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THE IMPORTANCE OF THE CANAL BASIN

THE HISTORICAL Chagres River Basin, which serves as the basin for the Panama Canal, extends some 3,260 kilometers in length and is not only the most important river basin in Panama but also one of the most strategic river basins in the world. Its two major lakes — Gatún and Alhajuela — function as reservoirs for the water needed to operate the inter-oceanic canal as well as to supply the water requirements of both Panamá City and Colón, urban concentrations that contain more than half the country's population.

Gatún Lake was created in 1913, when the Chagres River was closed off at its Atlantic outlet, while the Alhajuela was created in 1934 by damming up the Madden River in the high, mountainous part of the country.

Ecologically, the sub-basin of Alhajuela Lake is the more critical of the two since it is the source of (a) almost half the water of the ecosystem, as well as (2) the entire water supply for the city of Panamá. Finally, the major part of the vital protective forests that still survive are located around the headwaters of the Chagres River (Wadsworth, 1976: 22-24).

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The amount of water extracted from this basin is astronomical: some 2,800 million gallons daily. Of this, about 58% (1,624 million gallons) are released through sluices to the sea, thus enabling about 32 ships, on average, to transit the waterway daily; in other words, it takes about 52 million gallons of fresh water for each ship transiting the Canal, from one ocean to the other. Of the remainder, about 33% goes to generate hydroelectric power, another 4% is lost in the form of preventive release to prevent the sluices from overflowing, leaving only about 6% to be consumed as municipal drinking water. However, the demand for water has been increasing at a rapid rate, so much so that it has been projected that, by the year 2000, almost 4,000 million gallons per day will have to be extracted from the river basin (Grupo de Trabajo sobre la Cuenca del Canal de Panamá, 1986).

Because economic growth in the basin has been both haphazard and unplanned over the last 40 years, it has seriously undermined, and led to the deterioration of, its fragile ecosystem. It is a process which threatens the very ability of the ecosystem to continue to produce and store fresh water in sufficient quantity and quality to meet the enormous demands that will increasingly be placed upon it as we approach the year 2000 when the Canal is scheduled to pass into Panamanian hands. One of the greater challenges facing Panama as this moment draws near is how to bring into some kind of compatibility the competing needs of economic development on the one hand with the need to protect this vital tropical ecosystem on the other.

FRAGILITY OF THE ECOSYSTEM

THE importance of the basin lies in its function as a natural system which produces and stores sweet water and which, by its very geographical nature, can be easily degraded or destroyed.

The Canal basin is situated in a region given to heavy, if not excessive, precipitation, with an annual rainfall estimated

to range anywhere from 2,800 to 3,900 millimeters (110-153 inches). Most of this rain falls, with torrential violence, during a brief period of just a few months (Alvarado, 1985). The land itself is vulnerable: though over 63% of its terrain is made up of hills which may rise no more than 1,000 meters (3280 feet), many of these have slopes of up to 45 degrees. Terrain in the Alhajuela area is even more precipitous, with almost 94% of the terrain consisting of hills with slopes steeper than 45 degrees (Larson, 1979).

The land is poor, of a reddish, clay-like soil that erodes easily and is rendered hard and compact once its protective vegetation has been removed or destroyed. For the most part, the soil is poor and typical of that found in tropical forests, of which perhaps only 3% may be suitable for agriculture (Jonas and Ponce, 1986).

THE ECOSYSTEM CRISIS

THE MOST serious problem to threaten the ecosystem is deforestation. As recently as 1952, some 85% of the basin was covered by forests (Wadsworth, 1976); by 1983, that ratio had dropped to only 30%, so quickly has this process advanced (Robinson, 1985). It has been estimated that, from the early 1950s to the present, over 180,000 hectares (444,870 acres) have been stripped of their forest cover (Izaza, 1986). However, there are no reliable figures on the rate of deforestation, though estimates range anywhere from 3-10,000 hectares annually, which would be the equivalent of from 7,000 to 24,000 acres (Larson and Albertin, 1984).¹ Nevertheless, both rates are cause for concern since, if they continue at the present rate, the forests of the basin will disappear by the year 2000. The rate of deforestation presages dire consequences for the future of the Canal in other ways: deforestation fosters erosion of soil and contributes to the build-up of sediment in the lakes. Increased sedimentation will make the Canal less competitive as a route for world trade.

