# Chapter III

## ECONOMIC AND ENVIRONMENTAL POLICIES

*If sustainability requires a dynamic equilibrium among all the forms of capital that contribute to the development effort, then a sound policy would be one that would promote such a balance, so that the improvement of the environment would lead to economic and social development.*

### 1. Introduction

The impact of economic policies on the environment and natural resources is neither symmetrical nor neutral. Such policies have primary and secondary effects and externalities which must be duly recognized and evaluated. While the origin of these effects is varied, they all influence the behaviour of the economic agents involved in the use of these resources. Typical examples of these policies are those concerning changes in interest rates which affect the lead time of investments and therefore their rate of economic return; reallocation of fiscal resources and credit, which can alter the entire incentive structure; and devaluations of local currencies, which have an effect on the rate at which non-renewable natural resources are tapped.

On the other hand, a wide range of existing environmental policies do contribute to the achievement of sustainable development. The objective of these policies may be to reduce the rate of use of one or more resources, or to improve the direct protection of the environment. Examples abound: taxes on contaminating agents, modification of the property rights to a forestry or fishing resource, subsidies for technological changes that reduce pollution or controls for protecting against overgrazing in zones with fragile plant cover, among many others.

Since economic and environmental policies interact in the most diverse ways and mutually affect each other, it is important for this interaction to be consistent. One of the principal tasks facing the region in this decade, in fact, is to incorporate the environmental dimension into economic policy and planning. This incorporation of the environmental dimension should be achieved through macroeconomic instruments, such as structural adjustment programmes (national and sectoral), public investment and expenditure programmes and investment projects. Similarly, educational and public awareness efforts should incorporate environmental issues as a major component of equitable and sustainable development.

### 2. Major areas of environmental policy

The scope of environmental policies exceeds local or sectoral economic boundaries. There are three major areas of environmental policy which are of particular importance: i) personal and social consciousness-raising and education, ii) sectoral and national investment and iii) technology. Since the technological dimension of sustainability will be dealt with in chapter VI, this section will

examine only the first two, as well as other specific environmental policies.

2.1 *Personal/social awareness and education*

Increasing the awareness of the general public is a necessary pre-condition for the success of any development effort. In the absence of a proper understanding of the role played by nature in the well-being of individuals and the community, environmental actions are doomed to failure. It is in the national conscience –that amalgam of individual levels of awareness– that options are established and the most important priorities are set for development and the environment. A strong social conscience promotes consensus, increases the commitment of all agents participating in development and permits greater participation by the citizenry (see box III-1).

The individual and collective conscience has been a major protagonist in the history of development, and the importance of campaigns of persuasion to mobilize the population is a well-known theme. The power of "public opinion" has thus begun to modify the conduct of certain sectors that pollute air and water. Another expression of the importance of environmental awareness is the success of non-governmental organizations (NGOs) in organizing and mobilizing communities for sustainable development. These promote participation and consciousness-raising at the community level, thus achieving objectives of development which bilateral and multilateral organizations have not been capable of achieving. This is particularly true when the actions of NGOs take place within a favourable setting created by the general and regional measures adopted by the State. On the other hand, the absence of co-ordination and complementarity between public and private organizations, or conflict among them, have been the root causes of many failures.

The educational system, particularly at the primary level, is an important tool for modifying the values and conduct of the society *vis-à-vis* its natural resources. The socialization of these values among youth, together with the active participation of the latter in the design and execution of sustainable development, are the most effective means of ensuring the achievement of established developmental goals for the benefit of those sectors of the population –young people– who will be most affected by the deterioration of the environment.

The increasingly important role of women in the protection of resources also deserves mention here. Through them, the family and the community participate in environmental strategies. They constitute, moreover, a key element of the social conscience of the general public.

2.2 *Investment policies*

National investment policies provide the basis for the equilibrium among all the forms of capital that participate in development. These policies, which generally emerge within their sectoral ambit, define the forms of accumulation in the short and long term (see box III-2).

They promote the creation of a climate that stimulates private and public investment. In order for this to happen, however, it is essential to recognize that natural and environmental resources are forms of capital and, as such, should also receive investments.

