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Cuba Transition Project

ENVIRONMENTAL CONCERNS FOR A CUBA IN TRANSITION

By

Eudel Eduardo Cepero

INSTITUTE FOR CUBAN AND CUBAN-AMERICAN STUDIES

UNIVERSITY OF MIAMI

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Cuba Transition Project – CTP

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Summary

The ecological costs of the Cuban totalitarian model have yet to be assessed; however, future generations will inevitably have to pay a high price to repair the damage. Among the Cuban archipelago's most serious environmental problems are, in order of importance, soil degradation, deforestation, water pollution and contamination, deterioration of urban environments, and loss of biodiversity.

The only way to avoid increasing Cuba's heavy ecological burden is to establish basic environmental guidelines at the outset of a transition to democracy. These new guidelines should be based upon the principles of sustainable development and be part of a new economic design. During the transition to democracy, there will be three overarching stages or phases for dealing with the country's primary ecological problems: 1) the *environmental emergency phase*, 2) the *institutionalization phase*, and 3) the *sustainability stage*. Each stage will include a logical sequence of actions to allow the understanding (that is, social environmental awareness) required for the timely establishment of a new legal framework, up-to-date regulations, and incentives that will lead to a sustainable development model. At the end of this paper, suggested actions to be taken during each of the three phases are listed.

Soil Degradation

Domestic food production is severely limited and compromised because 60 percent of Cuba's farmlands are affected by soil degradation. Soil erosion affects more than 4 million hectares of farmlands and acidity is widespread in over 1.7 million hectares. Elevated saline and sodium levels exist in more than 1 million hectares. Compaction is present in some 2 million hectares and poor drainage problems are reported in 2.7 million hectares.

Deforestation

The irrational use of forests has become common practice under the Castro regime. As no current data are available on the actual total area of cover forest, the value of Cuba's forest resources is unknown. Most of the

remaining natural forests are in poor condition from being overexploited. An average of 200 forest fires occur each year, affecting some 5,000 hectares of forest. Reforestation has been precarious, due to poor quality seeds, a low survival rate of plantings, and a narrow range of forest species utilized.

Water Pollution and Contamination

Contamination and pollution of freshwater and inshore seawater have increasingly worsened, especially during the past few years. Water quality in most cities has deteriorated for the following reasons: 1) sewage networks are poorly maintained and insufficient to service the population; 2) many more wastewater treatment plants need to be built and the ones that exist are in critically poor repair; and 3) potable water service is deplorable, due to chronic insufficiencies in chlorination and deteriorated facilities for potable water treatment.

Deterioration of Urban Environments

The collection and disposal of solid waste in cities is lacking, as are the hygienic-sanitary conditions of landfills. It is common practice to collect and dispose of hospital waste together with residential garbage. Most facilities that produce hazardous wastes do not have systems in place for treating them. According to official figures, there are more than 2,200 contamination focal points considered to be highly toxic in the country.

Loss of Biodiversity

A substantial, unquantified loss of biodiversity exists, due, among other reasons, to improper management of certain ecosystems, the application of intensive farming, the marketing of endangered species, as well as conditions making it easy for important genetic resources to leave the country. Among the most serious biodiversity losses are the disappearance of substantial numbers of plant and animal species, the reduction of ecosystems, the destruction of coastal environments, and the collapse of urban sanitation systems.

Cuba's environmental status has been compromised, and catastrophes have begun to surface, such as the soil-related disaster involving the

appearance of significant desert areas in some regions of the archipelago. The current situation is the result of a chain of unsustainable actions and factors inflicted on ecosystems, especially during the past 40 years of developmental experiments, characterized by governmental willfulness, irrationality, and stubbornness.

If current negative trends in environmental variables continue, Cuba's national ecological account will fall dangerously close to possible bankruptcy. Tourism and agriculture—economic sectors identified as key to Cuba's future market economy—are based upon key natural resources. If those resources continue to deteriorate, projections for socioeconomic recovery in the medium term will be useless.

The extent of ecological degradation will have to be assessed at the beginning of the transition. After scientists gather that information, they will determine the primary environmental courses of action to be established for recovery. At this time, we can suggest that the following actions be considered, among others:

- Create a structure dedicated to environmental conservation and management within the government design established during the transition period.
- Detect and control the main, most hazardous contamination focal points in the country.
- Review the system of environmental laws and create an interim environmental regulatory instrument that ensures the conservation and sustainable use of the environment during the transition period.
- Establish a national program for basic soil conservation.
- Introduce the compulsory rule: "You Pollute, You Pay."
- Procure funding sources to promote research and environmental cooperation projects.
- Establish the framework and guarantees necessary for the rise and development of independent environmental associations and organizations.
- Promote education and a culture of respect for environmental conservation.

Introduction

Since the early 1960s, Cuba's development model has unsuccessfully attempted to make economic gains by using a centralized military production design. The model was adjusted to compensate for various internal and external political circumstances and decisions were made without regard for their long-term social or ecological costs. Unfortunately, the failed experiment has degenerated into a subsistence economy. Its most dramatic environmental impact[1] in the history of the archipelago has been the creation of desert areas in the provinces of Pinar del Río and Guantánamo, caused by the accelerated artificial transformation of the landscape. This degradation occurred because a nonsustainable economic development model was applied.[2]

A scourge on a national scale, desertification is the extreme example of Cuba's environmental chaos, as acknowledged by the island's authorities themselves: "The truth of the matter is that currently, in 11 of the 14 provinces and in the special municipality of the Isle of Youth, there are vestiges of desertification" (*Granma*, March 13, 2003).

Initiating Cuba's environmental recovery will be a complex endeavor, with courses of action to be determined by the extent of the deterioration, as well as by the economic, political, and social dynamics established during the transition to democracy period. Given the declining prognosis for the Cuban model, it is possible that no significant improvements will occur in the medium term. Instead, it is likely that the environmental situation will become worse.

While attempting to outline the basic course of Cuba's future environmental recovery is an uncertain task, particular current and future environmental problems can be addressed, given the main natural variables: soil, waters, vegetation, wildlife, as well as others arising from the health and sanitation systems, such as water supply, environmental legislation, and the population's basic needs.

When Cuba eventually undergoes a democratic transition, its new leadership can benefit from studying the experiences of the post-totalitarian and post-communist regime transitions. To date, we know that those countries' transitions had three stages:

- First, a period of breaking away from totalitarianism/communism to achieve democracy, followed by nation rebuilding, creation of a new constitutional system, freeing-up of the market, and legalization of private property.
- Second, a stage that established government and administrative institutions, the legal and justice systems, financial organizations, regulatory and incentive systems, and other institutions related to state and nation planning.
- The third phase involves efforts to stabilize the new democracy and to embark on freer trade; creation of an environment that encourages development of a civil society, political parties, independent organizations, reaffirmation of the division of powers, election periods, market competition, and others.

The above stages or cycles determine the type of transition to democracy a government goes through: *radical* if the transition commences with stabilization and liberation or *gradual* if it starts with the transformation of institutions and privatization (Pedersen 2000). At this point, let us consider three environmental protection analysis scenarios. With each one, we will see how a logical prioritizing of the actions should be established, although their order may vary—and may be inverted—depending upon the course of events. The three scenarios will be defined as environmental emergency, institutionalization, and sustainability phases or stages.