According to the studies of both Larson (1979) and Alvarado (1984), the sedimentation of the lakes has been increasing rapidly and becoming more severe. Over the last 15 years, Lake Alhajuela has lost 5% of its storage capacity, though Larson (the more pessimistic of the two) predicts that this percentage could rise to 23% by the end of the 1990s.

Another cause for concern is the decline in water quality due to increased pollution, visible in the murkiness or darkened color of the water and confirmed by the presence of bacteria and other organisms injurious to human health (Hutchinson, 1986).

CAUSES OF ECOSYSTEM DETERIORATION

THE Canal Basin owes the progressive deterioration of its environment to 5 principal developments: (1) population growth, (2) mining, (3) industrialization, (4) urbanization, and (5) road construction.

While the most immediate dangers derive from the fallout from deforestation, i.e. soil erosion and sedimentation, the greater threat, in the long run, comes from water pollution, which has risen in direct proportion to the continuous increase of both urbanization and industrialization.

1. Population Growth

A number of researchers and historians — like A. McKay (1977), O. Jaén (1981) and D. Lecompte (1984) — have found that the presence of human inhabitants in the Canal basin is of long standing. However, the impact of these earlier inhabitants on the environment was minimal since they tended not only to be few in number but to limit their occupancy to that narrow strip of land which has long served as the primary passage between the two oceans. Up until the middle of the 20th century, almost the entire region was covered by dense forests.

During the colonial period, the population never rose above 1,500 inhabitants who lived, clustered in small

communities, along the banks of the Chagres River and made their living from agriculture and the transport of passengers and cargo, by mule and small boat, across the Isthmus.² In the second half of the 19th century, the population began to grow: first, in response to the construction of the interoceanic railroad (1850-1855) and then to the work of the French in attempting to build a canal (1880-1890). By the end of the century, the area probably numbered about 20,000 inhabitants (Jaén, 1981). Despite the amount of activity which these works inspired, changes to the environment were confined to the immediate surroundings of the towns and camps which sprang up along the railroad line or near the excavations for the canal.

When the United States became engaged in building the Canal (1904-1914), the population rose to over 40,000 persons, most of whom were foreign workers. After completion of the Canal, the population dwindled as a result of two major events: (1) the United States created the Canal Zone, displacing most of the previous Panamanian population, and (2) Lakes Gatún and Alhajuela were created, which involved the flooding of some 480 kilometers and more than 50 small towns. By the end of the 1930s, there were no more than 8,000 inhabitants remaining in the basin.³

In the wake of World War II, a veritable population explosion took place which resulted in the growth of the area's population from about 20,000 (in 1950) to more than 100,000 (by 1980). About 66% of this increase has been centered in Alhajuela, where the population doubles every 10 years and still grows at 6% per annum (García, Bern and Morán, n.d.; Cortez, 1978). Initially, the major increase came from immigration: both that of peasants as well as a consequence of the outward thrust of urban dwellers from the cities of Panamá and Colón, which began to expand and extend into the basin along the path of the cross-isthmus highway. This highway, which crosses the isthmus alongside the Canal and the railroad, was completed in 1947, whereupon it became the axis along which the urbanization and industrialization of the basin proceeded. At present, the natural increase of the local

population provides the major source of its demographic growth.

For the purpose of this work, however, the most important implication of demographic growth on the environment comes from the migration of the *campesino* into the Canal Basin, since it is the systems of production which they bring with them that have been the primary cause behind most of the deforestation. Here it is necessary to stress that beneath the label of *campesino* is hidden a most complex and little studied social development.⁴

The peasant migration and its impact on the systems of production. In this century, the Canal Basin has been converted into the rural zone of the greatest ethnic, cultural, and economic complexity in Panama. To this area have come peasants from the provinces of Coclé, Veraguas, Chiriquí, Los Santos, Darién and Herrera, as well as indigenous *chocoés*, West Indians, Chinese, and Colombians.

