda: radical solutions at the heart of the developed world

Marinaleda is a small town in Andalusia region, in Spain. Since 1979, the town is led by a charismatic major, Juan Manuel Sánchez Gordillo. After a decade of occupations and hunger strikes the citizens of Marinaleda won a 1200-hectare farm from the Duke of Infantado. This property was just one of many instances in Spain of vast estates with arable land fenced off from the area's surrounding, usually starving, population. Villagers of Marinaleda walked 10 miles, every day, to occupy the Duke's land. The police every day evicted them and they returned, peacefully, the next day. In 1991, the Andalusian

government compensated the Duke with an undisclosed sum, and gave it for the people of Marinaleda. They planted the Duke's land, which previously grew nonlabor-intensive crops like sunflowers, with labor-intensive crops like olive trees. The land's exploitation is based on a total cooperative model. The idea was based on the following simple thought: the more labor required, the more jobs would be created. Once the olive trees were grown, an already labor-intensive process, they then had to be processed into oil. This requires a processing plant, and the employment of more workers. The necessary infrastructure was created by the surplus of the agricultural production, which was reinvested. The reinvestment of surplus without chasing profits is ever since the basis of Marinaleda's productive model. The town has nowadays an unemployment rate of 5%, whereas Spain has an unemployment rate of 27%. The cooperative model of Marinaleda is further supported by simple social welfare practices. For example, when a team goes to the farm, other teams stay back in the village for taking care of the children. The farm, known as El Humoso, sells its products internationally. The major claims that even if Marinaleda exists in a capitalist world, by proving that "we can work for reasons other than money" an act of subverting capitalism itself is realized.

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ENVIRONMENT AND DEVELOPMENT

Basic Principles, Human Activities, and Environmental Implications

Edited by **Stavros G. Poulopoulos** (Kazakh-British Technical University, School of Chemical Engineering, Almaty, Republic of Kazakhstan) and **Vassilis J. Inglezakis** (Nazarbayev University, School of Engineering, Department of Chemical Engineering, Astana, Republic of Kazakhstan).

A discussion on the greenhouse effect without considering the matter of energy would be incomplete; a review of nuclear energy without looking at waste disposal solutions would be insufficient. Above all, addressing environmental issues without examining the interpretation, content, and context of development would be futile. Editors Stavros Poulopoulos and Vassilis Inglezakis expound on this premise of human activities and their ongoing and dialectic interactions with the environment in ***Environment and Development: Basic Principles, Human Activities, and Environmental Implications***. Through the use of recent data and case studies, the book explains the connection between human development and the associated reactions in the environment along with engineering solutions proposed to achieve a harmonic coexistence of man and nature. Sustainable development, related research findings, and the relevant international environmental policies are recurring topics throughout.

KEY FEATURES:

- Discusses the various interpretations of the development concept as well as alternative pathways to sustainable development
- Analyzes environmental issues and proposes solutions grounded in recent research findings
- Presents tabulated data and figures to support the analysis and explain the issues presented
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