One way of incorporating essential elements of sustainable development is through national investment and public expenditure programmes. The formulation and review of such programmes represents a unique opportunity for determining whether there is a general balance among all forms of capital. Environmental and natural resource management programmes should be incorporated at this level. Their incorporation will depend on the different investment options that exist, on the perception of the net benefits to be received and on the economic criteria that will be used to select and evaluate these investments.

The criteria used to decide on a given investment, are not, however, generally subject to adjustment programmes. In practice, financial institutions evaluate investments on the basis of a certain anticipated level of opportunity cost. The only exceptions have been those investments directed towards education and public services. Hence investment programmes in the area of the environment have clearly suffered, partly on account of the physical impossibility of

**Box III-1**

## CHANGING PRODUCTION PATTERNS AND ENVIRONMENTAL CONSERVATION: MINING ENTERPRISES IN CHILE

The process of introducing technology for environmental monitoring in copper-works shows how the processes of changing production patterns have interacted with environmental conservation criteria in Chilean mining enterprises. In the 1980s, Chile increased its capacity for smelting concentrates from about 1.9 million tons a year in 1980 to 3.4 million tons in 1989. This achievement was the result of a policy to increase investments in State-owned mining, in which emphasis was placed on expanding the installed capacity by making operational improvements and introducing new fusion technology for the purpose of strengthening the performance of Chilean copper on international markets by increasing production and reducing costs.

The main advantages of the new fusion technology (the Outokumpu flash furnace, a modified Teniente convertor operating with oxygen-enriched air) were greater efficiency and lower energy consumption than those associated with conventional technologies (reverberatory furnaces). The new technology was for the most part incorporated without taking environmental conservation criteria into consideration and as a means of supplementing the reverberatory furnaces, which are still in operation (under various conditions of environmental control) in the six existing foundries.

Because production patterns were changed only under the impetus of economic factors associated with the profitability of the copper industry, and also because there was little awareness of the environmental impact of the mining industry or much desire to monitor compliance with environmental quality standards, it seemed reasonable not to invest in total technological renovation but rather in an approach in which old and new technologies were mixed, since in that way the marginal investment needed to expand production capacity was kept down to a minimum.

However, the increase in copper production was accompanied by a considerable rise in the emission of pollutants (sulfur dioxide and particles) from foundries and caused the levels of pollution in nearby farm regions and populated areas to soar. This gave rise to disputes with the farm sector and with communities, one of which was resolved in 1987, when the people of Chañaral (10 000 inhabitants) won a suit brought against the National Copper Corporation of Chile (CODELCO), the leading copper producing enterprise in the world. The Chañaral case provides an indication of what a force citizen pressure can be in identifying policies aimed at environmental control and introducing technologies for ensuring such control in the Chilean mining industry.

The new management of CODELCO-Chile has made it a strategic objective of the company to be a world producer of copper which operates with low costs while accepting its ecological responsibilities. In the case of the foundries, this means the gradual incorporation of environmental control technologies, which will usher in a number of changes in the production patterns of the copper industry in the 1990s.

The most reasonable environmental conservation criterion in Chilean foundries is that of applying different environmental regulations for existing plants than for new units. New foundries are to be required to utilize technology which, while commercially viable, ensures that environmental quality controls will be applied more diligently. As for existing units, the levels for the emission of pollutants set for them are to enable them to meet national standards of air quality within a reasonable period of time. Since this may mean very different levels of emission for foundries in different geographical locations, the control of emissions will not necessarily require that the production patterns of all units be changed, since in some cases merely incorporating environmental control technology in existing equipment will be enough to keep within the standards set.