What attracts the peasantry to this area? On the one hand, there is its proximity to the metropolitan region, the largest market of the country; on the other, they are also pushed by the crisis of the countryside in their regions of origin.

Each of these groups has come at different times, and each group has brought with it its own social institutions, methods of production, and cultural values. In this way, the peasant migrants have been able to preserve, to a great extent, their own ways of perceiving and interpreting the world around them.

In more recent times, the first wave of immigrants was made up of the farmers displaced from the old towns located along either "the line" or the River Chagres, which had been flooded in the process of creating Lake Gatún and now lay under its waters. Many of those families sought refuge either on higher ground or along the banks of the new lake system. Ethnically and culturally, these people were Afro-mestizos, growers of tubers and other perennials, whose main income came from the cultivation of bananas.⁵

Another group which established itself early on came from the West Indies. This population was made up of workers — black, English-speaking, and Protestant — who had opted to remain on the isthmus after construction on the Canal was completed rather than return to their densely populated islands of origin. The town of New Providence (*Nueva Providencia*) was founded in 1916 on the banks of Lake Gatún by workers from Barbados.⁶

Two waves of migration came from Colombia: the first wave came in response to the intensive lumbering industry which had existed in the area prior to creating Lake Gatún, while the second wave came, mostly from the departments of Chocó and Bolívar, to work on building the dam across the Madden.

For thirty years (1920-1950), the rural economy was oriented to producing bananas for the US market, until several factors — primitive means of production, impoverishment of soil, and inability to control plant disease — combined to lead to a rapid decline in production and, ultimately, to destruction of the industry. Plantations were profitable for only 4-5 years, whereupon they would be abandoned and other areas of the forest sought out and demolished in order to plant *guineos* (small bananas).

Because the banana front was always moving, in just a few years it soon penetrated several kilometers inland, which then contributed to the raising of prices almost prohibitively due to the cost of transporting the fruit to the loading platforms on Lake Gatún.

At the height of the “banana boom,” as this stage of economic prosperity was termed, the migration of *cholos* from the Coclé sierra accelerated. These peasants, latinized descendants of the indigenous Guaymas, had been slowly migrating toward the Chagres River basin ever since the 19th century (Panamá, 1916).

Initially, migration from the Coclé ran in cycles. The peasants worked on the plantations for brief periods to earn

money and then returned to the mountains. Eventually, many remained and settled in the river basin, forming such settlements as *Cerro Cama*, *Lagartera*, and *Lagarterita*. The economy of the Coclé people was based on both a “slash and burn” as well as on a farming (*finca*) type of agriculture. Raising livestock never played a major role.

Though the region was still heavily forested at the beginning of the 1950s, the arrival of newcomers from the interior — peasants from the extremely dry plains on the western Pacific side of Panama — gave impetus to the destruction of the forests. As these groups colonized the area, deforestation accelerated at an unusually rapid rate. This was due to their extensive cattle-raising, for which thousands of hectares of forest were razed and transformed into pasture for grazing. These *campesinos* in particular, mostly from the Azuero peninsula, are the most numerous and have had the greatest impact on land use and landholding.

During the 1960s and 1970s, peasant settlement continued and intensified. Almost all the basin area that surrounds Lake Gatún, plus the western section of Alhajuela, has been stripped of forests. Migration is now directed toward the last of the basin's forest reserves, which are located along the upper reaches of the Chagres River (Heckadon Moreno, 1981).

The crux of the problem posed by peasant migration to the area comes from their introduction, and employ, of traditional agricultural methods that make extensive use of natural resources — and which have a deleterious, if not disastrous, impact on the new environment.

The economy of these peasant households can be likened to a table supported by four legs: one leg is provided by agriculture, another by livestock, a third by wage labor, and the last leg by fishing. It is the first two “legs” which cause the most damage to the environment.⁷

Agriculture, probably the most important activity, is based on one or the other of two basic methods: either (1) a slash-and-burn type of cultivation or (2) that of the *finca*. The first

type requires that a different part of the forest be destroyed and burned each year in order to clear enough land to grow the basic grains and tubers which make up the bulk of the family diet. Though the rice and corn are raised primarily for domestic consumption, the corn makes it possible to raise poultry and pigs for market as well, albeit on a small scale.