The *Environmental Emergency* phase will focus on dealing with critical situations through the design and implementation of a body of temporary regulations and economic incentives. These will launch efforts aimed at soil recovery, reforestation, water decontamination, and reestablishment of environmental sanitation systems. At the same time, it is an essential task of this phase to set up and guarantee a legal framework under which any new environmental organizations could operate.

The *Environmental Institutionalization* phase will have as its basic objectives to establish environmental rights for all citizens of the republic; initiate the creation of new legislation for the protection and use of the environment; begin to establish permanent state environmental regulations, incentives, and policies; and establish priorities for the protection of coastal ecosystems, wildlife, and air quality.

The *Environmental Sustainability* stage will be geared toward establishing final regulations that guarantee the use and protection of the soil, waters, forests, coastal systems, and air, as well as—for biological safety—natural reserve areas and other related issues. During this phase, a national system of environmental standards should be implemented, and the development of the environmental business sector should be facilitated.

A detailed explanation of these three periods constitutes the basis for the analysis in this paper, which, given the constraints of time, space, and the sources consulted in drafting it, should be taken as a limited forecast, valid perhaps as a first uncertain step toward encouraging future and more complete assessments.

Environmental Emergency Phase

The environmental line of thought on which the present Cuban model has been based was initially outlined in the early 1960s and crystallized into national development guidelines at the end of that same decade. On May 21, 1963, Fidel Castro presented the key points of those ideas in a speech given at Moscow's Lomonosov University: "I said to myself: When communism has been built, the stage of social revolutions will have ended, but then a huge, great, infinite revolution will remain to be waged, and that is the revolution against the forces of nature. And the nature revolution will never end!" (*Granma*, November 28, 1967).

The ideas of conquest and subjugation of the natural environment have been at the heart of all the Castro regime's development attempts; they even formed an integral part of the scientific system, when they were incorporated into the research and development guidelines of the Academy of Science of Cuba, as set forth in chapter eight thereof: "The Institute of Geography, at the same time that it should start the plan for the national study and inventory of the country's natural resources, must seek to make a reality the concept of geography as the science of transformation of nature, which converts the seas to land, inlets into freshwater reservoirs, dry areas into wet ones, which transforms unproductive lands into agricultural lands" (*Granma*, January 2, 1968).

This mentality cleared the way for the design and execution of numerous projects that have caused enormous environmental impacts.

Among the projects not carried out or abandoned prior to completion are the following: The drainage of La Ciénaga de Zapata's wetland, the creation of a freshwater lake in the Bay of Nipe, and the circumvallating of the "Cuba Canal," the latter aimed at preventing rivers from flowing into the sea. Among the completed projects were the mechanized clearings of the so-called "Che Guevara Invading Brigade," which, between 1967 and 1969, according to approximate calculations, destroyed some 180,000 hectares of natural forest, the majority of which are now unproductive soil areas displaying signs of desertification.

And among more recent unsustainable actions are the rockfills, which are causeways built on foundations made of rocks and aggregates. Of special note, the so-called Cayo Coco rockfill, built on the Bahía de los Perros (Bay of Dogs), to the north of Ciego de Ávila, caused dramatic changes in the salinity, density, temperature, and amount of oxygen dissolved in the water, leading to the disappearance of 83 percent of commercial marine species and practically eliminating fishing activity in the well-known port of Punta Alegre. Paradoxically, this work, built to promote tourism on the islet, was hastened by Castro himself, who urged the builders on with an anti-ecological sentence that went on to become a national slogan: "What you have to do here is throw rocks and not look ahead." He said this when it was necessary to do just the opposite, to plan projects in light of their present and future effects upon the environment.

That is why the key to any sustainable transition will initially be a change away from the current mindset. A new government must establish initiatives that leave behind the Castro regime's development model based on the conquest and domination of nature and in its place promote a model that establishes progress within nature instead of domination over nature. What the transition needs to advocate amounts to sustainable development,[4] so that social and natural variables are considered equitably.

It is important that the new ideas and values of sustainable environmental development take hold not only in the minds of policymakers and project designers, but also in the minds of those who apply them and among the citizenry. Otherwise, it will be impossible to establish and gain compliance with regulations, incentives, and standards that conserve the

environment. This change of mindset is especially crucial because a constant fact of life in Cuban society is the absence of an ecological conscience,[5] which manifests itself in the daily actions and forms of behavior that impact the environment, and, in turn, harm the very people who behave in such ways.

Moreover, an initiative aimed at environmental education could precede the transition period, using various means to convey the precepts of nature conservation to the population. At the same time, environmental education can take place in the exile community, as some of the future players in Cuba's economic, political, and social arenas are among its members. It will be necessary to instill in them, as well, an understanding of the benefits of undertaking sustainable nation rebuilding.

However, it is not possible to go forward with an environmental education program or anything related to environmental protection without an organization dedicated to those needs. A basic task, then, will be to create a structure devoted to the conservation and management of the environment within the provisional government design or a particular entity dedicated to environmental oversight to be established during the transition period. In so doing, it must be remembered that there will probably be several bodies and institutions also directly related to nature protection duties, such as those that oversee agriculture, industry, mining, public health, and municipal or local authorities responsible for these areas.

At any rate, the interim environmental bureau, agency, or secretariat must be formed as a professional, efficient organization of an executive nature, in charge of evaluating, regulating, and implementing environmental control throughout the nation and extending to the provincial level. The many initial tasks of this body should include, among others: review of environmental protection structures and methodologies and the adaptation or creation of new designs; preservation of databases, assessments, studies, projects, research results, and human resources and materials dedicated to environmental protection; establishment of ties of cooperation and exchange with similar international bodies; and promotion of environmental cooperation and research projects through the management of funding sources. Perhaps the primary and most essential

task will be to design and apply a group of temporary regulations that make it possible to deal successfully with critical environmental problems, namely, soil degradation, deforestation, water pollution, and environmental sanitation.

Soil degradation. In Cuba, a bit less than 8 million hectares of agricultural soil exist, of which 4.2 million have been degraded by artificial erosion;[6] of the 4.2 million hectares, it is estimated that 25 percent suffer both from strong and very strong erosion. Soil degrading factors, such as poor drainage, salinization,[7] acidity,[8] compaction,[9] and the formation of infertile crusts[10] have also been observed.

All the foregoing has led to the official use of the term "desertification" to define the state of deterioration that the soil in some regions of the country is in. The appearance of desert areas on the island is the result of political, economic, and social factors, such as poverty, technical backwardness, improper land use, excessive pasturage, deforestation, poor management of water resources, and the implementation of unsustainable agrarian strategies. As a result, 46 percent of the soil falls under the category of low agricultural productivity, and 14 percent is considered "very low" for failing to reach 30 percent of the productive crop potential. That is, 60 percent of Cuba's farmland has low yields. This situation must be assessed carefully, not only because of its effect on the soil—a natural variable that is, per se, an ecosystem[11] and the support of other ecosystems, such as vegetation—but also due to the direct relationship it has with the revitalization of the agricultural sector and the national economy.