This environmental conservation policy will have certain significant consequences for Chilean foundries. First, plans to reduce emissions will be implemented in practically every foundry, which will mean investing in environmental control technologies (primarily for the plants which produce sulfuric acid), in new fusion technology and in engineering, studies and analyses. Second, fresh investments made for the purpose of increasing the smelting capacity of existing units must be preceded by an analysis of the environmental impact of the project showing that the changes in production patterns to be made will lie within the parameters of environmental conservation. Third, thanks to investments made in various sulfuric acid plants, the country will stop importing this input in 1993 and will be able to produce a higher proportion of copper at a lower operational cost by using hydrometallurgical technologies. Finally, since 95% of the present smelting capacity is controlled by State enterprises, the new policy would provide a strong incentive for executives, professionals and workers to improve the environmental management of these undertakings.

**Box III-2**

**PETROBRAS**

Brazilian Petroleum Inc. (PETROBRAS), with annual sales totalling nearly US$15 billion, has been one of the largest firms in Latin America for a number of years now. Despite its standing, however, the company's performance in terms of environmental control and protection used to be quite lackluster; its investments in environmental equipment and controls had not kept pace with the expansion of its production and its increasing levels of activity, and the firm therefore lacked the capability to reduce the risk of accidental spills and of a progressive degradation of the environment in the areas where its various fuel production and distribution activities are conducted. In fact, until a few years ago, the protective measures taken by the firm were limited to the bare minimum required by law and, even in this respect, it received numerous complaints from State environmental protection agencies regarding a failure to meet environmental standards.

In recent years, however, PETROBRAS has been making an increasingly determined effort to remedy this situation, despite the fact that it, along with most public utility companies in Brazil, has been experiencing budgetary difficulties. Its initiatives in this connection have focused on organizational matters and investment plans as well as the pursual of specific environmental research and development programmes.

At the organizational level, there has been a noteworthy increase in exchanges of expertise and in collaboration among the 12 industrial complexes of PETROBRAS located throughout the country.

PETROBRAS has two branches which have specifically been placed in charge of environmental matters: the Leopoldo Américo Miguez de Mello Research and Development Centre (CENPES) and the Superintendency for Environmental Safety (SUSEMA) The latter, which is attached to the Office of the President, is primarily concerned with the institutional relations of PETROBRAS. In addition, each technical department has an Advisory Office for Environmental Safety (ASSEMA) which serves to promote a decentralized management of environmental affairs in each industrial complex. The firm's regularly scheduled personnel training programmes include modules on the preservation of the environment. Mention should also be made of the recently created Advisory Office for Industrial Protection (APIN), a subsidiary unit of PETROBRAS Distribuidora S.A., which is responsible for addressing problems related to safety and the environment in the industry.

The amount of funding allocated for investments in environmental controls has risen steadily in recent years. Projects representing a total investment of US$330 million are currently under way in areas such as the treatment of liquid effluents; solid waste incineration; the monitoring and treatment of gas emissions; the recovery of sulphur, water and crude oil; waste treatment and disposal; electrostatic particle precipitation; the use of vacuum chambers to improve drainage systems; and the separation of by-products by means of horizontal centrifuging.

The fact that these investment projects depend on the firm's general budget for their financing has frequently occasioned delays in their implementation. The establishment of a separate budget for environmental preservation initiatives has been proposed as a means of preventing such delays and protecting environmental projects from the frequent cuts in the general budget necessitated by the present economic situation.

Simply to comply with existing environmental regulations, investments totalling nearly US$150 million are planned over the next five years. It is estimated that such investments would represent between 7% and 10% of the total cost of establishing any new industrial complex.

In the field of research, CENPES has recently conducted specific programmes in a variety of areas:

- The establishment of standards for the biodegradation of petroleum wastes by means of land-farming techniques;
- Bioassays for the treatment of liquid effluents;
- Studies on the biological treatment of liquid effluents (in co-operation with the Environmental Sanitation Technologies Company (CETESB));
- Experimental measurements of emissions of liquids and gases;
- Networks for monitoring environmental quality in the areas influenced by the activities of oil refineries;
- The development of products which do less harm to the environment (diesel oil, gasoline, desulphurized fuels);
- Reforestation programmes in the vicinity of the Cubatão refinery, and the reclamation of despoiled areas in the São Mateus mine.

Now, however, because the firm is temporarily unable to send technical missions abroad on a regular basis, as it had in earlier years, and given the

fact that not all the special technologies that are needed are available in Brazil, the firm has been unable to continue to make satisfactory progress in the area of environmental protection.