Finca-type agriculture, on the other hand, relies on a more permanent type of cultivation, in which a number of different crops are rotated and intermingled, some for family consumption and the rest for sale. Although this system is better adapted to the fragile nature of the land, it is now becoming less and less common for a number of reasons: lack of credit and technical assistance, the high cost of transportation, and the low prices that farmers receive from middlemen. While *finca* agriculture is drying up for lack of incentives, the slash-and-burn method is also declining in tandem with the disappearance of the forests.

In order to obtain its minimum supply of food, each family must have access to at least 1-2 hectares of forest, which then must be cleared for planting. Clearing practices rely on primitive measures, such as fire, and the use of rudimentary tools, like the axe and machete. Generally, these plots remain productive for about a year, after which the yield quickly falls off due to the poor soil, whose fertility is rapidly depleted in the absence of either fertilizers (to replenish nutrients) or herbicides (to control/combat insects and plant diseases). Very seldom do these plots yield a surplus which can be sold.

Ecologically, slash-and-burn agriculture constitutes a rational system of land use where the population is small and forests are plentiful. However, several factors have intervened over the last 30 years to upset the balance which this system must maintain with nature. One factor has been a constant increase in the peasant population. Another factor is the *campesino's* need for cash money. Third, and unlike the situation in the past, the slash-and-burn plots have not been allowed to lie fallow in order to give the forest time to

regenerate before sowing again. Thus the extinction of the forests is hastened.

Another aggravating factor has been caused by the introduction of government regulations designed to protect the forest, which have contributed to the growing scarcity of forest land available to slash-and-burn cultivators. According to the 1977 Torrijos-Carter Treaties, Panama promised to guarantee that sufficient water would be available to operate the Canal. In order to carry out this pledge, it was necessary to establish a corps of forest rangers to protect the forests of the basin and to regulate, by means of licenses, the practice of slash-and-burn agriculture. In 1987, destruction of virgin forest was forbidden on a permanent basis. However, the government did continue to allow use of slash-and-burn techniques, though only in second-growth forests, for the next 5 years. At the end of that time, the prohibition of slash-and-burn was extended to second-growth areas as well. In essence, the government decided that, in order to save the Canal, the forests had to be protected from the machetes of the farmers.

This means that it is very difficult for peasant farmers to obtain parcels of primary forest for slash-and-burn type agriculture. The shrinking of the forest area, the prohibition against cutting trees, and the decreasing yields from crops have brought about a shortage of basic grains which is forcing a growing number of families to buy these foodstuffs from stores. Before this combination of forces, the peasants felt insecure, frustrated, and at the mercy of destructive forces beyond their control. Not being able to feed their families through their own efforts creates anguish and resentment among the peoples so affected.

As a result and understandably, political dissatisfaction is widespread throughout the region, making the task of those officials responsible for carrying out the laws to protect the environment just that much more difficult.

At the present time, 90% of the land formerly covered by forests is now devoted to the raising of cattle. This is unfortunate and one of the worst alternatives for development

given the high rainfall, hilly terrain, and impoverished soil. Nevertheless, this is the economic activity that has received the most stimulus from institutions, both public and private, in order to incorporate the forest regions into the economy of the country. Almost 98% of the farm loans granted by the state development bank have gone to the cattle industry in the Canal basin (García, 1986).

This support for the cattle industry is essentially a response to the demand for meat in the urban markets of the metropolitan areas. However, the cattle industry is technologically unsophisticated; as a result, it not only causes serious damage to the environment but its overall productivity is quite low.

The principal grasses are the *fragua* and the *indiana*. In the dry season, the pasture is burned, which leaves the soil exposed to the impact of the heavy rains and the wear and tear of the cattle's hooves as they go up and down the steep hillsides. As the rains wash away the soil, eroding the landscape, great gullies and deep ditches are carved in the pastures. Another detrimental practice is that of maintaining more cattle than the pasturage can support. The surplus of animals leads to overgrazing, with the result that the vegetation that they spurn soon becomes dominant. When the combination of erosion and inedible growth finally destroy the pasturage, the fields become "lost," as the saying goes, and are abandoned. This destructive process is gradually extending further and further throughout the basin.