The increase in soil degradation creates a regressive algorithm that implies a decrease in direct productive yields in the field and an increase in costs apart from the growing fields, for example, when washouts destroy the agricultural and social infrastructure, such as roads, sewers, canals, irrigation systems, and others. Therefore, the proper use of the land, the application of soil conservation practices,[12] and reforestation and other actions geared toward recovering agricultural ecosystems[13] must be implemented quickly. A correct combination of regulations and incentives to promote land conservation would perhaps be a starting point, including financial stimuli related to credits; payment facilities or tax rebates for

establishing permanent plantings in high slope areas; and payment facilities for applying soil conservation practices or for planting organic crops, among others. Likewise, it will be necessary to implement regulations limiting the use of improper practices, accompanied by efficient awareness and education campaigns regarding correct land use.

Deforestation. It is difficult to ascertain accurately how much of Cuba is covered by forests today, because many conflicting estimates have been published. For example, an article that appeared in the *Trabajadores* weekly in 1997 claimed, "The country's wooded surface area should amount to 27%. At present, it is 21%." However, another press article, published in the weekly *Juventud Rebelde*, said that a spectacular growth in the wooded surface area had occurred by June 2000. This article said, "Currently, 23.4% of Cuba's total surface area is covered by tree plantings, and in 1959 we only had about 18%." If, until 1997, the Cuban government recognized a wooded surface area of 2.4 million hectares—that is, 21 percent of the archipelago—then this new sum is truly incredible, as it implies a growth of 2.4 percent in just two years, while between 1959 and 1997, a growth of only 3 percent was achieved.

Nevertheless, it is evident that a drastic decrease has occurred in Cuba's forest surface area. The situation is serious, given the fact that three-fourths or 75 percent of the logging comes from scarce natural forests and not from artificial plantings that are insufficient to meet the nation's demand for lumber which, among other amounts, annually consumed 1 million cubic meters of firewood in the sugar cane industry alone (Cepero 2000). Forest fires constitute another factor that has an impact on the decrease in wooded areas, since an average of 200 blazes per year occur throughout the country, destroying some 5,000 hectares of forest. There is an extensive list of natural causes and silvicolous conditions that favor these fires, as well as the fact that the forest service is precarious, backward in its methods, and has insufficient human and other resources to safeguard the forests (Cepero 2000).

Considering the foregoing, it is necessary to institute forestry and financial regulations that permit the use, preservation, and recovery of natural forests, such as adequate payments for cutting permits, felling

prohibitions, and restrictions when deemed necessary, as well as permanent bans on certain species and special taxes for using other species considered scarce, and penalties for violating such forestry regulations as may be established. Also to be considered are financial and tax incentives for those landowners with natural forests who implement self-imposed bans on felling for specific periods of time or who carry out silvicolous practices[14] that benefit the forests, and such other incentives as may be deemed useful.

Additional consideration should be given to the possibility of implementing an aggressive program that includes economic incentives aimed at promoting the planting of artificial timber-producing forests to relieve the strain on the natural ones. Indirect measures, such as the reduction of duties on imports of lumber or related products, could meet this need, although these actions might create potential negative economic effects.

Given the fact that economic activity related to forestry will be regulated by market laws, it is necessary to design efficient rules and regulations that ensure public transparency of all purchasing, logging, usage, or any other processes as may be established to take advantage of forest resources. It will be necessary to create clear, detailed codes, especially for felling and haulage of timber from the forest. Compliance with these codes must be mandatory.

In the field of protection, special attention must be paid to the gallery forests, located along stream banks, due to their importance as an ecological niche for different species of wildlife and for their natural role in soil and water conservation. A way to achieve this could be to declare the gallery forests government property, as well as to establish tax cuts for agricultural production on properties where this arboreal environment is adequately maintained. Prior to any regulation in this regard, the precedent must be set for the breadth of the protective vegetation belt along the banks of streams and reservoirs. Several alternatives exist that must be taken into consideration. One of these alternatives that can be implemented easily must be selected, for example, according to the category of the river[15] and based on normal water levels.[16]

Another vegetation association that deserves immediate attention are the mangrove forests, because they play such an important role in coastal

protection and serve as barriers against generalized soil salinization processes. It would be advisable to establish a moratorium on the felling of mangroves, as well as an environmental permit and assessment system that would impede any development affecting certain stretches of mangrove.

None of the foregoing protective measures could be put into practice without an adequate, modern, efficient forest service, dedicated to conducting the necessary studies and assessments, enforcing regulations, and conserving the nation's forest resources. Thus, the creation of a modern forest service should be one of the transitional government's prime objectives.

Another important issue is the conservation of natural areas. The archipelago boasts 80 main natural areas and 287 other natural areas well-known for their pristine environmental values. There are also 8 natural reserves, 22 ecological reserves, 11 natural gardens, 14 natural parks, 11 wildlife refuges, four natural landmarks, and two protected natural landscapes. In addition, there are six biosphere reserves designated by UNESCO: Sierra del Rosario, Guanahacabibes Peninsula, Baconao, Cuchillas del Toa, and the newest ones, Ciénaga de Zapata and Buenavista, which were added in 2000.

As the transition period will be a time of change, breaks, and tensions, it will be advisable to declare a temporary moratorium on all types of construction, development, marketing, and exploitation of natural resources within the territories recognized in the current system as protected areas and any other areas of similar interest, until such time as the pertinent bases for the sustainable use of those fragile ecosystems have been established.

Water pollution. In Cuba, the pollution of rivers, streams, reservoirs, coastal areas, and bays is an environmental reality. The most eloquent example is the Almendares River, with a basin measuring approximately 402.02 square kilometers, which drains a large portion of the country's capital. According to government estimates, approximately 19,315 cubic meters of waste are dumped into this river on a daily basis. The coastal areas receive the contamination that is transported by the polluted rivers, the most notable case being the Bay of Havana, considered one of the planet's most polluted bays. According to the Cuban government, there

are 2,200 contamination sites of national importance due to their toxicity, of which 776 are of industrial origin, 566 are agricultural, 818 come from urban outflow, and the rest fall into the category of "other." In addition, about 60 percent of pollution sites lack treatment systems, only 29 percent of sewage is decontaminated nationwide, and 53 percent of existing treatment plants are in poor condition.

During the initial stage of the transition, it will be necessary to assess, review, and make public the nation's inventory of existing pollution and contamination sources and to design strategies that could bring the country's most hazardous pollution sites under control quickly. It would also be prudent to implement a basic information system on both national and provincial levels, where all those businesses, factories, schools, hospitals, and others that dump waste would be registered, taking into account a minimum permissible quantity of waste, treated or not, in hydric or coastal systems.

Another means of enforcing regulation would be to establish the principle of "You Pollute, You Pay"[17] in all transactions and operations of a commercial, business, public bid, or any other nature that might involve a pollution risk. This could be applied immediately to new cases, and a moratorium could be granted to those based on the existing infrastructure. Special care should be taken in setting the amounts of fines payable for polluting, so that they act as incentives not to pollute or make it possible to collect sufficient funds to repair the damage from pollution, should the transition authorities decide to begin remediation measures.

Water wastage is another environmental problem affecting hydric resources that generates numerous pollution sites due to leaks. Suffice it to say that of the 30 million cubic meters of water pumped monthly to the city of Havana, 12 million are wasted due not only to the deteriorated state of the aqueducts, but also to excess consumption caused by inefficient industrial and manufacturing parks located in the capital. Similar situations occur throughout the rest of the country's urban areas and, in some cities, with greater frequency.