Although, in the beginning, it took one hectare of grass to support one head of cattle, eventually two hectares were required, then three, up to four hectares per head. The cattle industry, on a small or medium scale, is barely profitable.

Extending the cattle industry further and further across the land not only results in the expulsion of men from the land but it generates little employment and leads to ever larger concentrations of land-holding. Right now, in the basin, there is a marked tendency for land to become concentrated in the hands of a few large landowners. Although, in the first stage, ranchers displaced the peasant farmers, in the second stage, the

small and mid-sized ranchers sold their *fincas* to other ranchers, who became transformed into large landed proprietors in the process. However, despite the fact that these thousands of peasant families have been the main agents of the deforestation, they will still have to be an essential part of the solution if the Canal basin is to be saved.

Let us close this part of the discussion by emphasizing the dilemma of the peasant economy, whose crisis has been aggravated by the government's decision to protect the forests in order to insure that there is sufficient water for the Canal and for the metropolitan population. In effect, the government decided to eliminate — in just 5 years — all slash-and-burn agriculture, a period in which there should have been offered, and disseminated among the peasantry, new methods of production that would be economically, ecologically, and socially viable. It is urgent that peasant methods of production be modernized. This will require that the farmer have access to low-interest loans, effective and timely technical assistance, means for penetrating the market, and just prices for his products. In the basin, these vital support services for production have been either deficient or non-existent.

While the peasant economy is in decline, there are other economic areas which also have a great impact on the environment.

2. Mining

There are two sorts of mining. At the artisan level this involves panning for gold in the streams and shallows of the rivers, a hard task to which hundreds of humble peasants devote themselves in order to obtain cash. However, it is the large-scale, mechanical extraction of primary materials for the construction industry which places the greatest burden on, and has the greatest repercussions for, the environment.

The construction industries of Panama City and Colón have been exhausting their sources of stone, gravel, sand, lime, etc., located in the vicinity of those metropolitan areas. In

consequence, each year those companies must go farther afield in pursuit of the necessary raw materials, which must then be transported across ever-increasing distances, a situation which not only adds to their cost but is also a factor in creating frequent shortages. For this reason, the ownership and control of those sources of supply closest to the metropolitan area have turned into an issue of major economic importance. This has forced an increase in the number of mining companies extending their interests across the basin. There are presently some 22,000 mining concessions listed and another 17,000 under negotiation (Mérida, 1986).

The mining industry thus presents us with another dilemma regarding the appropriate tradeoffs between development and conservation. Mining cannot be prohibited because that would be too serious a blow for the construction industry, a major source of employment in the urban areas. However, it is necessary to try to strike a balance by establishing where, and under what conditions, this activity should be carried out.

3. Industrialization

Thirty years ago, there was only one plant — a cement factory — located within the basin area. Today, there are many factories, turning out plastic products, glass, paper, lubricants, soaps, pesticides, pharmaceuticals, foundries, sawmills, and the like. Besides the manufacturing plants, there are others engaged in the large-scale raising, and processing, of poultry and pigs.

The number of such plants is bound to increase even more in the future since the region offers a number of conditions favorable to industry: good highways and transportation services, a railroad, water, and proximity to both the country's largest markets as well as to the best ports and international airports. Not only that, but the land is cheaper than in the cities of Panamá and Colón.

Factories, however, are great generators of waste material in the form of garbage, polluted water, and smoke. At the same time, industrialization has brought an increase in the population, with all the accompanying impact on the environment which that implies.

The process of industrialization is an anarchic one, with environmental controls and regulations almost non-existent. This situation offers cause for alarm given the fact that some of the plants process highly toxic substances. Another worrying effect of industrialization is that it has brought with it an increase in contaminated water. Factories discharge their waste water directly onto the banks and into the rivers that feed the lakes, a practice which threatens the water quality of those sources that supply municipal drinking water to the cities of Panamá and Colón.

Panamá, a poor country with a high level of unemployment, needs to broaden its industrial base and to depend less on a service economy. However, this process should not come at the expense of its natural environment, nor risk deterioration in the health and quality of life of its population. How can this dilemma be reconciled? It is important to ask such questions as: what kind of factories should be permitted within the basin and which not? Where should they be established and where not? And, above all, how — and who — should set the standards on pollution?