The use of water by residents, the agricultural and industrial sectors, and others must be regulated by establishing payments for water consumption, not to limit domestic use drastically nor to limit the develop-

ment of businesses and economic initiatives, but to encourage the conservation of water and to require the population to contribute toward the expense of rebuilding and restoring the nation's antiquated water system. It would be prudent to differentiate between the use of surface water and the use of water tables, many of which are overexploited, because the complete depletion of water tables implies unpredictable, serious ecological and economic costs.

Environmental Sanitation. Official estimates released by the Cuban government indicate that in Havana alone, more than one million tons of garbage are produced annually, most of which ends up in rivers or the sea. The streets, empty lots, abandoned buildings, and sidewalks of the capital have been converted into garbage dumps, from which, at critical moments, the authorities remove thousands of tons of waste in an attempt to control outbreaks of dangerous diseases, such as dengue, malaria, leptospirosis, and others, which in the past few years have claimed an untold number of lives. In Havana, the largest city in the country, waste is collected irregularly and inefficiently and deposited in collapsed landfills, where garbage is burned outdoors with no controls whatsoever.

The deterioration of environmental hygiene is not foreign to other Cuban cities. In Camagüey, there are at least 110 landfills that are not adequately managed, the rivers and streams that traverse the city are polluted, and clandestine dumps exist in more than a few places along their banks. Septic tanks are never or rarely cleaned out, given the scarcity of auto parts to repair and maintain the insufficient fleet of septic tank cleanup trucks. This situation, combined with other sanitary problems, makes this city one of the most affected by acute diarrheal diseases, shigellosis, and hepatitis A.

In Villa Clara, for example, although the government claims that 97 percent of the population has garbage collection service, the system of horse-drawn carriages predominates (serving 66 percent), with only 13 percent of the population's trash collected by garbage trucks. The final disposal is made in 100 authorized sites, only one of which is a sanitation landfill. The rest are open-air dumps, 86 percent of which are in poor condition. In addition, Villa Clara has approximately 273 declared clandestine garbage dumps.

The precarious state of urban sanitation will tend to worsen as the economic and social crises become worse. Guaranteeing efficient and safe garbage collection systems in the major cities must be a priority for the transition government, perhaps preceded by an emergency program to pick up all waste, garbage, trash, and debris located in the streets or on the sidewalks. These tasks can become efficient if adequate management is established in the nation's main landfills, together with actions to eradicate disease-transmitting sites, without forgetting efficient education campaigns complemented with a national system to monitor and alert against epidemics and outbreaks of infectious diseases.

Environmental taxes on the marketing of dangerous substances contained in products such as fuels, automobile batteries, television screens, degreasers, detergents, and other items must be considered, in order to collect enough funds for adequate treatment of these toxic products. The same measures could be applied if mass imports of second-hand items (used for commercial purposes) begin to come in, because these things will not last long and will place a greater strain on the already collapsed national waste collection and disposal system. At the same time, promoting the recycling business can help to improve hygiene and create jobs. According to official figures, out of 170 million aluminum cans in circulation, only 17 percent are recycled.

Another issue of concern is the water supply. Water treatment plants' facilities must be operational to guarantee safe water quality or emergency programs must be designed to improve the quality of the water consumed. A prophylactic method would be to provide periodic water samples at the treatment plants, water wells, and any public water sources or to put in place other mechanisms that would allow the population to know the quality of the water they are consuming.

The poor condition of sewer systems in major cities is another challenge that must be faced, at least by starting to rebuild the most deteriorated ones, as this constitutes a dangerous source of contamination that often affects the quality of drinking water. In Havana alone, some 900,000 inhabitants lack sewer service, meaning that this human wastewater is dumped directly into rivers, streams, and ditches, and even into underground aquifers. The Cuban capital's obsolete sewer system, con-

structed between 1908 and 1915, serves only 63 percent of the city's inhabitants. This system was designed to serve some 315,000 people, with enough capacity to extend to 600,000. At this time, the official population of the city of Havana is 2,192,321 inhabitants.

Finally, and this is a very important point, it will not be possible to kick off Cuba's environmental recovery without the free and active participation of its citizens. Citizen participation must be guaranteed. One of the first steps of the transition period needs to be the establishment of the framework and guarantees needed for the development of independent, nongovernmental organizations, including citizens' environmental associations. This is an essential condition that must go hand-in-hand with the strictest public transparency in all aspects of environmental issues.

Environmental Institutionalization Phase

Article 27 of the current Constitution of the Republic of Cuba says: "The state protects the environment. Likewise: Citizens have the duty to contribute to the protection of the water, flora, fauna and all of nature's rich potential."

The absence in the Constitution of wording that guarantees every person's inalienable right to enjoy an environment that is healthy, ecologically balanced, and suitable for living, as well as the conservation of the landscape and nature, limits the exercise of constitutional rights and protection of individuals, on a case-by-case basis, to act in their own defense or to obtain immediate protection against degradation of the environment, regardless of whether the effects are direct or indirect, because absence of a healthy environment for humans and lack of conservation of natural resources do not constitute violations of fundamental rights as they are defined.

It will be necessary to include in the new Constitution or a supreme legal instrument of the republic the following guarantee: *All Cuban citizens have the basic and inalienable right to live in an environment that is healthy, ecologically balanced, and suitable for human life, where the preservation of the landscape, nature, and natural resources is enforced by law. All citizens have the duty to conserve the environment. It is the obligation of the state to guarantee individuals a healthy and productive*

life in harmony with a safe, pollution-free environment.

Establishing environmental rights will be an essential task as Cuba's new environmental legislation develops, overseen by a harmonious regulatory body called for by the Constitution. All laws and resolutions will need to be part of a practical and effective framework. For this endeavor, it will be advisable to evaluate current environmental legislation, established in Law No. 81 on the Environment, made up of 14 titles, 34 chapters, 163 articles, and 3 provisions, as well as the rest of the legal scaffolding throughout which the acts, about 300 of them, are widely scattered, including 37 laws, 36 decree laws, 83 decrees, 95 resolutions, 78 technical standards, and 9 with other titles.

Within current environmental laws, corrective procedures consist of a group of benevolent enforcement rules that are not applied. A case in point is article 34 of Decree 179: "Protection, use and conservation of the soil and violations," which establishes a fine of 50 pesos to whoever fails to conserve the fertile layer of the soil, regardless of the area affected. Thus, the amount of the fine is not greater than the benefit that can be reaped from such acts, and, therefore, the fine ceases to be effective. Along the same lines, there are no incentives, economic or otherwise, aimed at promoting actions to protect nature. An important action will be the revision of environmental legislation as it relates to international treaties to which Cuba is a signatory, assuming strict compliance therewith, as well as weighing whether to subscribe to those laws that may be of interest to the international community of nations and the country.

During this stage, the interim environmental secretariat, agency, or bureau must become a permanent ministry or department of the state. Moreover, consideration can be given to creating a prosecutor's office to guarantee citizens' environmental rights. The ministry or department of the environment could be linked to another ministry overseeing the natural environment, such as tourism, or perhaps one devoted to research and scientific endeavors, that is, technology. Such a linkage might prevent excess bureaucracy in the republic's new governmental structure.

Regardless of how the state is restructured during the transition, the issue of the environment must be handled by a government institution with ministerial decision-making power that is not subordinate to a min-

istry, such as a department or commission. In any event, it will be advisable to organize a system of environmental inspectors and mandatory registration of any pollution and contamination sources, waste generators, fuel tanks and others to create procedures for regulations and incentives.

During this phase, all the work previously performed must be perfected and institutionalized, the design of environmental policies going from interim to final status, with short-, medium- and long-term projections. It will be essential, moreover, to maintain control over critical variables: land degradation, deforestation, water pollution, and environmental sanitation, as well as to include priorities to protect coastal and beach areas, to protect wildlife, and to improve air quality.

Coastal and Beach Areas. The Cuban archipelago consists of some 4,195 islands, keys, and islets, grouped into four sub-archipelagos, namely: Los Canarreos, Los Colorados, Jardines de la Reina, and Jardines del Rey. This last one is the largest, with 400 islets, and until the late 1980s, it featured nearly pristine landscapes of inland lagoons, beaches protected by large sand fossil dune systems, and mangrove formations with different floral variations, where some 1,249 species of land animals were concentrated, 20 percent of which are considered endemic to Cuba.

However, the unsustainable development to attract tourism being carried out by government building brigades has caused, among other impacts, the destruction of some 10,000 acres of mangroves; the creation of 428.4 hectares of holes produced by quarry mining and borrow pits in Cayo Coco, Cayo Guillermo, and Cayo Romano; and accelerated processes of beach sand erosion due to the building of hotels and tourism infrastructure on coastal sand dune areas. Within a period of 15 years, features of considerable environmental value have been destroyed in Cuba's northern keys, endangering the ecosystem and all its investments, given the dramatic deterioration of the natural resources (landscapes and beaches) that gave rise to them.

Organizing the sustainable use of the keys is necessary to prevent the permanent loss of their natural and economic resources. To that end, a recommendation could be made that any new work or ongoing project be postponed until such time as coastal regulations requiring the conservation and guaranteeing the proper use of those ecosystems are established.

The hotel multinationals, owners, and others that have been exploiting natural resources and causing environmental damage must be held legally responsible for immediately stopping all damaging activities and for repairing damage, where possible or for financing the restoration and recovery of ruined areas. The elements of the infrastructure, now the property of the Cuban government, that eventually become privatized must be required to enter into legally binding agreements to ensure that the new owners take the pertinent measures, in clear and timely terms, aimed at correcting harm to the environment caused by the current regime.

Rockfills, the bases for constructing new roads, have created major environmental impacts, for example, dramatic changes in the salinity, density, temperature, and oxygen dissolved in the inshore seawater, all of which affect the mangroves and fish in the northern keys. While the eventual transformation of these rockfills into bridges may not be a task for the transition period, it would be beneficial to impose an environmental tax, as soon as possible, in the form of tolls paid by whoever uses these roadways. A special fund to transform the rockfills into viaducts compatible with the environment should be created.

Another serious problem that needs to be addressed is the accelerated processes of beach sand erosion along the coastline of the entire archipelago. A case in point is the internationally famous Varadero Beach, located on the Hicacos peninsula on the island's northeast coast, where irreversible erosion is occurring due, among other things, to the extraction of at least one million cubic meters of sand for building purposes between 1968 and 1978. The erosion of Varadero reached incredible levels between 1979 and 1987, when the beach receded an average of 1.20 meters per year; it was possible to see rock outcroppings at several points along the shore. At this time, it is necessary to carry out costly sandfills every five years to maintain the beach's physical and aesthetic state.

The destruction of Cuba's beaches is attributable to several causes, including but not limited to indiscriminate clearing of vegetation; excessive use of earthmoving, terracing, earthwork, and fills; insistence on destroying natural coastal lagoons and first-line beaches; and the construction of large, heavy urban structures not suitable for coastal areas.

However, the two most common destructive actions affecting the beaches have been the extraction of sand from the natural banks that supply it and the building of permanent structures on coastal sand dunes, thereby accelerating and concentrating the effect of the waves' strength.

Both sand extraction and building on the coastal sand dunes must be prohibited immediately. An enforceable regulation must be enacted that establishes simply and clearly the width of the protective stretch of sandy beaches and the building setback line, on which any construction or development project will be banned. Likewise, it will be necessary to implement legislation to remove all structures located within the protected zone or to require their owners to take immediate measures to stop the erosion caused by the buildings.

Within Cuba's territorial waters, several natural areas house important marine resources, including valuable mangrove populations and coral reef areas, especially in Cuba's southern keys. Due to their isolation and the lack of funds to exploit them, these areas are very well preserved and must be declared natural marine sanctuaries, so that programs can be implemented for their sustainable use.

Wildlife. Cuba's wildlife has been strongly affected during the past four decades; as an example, some 20 species of birds apparently have disappeared, while others, like the *Gavilán Caguarero*, are critically threatened. The loss of their habitat, due to the fast-paced deforestation of natural forests, poaching, the gathering of specimens for dubious scientific purposes, boundless commercial exploitation, and other excesses, has caused the decline of various species of wildlife on the archipelago.

Another widespread practice has been the introduction of species for commercial purposes and without prior environmental assessment. The long list includes the *lubina* (a variety of sea bass from Southern Europe); freshwater lobster (a native of the tropical region of Northeastern Australia); catfish (from Thailand); water buffalo (from other countries of Asia); zebras and monkeys (from Africa) and many others.

The effects of these introduced species into the island's ecosystem are not known, especially regarding the multiple varieties of fish implanted in the countless artificial dams and minidams. In the case of the water buffalo, most experts on the subject consider the archipelago's natural

environment too fragile for these animals, while the impact on plant life caused by the monkeys introduced on some of Cuba's northern keys has been categorized as catastrophic.

Indirectly, the recovery of natural forests and the preservation of natural areas, gallery forests, and others will help to conserve and recover the habitats of many species. Nevertheless, implementing specific regulations and structures to protect wildlife will be necessary. For example, fishing and hunting regulations must be established, with bans on these activities for periods of time for specific species, as well as establishing limits on size, weight, and quantity. Commercial wildlife exploitation would also have to be regulated, in accordance with international standards and such national models as may be established, designating protected species according to international regulations. The importing of animals, fish, insects, and other foreign specimens earmarked for commercial use should be prohibited immediately, and any other imports for different purposes should be assessed by means of environmental impact studies, to be financed by the interested parties. Necessary assessments must be instituted to handle introduced species and to weigh, on a case-by-case basis, the appropriate course of action either to eliminate them from the ecosystems or to find uses for them in safe, sustainable ways.

Air. Cuba's precarious air quality is nothing new. Available statistics report a dramatic 43 percent rise in the incidence of acute respiratory diseases in the past 15 years. A study conducted in mid-2001, in Havana's so-called historic sector, revealed that the readings of sedimented dust in several points of this area surpassed the limits established by the World Health Organization. The study indicated, moreover, that the chloride and sulfur dioxide contents were also very high in that neighborhood of Cuba's capital, where a large concentration of the population live in cramped quarters.

The poor air quality of several Cuban cities is generally due to local pollution from industrial facilities, such as sugar cane industries, cement factories, thermoelectric plants, hospital crematoriums, automobiles, and so on. A typical case is Moa, where toxic gases and dust from the nickel plants on the outskirts of the city cause acute respiratory diseases in the inhabitants. The residents of Moa suffer from the sharp ammonia odor, as

the nickel industry lacks the treatment systems needed to avoid the strong pollution that it causes in the area.