4. Urbanization

The basin of the Panama Canal is one of the regions of greatest urban growth in the country. This growth is a consequence of two major developments. The first is the expansion of the two terminal cities at either end: e.g., the city of Colón, which has been moving southward from one end, and the other, Panamá City, moving northward, following the trans-isthmian trajectory. It is possible that, by the year 2000, both cities will find themselves connected by an elongated corridor of houses. The other contributor to growth has come

from the increased industrialization, which has generated much employment and brought better services to the area.

Many factors that make the area favorable for industrialization also encourage its urbanization. For example, not only is land cheaper outside than inside the cities of Panamá and Colón, but there is also a good public transportation system. In addition to the expansion of the cities, other settlements have sprung up in the rural areas around the lakes, and in the mountains surrounding the basin.

Increasing urbanization carries problems along with growth, most having to do with pollution. Families produce garbage and waste water. The traditional practice has been to discharge water and waste material into the streams and rivers, which then empty into the lakes.

It thus becomes an urgent matter to reconcile the process of increasing urbanization with sufficient protection of the environment in order to ensure that the quality of the water delivered to the metropolitan region remains sufficiently high that it does not constitute a threat to public health.

5. Road Construction

The increase in population goes hand in hand with intensive construction of roads and highways. Because this activity is unregulated also, it has become a major factor in land erosion and contributor to the silting up of water courses.

At the same time, secondary roads, often built at the instigation, and for the convenience, of lumber and mining companies, lead off the main highways to which they are tied and into remote areas, thus facilitating and serving to encourage settlement there.

Practically anyone with any authority feels entitled to sanction the building of roads: local authorities, public institutions, the army, and private businesses. Such thoroughfares are usually built without any concern for their impact on the environment. The majority turn out to be the

well-known "summer short-cuts," poorly done and without provision for their subsequent maintenance. Tractors cut trails in the summer which are left to deteriorate in the winter, subject to the coming and going of animals and vehicles which turn the soil into a muddy morass that later, under the impact of the heavy rains, becomes washed away into rivers and streams.

While it is difficult, if not impossible, to bring road construction to a halt, some criteria must be established to define who can build roads, where they can (or cannot) be built, and under what technical conditions.

The environmental impact of the economic processes analyzed above is aggravated by the presence of non-economic factors.

PROBLEMS: ADMINISTRATIVE, LEGAL, AND CULTURAL

EVEN THOUGH the basin makes up a geographical entity, Panamanians are unaccustomed to looking at, and analyzing, its problems as a whole. This is due, in part, to the fragmentation of its administration. The basin area is divided into two provinces, seven districts, and 30 *corregimientos* (districts under the jurisdiction of a *corregidor*). Furthermore, these also correspond to areas of the old Canal Zone, which is divided up into a variety of civil and military jurisdictions for administrative purposes.

Another area of concern is the number of public and private institutions which operate with little or no coordination with one another. The administrative situation resembles an orchestra in which each musician follows a separate score. Not only does this often result in a duplication of effort, but also, at times, the pursuit of opposing goals. Neither is there any one single management plan or strategy that would be acceptable to all the different institutions involved.

Laws to protect the environment present another sticky situation. There are a great number of decrees, laws, and

standards established which are designed to protect the environment. However, on the whole, this body of law is obsolete and there is no relation between the punishment and the crime from the standpoint of the kind and/or magnitude of damage done. In Panama, those who destroy or pollute the environment do not have to “pay the piper.”

Given the negative view which the Panamanians have of natural resources, it is not at all easy either to apply the laws or to take steps to protect the environment. Regardless of class or level of education, Panamanians consider their natural resources to be inexhaustible. This is a dangerous myth. To save the basin will require a change in both cultural values and the outlook of the people, a change in which a variety of forces — the educational system (both formal and informal), the media, and civic groups — will have to play a key role.

Halting the deterioration of the Panama Canal basin will also require a high degree of administrative efficiency, political will, the participation of civilian groups, and economic resources. From whence will these resources come, given the present crisis in which Panama and the rest of Latin America finds itself?