Improving air quality in the major cities must become an urgent task, given the direct relationship between air pollution and the health of citizens. Probably the best way to begin to control the problem is to establish a basic regulation that indicates which gases cannot be released into the atmosphere, the quantities of those that may be released, as well as the permissible amounts of suspended dust and particles. Future local and municipal governments, due to their proximity to sources of pollution and those affected by it, must play an important role in enforcing the rules and in handling the claims to eliminate the problem.

Multinational corporations, owners, or others who have been operating facilities that cause air pollution must be required to stop doing so immediately. At any rate, it will be necessary to evaluate the polluting sites and to divulge the types of pollution they cause, followed by making the consequences of the pollution known to the public and establishing timeframes for manufacturing or other industries to cease releasing pollutants into the atmosphere.

Sustainability Stage

The initial establishment of a development model based on environmental sustainability must be characterized by the maturity of the executive, judicial, and social institutions dedicated to the issue of environmental management and protection. One of the many challenges of this new phase is guaranteeing that the new ministry of the environment is a governing body where professionalism and compliance with the rules prevail over any political interests that happen to be in vogue at the moment.

The creation and establishment under democratic rules of the final laws governing the protection of soil, forests, waters, wildlife, air quality, coasts, biological safety, natural protected areas, pollutants and contaminants, as well as regulations for the filing of lawsuits for environmental harm caused to persons, property, or others will be basic requirements of a democratic Cuba. To accomplish these goals, people who represent different social interests, people who are seeking opportunities for

economic development, and people who are dedicated to the preservation of environmental variables will have to reach a consensus.

Another area that must be corrected is the system of environmental standards, which, for the most part, is out of sync with reality. Currently, the system limits itself to describing methods for identifying pollutants and contaminants. The environmental standards do not regulate industrial emissions into the environment, and the measurement equipment to perform the required testing does not exist. An important objective is the creation of a national environmental standards system, consistent with international environmental standards or ISO 14000 (Family of International Standards for Environmental Management), which will only be possible if it is backed by a national system for monitoring and sampling such environmental quality indicators as may be established.

While the regulation for the performance and approval of environmental impact assessments[18] was mandated in 1997, including the requirement to apply for an environmental permit prior to executing any work or project, it has not really worked in practice, because it is the government that makes the investments and grants the permits. There are numerous examples of environmental impacts because actions have been performed without the required environmental permits, among them, the Cayo Coco international airport, to the north of Ciego de Ávila, as well as most of the mining concessions granted to mixed-capital companies controlled by the Cuban state. This important aspect of environmental regulation must be redeemed and established by means of the necessary legislation.

Environmental assessments, be they studies, permits, inspections, or otherwise, must be incorporated not only as mandatory rules, but also as legal guaranty instruments in the face of possible suits for damage that may be caused to the environment, property, persons, or others, and also as part of the real estate industry.

The foregoing leads us to the issue of the need to facilitate the rise of the environmental economic sector, the principal exponents of which are the businesses engaged in conducting environmental assessments, taking samplings, and environmental abatement. To that end, state certification and authorization systems must be established to carry out those activities

and to guarantee the technical levels of expertise of the professionals and businesses engaged in providing those services. In order for individuals or businesses to conduct environmental impact studies, they must obtain the mandatory pertinent approval, subject to proof of knowledge and payment of the permit. Another possibility would be for laboratories interested in taking samplings of asbestos, lead, heavy metals, or other elements to be required to obtain a state certification license, pursuant to such technical requirements as may be established. The same would apply for businesses engaged in soil decontamination, environmental cleanup, and so on.

To empower the environmental industry, a duty-free tariff can be established on imports of equipment used in assessing environmental quality and those used for decontamination purposes. Likewise, state permits and inspections to ensure compliance with environmental regulations will play a major role in promoting the search for services specializing in decontamination, waste recycling, proper disposal of hazardous waste, as well as environmental consulting businesses that tell clients how to follow environmental regulations.

The funds acquired from environmental taxes, permits, and licenses must be used correctly to empower this new economic sector, promoting transparent bidding processes for those interested in performing tasks involving recycling, garbage collection, sewage treatment, studies, assessments, and other related activities, with the selection of the best option being left up to free competition. The state's environmental apparatus must limit its duties to matters of methodology, regulation, inspection, and certification.

During this stage, local governments must have a say in the decision-making process relating to environmental regulation, natural resource management, sanitation, and other issues within their scope of jurisdiction. Considering that soil, water, and vegetation degradation and deterioration are not isolated incidents, they are manifested in river hydrographic basins, also called watersheds,[19] almost always located in or near cities or towns.

River Hydrographic Basins

In Cuba, there are 632 watersheds larger than 5 square kilometers, of which the ones pertaining to the Cauto, Zaza, and Sagua la Grande rivers stand out due to their size, as the three largest, in that order. The main environmental problems of the river basins are that they are used as dumps for urban, industrial, and agricultural waste; they also exhibit deforestation, water and soil salinization, and land erosion.

As an illustration of what is going on in the Cuban river basins, the Cauto River, located in the eastern area of the island, is a case in point. The truly depressing, current reality is that this basin, drained by the Cauto River, is 343 kilometers in length and 9,540 square kilometers in area. Strongly contaminated and salinized waters, deforested banks, eroded soil, and extensive stretches of saline barren plains are signs of a landscape in a critical state of collapse. The archipelago's largest river, the Cauto is poisoned by 652 pollution sites whose loads of waste are dumped from the provinces of Santiago de Cuba, Holguín, and Las Tunas. The Cauto River basin's average rate of evaporation (1,951 millimeters (mm) per year) is greater than the precipitation rate (1,190 mm per year), which is due in large part to deforestation. Thirty-six percent of this basin's soil is considered either very strongly or strongly eroded; in these areas, it is possible to observe huge gullies[20] more than 30 meters deep and spectacular landslides on the river's edge.

Starting in the mid-sixties, the lower course of the Cauto River served as a testing ground for plans involving the country's agricultural development that were designed without considering potential environmental impacts. Recognized among the main causes of the current state of affairs are the irrational mechanized clearing of large wooded areas for pastureland and rice farming purposes, as well as the building of pharaonic irrigation systems, together with the excessive damming of the basin with reservoirs, such as the one at Cauto-El Paso.

It would be advisable to review and update the numerous studies that exist for the management of watersheds and to determine procedures to enforce local measures that guarantee soil and water improvement. Those assessments could also be used as a basis for creating investment portfo-

lios designed to attract funds from international environmental agencies, foundations, and banks interested in funding studies and management strategies that would integrate nature areas, generating social benefits on a local scale.

The promotion of research related to nature assessments, restoration of ecosystems, and related activities, must culminate during this period. The most advisable approach is to support the quest for financing from international organizations, governments, universities, and research institutions. Those who oversee the research grants must guarantee competitiveness rules that allow the most efficient projects to have access to the funds. These procedures will ensure the scientific endorsement necessary for the establishment of strong environmental practices, creation of job opportunities, establishment of research infrastructures, transfer of technologies, and other benefits. Another goal that must be taken into account is the promotion, in the public and private education sectors and in the media, of environmental conservation education and cultural programs.

The sustainability phase must include an integrating element among government, society, and business entities that would enable economic growth and environmental protection to become compatible with each other. In practice, these three sectors' right to act freely and all parties' willingness to participate in open discussions and to search for a consensus must be given priority in resolving environmental conflicts.