AN ECONOMIC PROPOSAL TO SAVE THE CANAL BASIN

THE PANAMA Canal basin, as we have seen, is a marvelous system for the production and storage of fresh water. Ironically, neither the users nor the beneficiaries of this system — international trade and the inhabitants of Panamá City and Colón — contribute anything towards protecting that vital water resource. The urban consumer pays only a small fee to cover the cost of making the water potable. Neither does the Panama Canal Commission, which is controlled by the United States and which uses 94% of the water, pay anything for this resource since, according to the Torrijos-Carter Treaties of 1977, Panama must provide all the water, free of charge, required to operate the Canal up to the year 2000. Ships transiting the Canal pay a tariff of \$1.76 per ton to the Canal

Commission, a fee which nets the Canal Commission more than \$400 million per year according to its own report. Nevertheless, not one cent of this fee is allocated for the critical task of protecting the Canal basin.

Up to the present time, Panama has assumed the cost of programs to protect the basin by means of international loans, granted, more specifically, by the US Agency for International Development (US-AID). For this reason, there is no way that Panama, already burdened by a gigantic foreign debt, can continue to add to this indebtedness by bearing all the costs of protecting this vital ecosystem, whose major beneficiary is the international community. Therefore, it is imperative to increase the present fee for using the Canal by some 3 cents per ton. Each cent by which the fee is raised will represent an annual increase of income of about \$3 million. Increasing the tariff by 3 cents will represent a sum on the order of \$9 million, which could be allocated to the task of safeguarding this vital artery of international communication and progress.

NOTES

1. See also Isaza (1986).
2. An interesting book on life in the Chagres River basin during the colonial period and, above all, in the 19th century, is that of Easter Minter (1948).
3. Displacing Panamanian *campesinos* from the Canal Zone in the early decades of the 20th century is the main subject of a monograph by Gonifacio Pereira Jiménez (n.d.).
4. One of the few researchers who have touched on the issue of the peasantry of the Canal basin is Francisco Herrera (see his two studies).
5. In his novel entitled *Pueblos Perdidos*, Gil Blas Tejeira captures the trauma suffered by the farmers who lived in the towns along the Chagres when Gatún Lake was created.
6. According to Omar Jaén Suárez (1978: 309-318), the export of bananas from the Chagres River basin to the markets of the United States was initiated at the beginning of 1857, thanks to the inter-ocean railroad and the advent of the steamship.

7. Information on *campesino* systems of production described here are provided by Heckadon Moreno (1981).

REFERENCES

- ALVARADO K., L. (1985) "Final Report on Sedimentation in Madden Reservoir." Panamá, República de Panamá: Panama Canal Commission, Meteorological and Hydrographic Branch.
- CORTEZ, R. (1978) "La población de la cuenca," pp. 45-52 in S. Heckadon Moreno (ed.) La cuenca del Canal de Panamá: actas de los seminarios talleres. Panamá, R. de Panamá: Grupo de Trabajo sobre la Cuenca del Canal de Panamá.
- EASTER MINTER, J. (1948) The Chagres River of Westward Passage. New York, NY: Rinehart and Co.
- GARCIA, M. (1986) "El crédito agropecuario," pp. 159-166 in S. Heckadon Moreno (ed.) La Cuenca del Canal de Panamá: actas de los seminarios talleres. Panamá, R. de Panamá: Grupo de Trabajo sobre la cuenca del Canal de Panamá.
- GARCIA, A., G. BERN and G. MORAN (n.d.) "Algunas características de la población en el area de la cuenca del Canal de Panamá." Panamá, R. de Panamá: Ministerio de Planificación y Dirección de Recursos Naturales Renovables.
- Grupo de Trabajo sobre la Cuenca del Canal de Panamá (1986) "Informe del Grupo de Trabajo sobre la cuenca del Canal del Panamá" (Executive Summary). Panamá, R. de Panamá: Grupo de Trabajo sobre la Cuenca del Canal de Panamá.
- HECKADON MORENO, S. (1981) "Los sistemas de producción campesinos y los recursos naturales en la Cuenca del Canal de Panamá." Panamá, R. de Panamá: Dirección de Recursos Naturales Renovables y Agencia para el Desarrollo Internacional (AID).
- HERRERA, F. (n.d.) "Estudio socio-económico de tres comunidades en el sector oeste de la Cuenca del Canal." Panamá, R. de Panamá: Smithsonian Institute of Tropical Research.
- _____ (n.d.) "Análisis de factibilidad social de la Cuenca del Canal." Panamá, R. de Panamá: US Agency for International Development (US-AID).