Conclusions

Over the past forty years, Cuba's environment has deteriorated markedly. The soil, vegetation, and water are the elements that have suffered the most degradation. Continuous impacts on these natural resources have produced cumulative negative effects on several environmental variables, causing them to be classified on an ascending scale of degradation as moderate, severe, critical, and irreversible. A clear example is that in some areas the soil variable has reached a nearly terminal state; consequently, a new landscape has appeared within the island's geography: desert areas.

For decades, the Cuban government's limited actions on behalf of

environmental protection have failed in the area of land improvement and soil conservation, despite the fact that the destruction of this resource constitutes the country's main ecological problem. Likewise, it is important to note that number four on the list of most affected natural elements is the degradation of coastal areas and beaches, resulting from the impact that tourism has had and continues to exert on major seaboard systems.

It is important to note that there are other issues, which do not fit within the framework of the phase or stage being evaluated in this paper, but that must be considered due to their importance. For example, an issue that has been only partially evaluated is financing. While some benefits to be gained by conserving the environment may be tangible and, therefore, easy to quantify, others will be of an intangible nature and more difficult to assess. Moreover, numerous improvements will be obtained in the long term or indirectly, which can lead to their being undervalued. Thus, any aid or investment package, whether at the micro- or macroeconomic level, that is geared toward development actions, should include a percentage of its amount earmarked for environmental protection.

An innovative option would be to include in national debt negotiations the issue of environmental impact caused by infrastructure and project development without environmental care, mostly undertaken by former communist countries, financed by loans that are now the major sources of Cuba's national debt. In this way, an attempt would be made to obtain ecological remissions or payment reductions to help the environmental and economic recovery during the transition to democracy period.

Another matter that has not been assessed is that of political boundaries and territorial properties, which will probably be reviewed and changed or reevaluated during the transition period, because the current jurisdictional boundaries do not match the functional and regional zoning limits required in a free market system.

Throughout history, the imaginary lines that separate territories have generally been established by complex socioeconomic processes, with the results being as dynamic as the human beings who drew them. In recent times, the deterioration of the environment has reached levels that have rendered the concept of borders meaningless, since borders are eas-

ily crossed by water and air pollution, soil erosion, and other types of environmental degradation.

In the case of political boundaries, especially municipal and provincial ones, any new demarcations should take into account—in addition to social, cultural, and historical factors—the jurisdictions of natural territorial elements, as nature has outlined its own municipalities, provinces, and nations. Hence, river basins and sub-basins, mountain ranges, plains, swamplands, and other areas exist where life interacts in harmoniously defined and geographically delimited ecosystems. It is advisable to use the principle of integration of natural physical and socioeconomic factors to define the nation's territorial limits. In this way, the splitting in half of an ecosystem, such as Ciénaga de Zapata wetland, between two provinces would be avoided; such arbitrary divisions create all kinds of problems in establishing controls, budgets, and regulations.

Finally, several of the issues mentioned in the analysis, such as environmental legislation and the establishment of a ministry or department of the environment, deserve to be evaluated in detail. Nevertheless, it is possible to conclude that the basic idea for the transition is to go from the *environmental emergency phase* to the *institutionalization phase* until reaching the *sustainability stage*, each with a logical sequence of actions (listed below) allowing for social environmental awareness, so that the new legal framework, regulations, and incentives leading to a sustainable environmental development model may be established.

Recommendations

Making recommendations for the future management of Cuba's environment when the transition commences is a challenge that involves a high degree of uncertainty, particularly as actual conditions may differ from those weighed in this assessment. However, it will be useful, as a starting point, to have a list of basic actions to be taken during each of the three phases. Of course, when the actual transition to democracy begins, this list will need to be partially or completely revised.

Environmental Emergency Phase

- Create an interim Environmental Agency, dedicated to environmental preservation and management within the governmental design established during the early days of the transition period.
- Preserve databases, assessments, studies, projects, research results, as well as human resources and materials dedicated to environmental protection.
- Establish a small and efficient nationwide environmental inspection mechanism.
- Set up the framework and guarantees needed for the rise and development of independent environmental associations and organizations.
- Promote education and a culture of respect for environmental conservation.
- Establish ties of cooperation and exchange on environmental issues with homologous international agencies.
- Design and establish or adapt the interim regulations and legal instruments needed to deal successfully with the most critical environmental problems, namely: land degradation, deforestation, water pollution, and environmental sanitation.
- Create a national program for basic soil conservation, by means of an economic benefits package, together with regulations that encourage land conservation.
- Establish a national program for reforestation and recovery of natural forests, with priority given to gallery or riverbank forests, while an economic benefits package encourages the planting of trees.
- Create the government institution that will be devoted to the conservation of the republic's forest resources (a National Forestry Service).
- Declare a temporary moratorium on any type of construction, development, marketing, or exploitation within the "protected areas" recognized within the current system and any other areas of equal interest.

- Detect and control the main and most aggressive pollution sites in the country, and assess and disclose the nation's inventory of pollution and contamination sources.
- Institute the principle of "You Pollute, You Pay" in all commercial, business, public bid, and other transactions and operations that might involve a pollution risk.
- Start up, on an emergency basis, a national environmental program that includes, among other actions, guaranteeing efficient and safe garbage collection systems in the major cities and proper management of the nation's main landfills.
- Design and implement a basic monitoring and alert system against epidemics and outbreaks of infectious diseases.
- Guarantee the efficient operation and high quality of service at the nation's water treatment plants.

Environmental Institutionalization Phase

- Include in the new constitutional charter or supreme legal instrument of the transition period the guarantee of environmental rights to all citizens.
- Transform the interim Environmental Agency into a permanent state ministry or Department of the Environment; design the republic's final environmental policies, with short-, medium- and long-term projections.
- Review the international environmental legislation and treaties to which Cuba is a signatory, assuming strict compliance therewith, and subscribe to those that are in the interest of the international community and the nation.
- Establish the coastal regulations necessary to conserve and guarantee the proper use of those ecosystems.
- Immediately order multinational hotel companies, owners, or others that have been operating facilities that cause environmental impacts

in coastal and beach areas to cease the cause of the damage and repair it when possible or finance the recovery thereof.

- Establish in the privatization settlements of the tourist facilities that were owned by the Cuban government the agreements and clauses required so that the new owners take pertinent measures, in clear and timely terms, to correct any environmental damage.
- Institute regulations to determine the width of the protective stretch of sandy beaches and buildings' setback lines, where any construction or development will be prohibited. Likewise, implement agreements for the removal of structures located within the protective stretch or for financing the measures to diminish the erosive effects caused by the same.
- Establish regulations and structures dedicated to wildlife protection, management, and conservation.
- Regulate immediately the imports of animals, fish, insects, and other foreign specimens for commercial or other purposes.
- Design and implement suitable practices for the handling and control of exotic species introduced into the archipelago's ecosystems.
- Implement basic regulations regarding which gases must not be released into the atmosphere, the quantities of those that can be released, and the amounts of permissible suspended dust and particles.

Sustainability Period

- Create and establish, under democratic rules, final laws regulating soil protection, forests, water, wildlife, air quality, coasts, biological safety, natural protected areas, and polluting substances, among others.
- Institute regulations and mechanisms allowing the filing of lawsuits for environmental harm caused to persons, property, or others.
- Organize and implement a national system of environmental quality indicator regulations, monitoring, and sampling in keeping with international environmental standards.