- HUTCHINSON, R. (1986) "Calidad y demanda de agua para la población de la región metropolitana," pp. 87-108 in S. Heckadon Moreno (ed.) *La Cuenca del Canal de Panamá: actas de los seminarios talleres*. Panamá, R. de Panamá: Grupo de Trabajo sobre la Cuenca del Canal de Panamá.
- ISAZA, C. (1986) "Análisis de los factores que influyen en la erosión de la cuenca," pp. 121-141 in S. Heckadon Moreno (ed.) *La Cuenca del Canal de Panamá: actas de los seminarios talleres*. Panamá, R. de Panamá: Grupo de Trabajo sobre la Cuenca del Canal de Panamá.
- JAEN SUAREZ, O. (1981) "La creación de una franja pionera en las riberas del Canal de Panamá," pp. 121-151 in Smithsonian Institute of Tropical Research (ed.) *Hombres y ecología en Panamá*. Panamá, Panamá: Editorial Universitaria.
- _____ (1978) *La población del Istmo de Panamá del siglo XVI al siglo XX*. Panamá, República de Panamá: n.p.
- JONAS, J. and V. PONCE (1986) "Los tipos de suelo y limitaciones para su uso," pp. 109-120 in S. Heckadon Moreno (ed.) *La Cuenca del Canal de Panamá: actas de los seminarios talleres*. Panamá, R. de Panamá: Grupo de Trabajo sobre la Cuenca del Canal de Panamá.
- LARSON, C. (1979) "Erosion and Sediment Yield as Affected by Land Use and Slope in the Panama Canal Watershed," pp. 1086-1095 in Part III of the Proceedings of the II World Congress on Water Resources, sponsored by the International Water Resources Association, in México (DF), México.
- LARSON, C. and W. ALBERTIN (1984) "Controlling Deforestation, erosion and sedimentation in the Panama Canal Watershed" (Paper presented at the International Workshop on the Management of River and Reservoir Sedimentation). Hawaii: Environmental Policy Institute.
- LECOMPTE, D. (1984) "Transformación del medio geográfico en la región canalera," pp. 57-76 in *Tierra y Hombre* (Revista del Departamento de Geografía). Panamá, R. de Panamá: Universidad de Panamá, Departamento de Geografía.
- McKAY, A. (1977) "Salud comunitaria y colonización rural en Panamá: el caso de Cerro Cama." pp. 50-75 in S. Heckadon Moreno and A. McKay (eds.) *Colonización y destrucción de bosques de Panamá*. Panamá, R. de Panamá: Asociación Panameña de Antropología.

- MERIDA, J. (1986) "El potencial minero de la cuenca del Canal," pp. 193-200 in S. Heckadon Moreno (ed.) *La Cuenca del Canal de Panamá: actas de los seminarios talleres*. Panamá, R. de Panamá: Grupo de Trabajo sobre la Cuenca del Canal de Panamá.
- Panamá. (1916) "Informe del Gobernador de la Provincia de Colón," p.42 in *Memoria de Gobierno y Justicia*. Panamá: Tipografía Diario de Panamá.
- PEREIRA JIMENEZ, G. (n.d.) "Biografía del Río Chagres" (monograph). Panamá, R. de Panamá: Imprenta Nacional.
- ROBINSON, F. (1985) *A Report on the Panama Canal Rainforests*. Panamá, R. de Panamá: Panama Canal Commission, Meterological and Hydrographic Branch.
- WADSWORTH, F. (1976/77) "Deforestation: Death to the Panama Canal" (Paper presented at US Conference on Tropical Deforestation). Washington, DC: US Department of State and Agency for International Development (AID).