- Facilitate the rise of the environmental economic sector, primarily businesses engaging in the performance of assessments, samplings, and remediation of environmental damage.
- Promote transparent bidding processes for those interested in performing recycling, waste collection, water treatment, studies, assessments, or other tasks. The selection should be determined by free competition.
- Guarantee the legal mechanisms and authority needed for local governments to participate in the decision-making process with regard to environmental regulation, natural resource management, sanitation, and other issues, within the framework of their jurisdiction.
- Include in national debt negotiations the issue of environmental impacts and the costs caused by the infrastructure or projects financed with such funds.

Notes

[1] There are numerous definitions of environmental impact, but for the purposes of this paper, it can be understood to be any change in the environment, be it adverse or beneficial, resulting from activities, products or services. (Author's note)

[2] An unsustainable model for economic development is basically one that does not satisfy human needs and destroys the natural ecosystems that sustain it. (Author's note)

[3] The concept of desertification has been broadly debated since 1977; currently, the United Nations Convention to Combat Desertification defines it as follows: "desertification is the degradation of land in arid, semi-arid and dry subhumid areas as a result of several factors, such as climactic variations and human activities."

[4] According to the definition used by the United Nations Global Commission on Environment and Development in 1987, sustainable development is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

[5] Yábloko, Alexei, and Edberg, Rolf, *Un difícil camino hacia el domingo*, (Moscow: Editorial Progreso, 1990), p. 159. "It is hard for us to trust in the individual's morals, because it is so easy to refuse responsibilities and hush the 'ecological conscience'; one tells oneself: I'm doing the same thing that others are doing; or adduces that decisions are made by superiors."

[6] Natural or geological erosion is the loss of soil materials on account of the action of water and wind, tempered by other environmental elements, such as vegetation. Artificial or anthropic erosion is the accelerated process of loss of soil materials on account of water or wind, due to the fact that man's actions eliminate factors that temper the natural process or intensify what causes it. (Author's note)

[7] Soil salinization can be understood as the increase of the soluble salts contained in farmland to levels prejudicial to vegetation. This process generally is the result of the salinization of subterranean waters, overexploitation of soils with little permeability, use of salinized water for irrigation purposes, clearing of coastal vegetation, or excessive application of chemical compounds. (Author's note)

[8] Soil acidity is a complex process that, in simple terms, implies a decrease or change in the land's chemical elements necessary for vegetation to live. It is generally caused by excessive irrigation, intensive applications of ammonia-based fertilizers, and other actions that degrade the biochemical structure of the soil. (Author's note)

[9] Soil compaction is the loss of volume in the soil mass due to an outside force. It is generally caused by excessive use of farming tools and machinery. Compaction reduces the growth of plant roots and, consequently, of vegetation in general. (Author's note)

[10] Infertile crusts in the soil are generally associated with land salinization processes, due to the appearance on the soil's surface of a whitish layer composed of salts. (Author's note)

[11] Several definitions of ecosystem exist, which essentially try to explain the complex interrelationship in time and space of physical and biological factors. The ecosystem is the level superior to that of the organisms in which nature is organized. A river, a forest, or a lake constitute an ecosystem. (Author's note)

[12] Soil conservation practices are agricultural practices that are applied to obtain crops and at the same time maintain and improve the productive capacity of the land; for example, contouring furrows against the field's slope. (Author's note)

[13] According to the Food and Agriculture Organization of the United Nations, "Agricultural ecosystems or agroecosystems are those 'ecosystems that are used for agriculture' in similar ways, with similar components, similar interactions and functions. Agroecosystems comprise polycultures, monocultures, and mixed systems, including crop-livestock systems, agroforestry, agro-silvo-pastoral systems, aquaculture as well as rangelands, pastures and fallow lands. They are found all over the world from wetlands and lowlands to drylands and mountains and their interactions with human activities, including socio-economic activities and sociocultural diversity, are a determining factor."

[14] Silvicolous practices are actions aimed at the development, planting, and care of the forest. (Author's note)

[15] A river can be major or minor depending on the tributaries that flow into it. (Author's note)

[16] Normal water level is the name given to the mean height or crest reached by the water in a river, lake, or reservoir without extremes occurring. (Author's note)

[17] The admonition "You pollute, you pay" was adopted in 1972 by the Organization for Cooperation and Economic Development. It implies that the parties responsible for polluting must pay the cost of the measures necessary to prevent or diminish the pollution. (Author's note)

[18] Environmental impact assessment (EIA) is the process of consideration and analysis of the possible effects that an activity of change induced in the environment can cause and the planning of the actions required to prevent or diminish such impacts. The first environmental impact assessment was conducted in the United States in 1970; at present, it is part of the environmental regulations in numerous countries. (Author's note)

[19] River basins or watersheds are topographically limited territories drained by a single surface current system, which can be major or minor depending on their nature. (Author's note)

[20] Gullies are a phenomenon caused by accelerated soil erosion due to the concentration of surface runoff in a field with a specific slope, generating the formation of ruts, canals, and even ravines. (Author's note)

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About the Author

Eudel Eduardo Cepero was born in Camagüey, on April 18, 1961. He graduated in 1983 from the Higher Pedagogical Institute Jose Martí with a Licentiate degree in Geography (B.S. in Geography). For fifteen years he worked at the Ministry of Agriculture's Empresa Nacional de Proyectos Agropecuarios, Camagüey Affiliate. He currently works as environmental assessment coordinator at the Hemispheric Center for Environmental Technology at Florida International University.

Mr. Cepero has served as Professor of Geography (1983-1984); Soil Conservation Projects Technician (1984-1987); Planning and Rural Development Project Manager (1987-1989); and Specialist in Planning and Rural Development (1989-1999). Additionally, he acted as coordinator of the Máximo River Watershed Management Project in Camagüey (1992-1994).

Mr. Cepero's graduate education includes courses at the Universidad de Camagüey, the Instituto de Hidro-Economía, Instituto Superior Pedagógico de Camagüey, Universidad de la Habana, and Miami-Dade Community College. He has taken part in some twenty scientific events as a speaker, author, guest, and jury member. He is the author and coauthor of several research projects, including, *Automatización de los Cálculos de la Ecuación Universal de Pérdidas de Suelo and Cartografía de Suelos Erosionados y Concepto de Municipios Hidrográficos*.

Mr. Cepero has published several scientific papers, one of them in the magazine *Unasylva* of the Food and Agriculture Organization of the United Nations, as well as numerous articles on environmental issues in newspapers and magazines. He writes on ecology for *El Nuevo Herald* on a regular basis.

In 1996, in Camagüey, he founded *La Agencia Ambiental Entorno Cubano* (Cuba's Environmental Agency), the first part of a project aimed at establishing the precepts of environmental protection and sustainable development in Cuba's incipient civil society. He has written the annual reports, *La situación ambiental de Cuba 1997, 1998, 1999, 2000 and 2001*.

In Cuba, Mr. Cepero was persecuted, interrogated, harassed, and subjected to professional discrimination, which frequently prevented him from

carrying out his work. In 1996, the government of The Netherlands awarded him a diplomate and master's program scholarship, but the Cuban authorities denied him a permit to leave the country. The government acted similarly in 1999, when it expelled him from a master's degree program at the Universidad de Camagüey. When he left Cuba in July 1999, the political police advised him that he was forbidden to return.

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