Source: ECLAC, Tecnología, competitividad y sustentabilidad (LC/L.608), Santiago, Chile, January 1991. (Document prepared by the Joint ECLAC/UNIDO Industry and Technology Division.)

calculating the economic rates of return, and also because of the lack of symmetry between the intertemporal origin of benefits and the allocation of costs. This subject will be dealt with in greater detail in chapter VIII, which deals with financing and sustainability.

Finally, investment policies and programmes should be evaluated on the basis of their contribution to the sustainability of economic development. The lesson to be drawn from many completed projects is that negative external effects could have been avoided if, in addition to the traditional economic appraisal, there had been rigorous institutional and environmental impact studies.

### 2.3 *Other environmental policies*

A wide range of specific environmental policies also exists. These are designed to regulate access to natural resources and their use and to eliminate certain effects which are prejudicial to development.[1] A difference is noted between these two aspects only to define the areas of institutional decisions involved in this subject. In practice, these policies constitute an indivisible "package" of instruments. Some of these policies affect the behaviour of economic agents in the allocation and distribution of their resources. In this regard they are similar to the economic policies discussed above. Examples might include taxes on polluters, or subsidies for those adopting clean technologies. In both cases, these instruments will change the relative prices or net earnings of the affected parties.

Other policies modify the prices of inputs and products that affect the environment, i.e., by setting minimum or maximum prices for environment-related goods or services not traded in traditional markets, by instituting taxes or subsidies that change the use rates of mineral resources or by taxing or subsidizing land in order to alter its allocation or productivity.

However, environmental policies have tended to favour the use of instruments for the direct regulation of resources at the expense of indirect economic instruments. Examples include closed seasons for fishing; zoning for the exploitation of forestry resources; exploitation quotas for resources in danger of depletion; production quotas for polluting products; and protection of certain areas, such as native forests, flora and fauna, in order to preserve ecological diversity.

Rights of access, as in the case of national parks, represent a type of policy frequently used. In other areas of the economy, such as the forestry sector, entrance fees are complemented by regulations governing lumber prices and logging Mention should also be made of so-called "regulations". Generally speaking, environmental policies are regulatory in nature, i.e., they set standards for measuring the behaviour of economic agents Of the plethora of regulatory instruments in the region, a substantial number are not enforced despite being part of the legal system.

Lastly, policies governing property rights and restrictions also affect environmental policy, since there is a significant number of cases in which the performance of economic and social agents largely depends on tenure systems. Where property rights do not exist, or are not properly exercised by their public or private holders, it is impossible to control the exploitation of a natural resource, since the user will be motivated to exhaust the potential rent from the resource rapidly, thereby depleting it. This fact produces a

chain reaction: when an agent exploits a resource, others will follow his example, thus setting off a race to capture the potential rent from the resource. In most countries, property rights generally do not exist with regard to irrigation water, ocean fishing and land allocation.

## 3. Relationship between economic policies and the environment

A complex interrelationship exists between economic and environmental policies, which may be characterized schematically through a conceptual and practical framework that illustrates how certain economic policies which have been implemented in the region over the past two decades have affected the environment. This makes it possible to identify the most important relationships between economic and ecological systems; it also helps to identify criteria for the formulation of policies, and permits the establishment of a system to evaluate these policies in terms of the sustainability of development.

The link between economic policies and the environment is illustrated by the following factors:

i) availability of stock of a particular resource;

ii) flow of benefits which it is expected will be derived from a given resource;

iii) spatial distribution of economic and social activities;

iv) land allocation and use (a topic which because of its importance will be dealt with separately);

v) incentives for investing and reinvesting in a resource;

vi) behaviour of economic agents in terms of the "rent" to be derived from a resource;

vii) comparative and absolute advantages in international trade;

viii) redistribution and equity at the national, regional and local levels (all environmental problems involve redistribution);

ix) effectiveness of economic and environmental policy instruments;

x) time preferences (intertemporal use of a resource); and

xi) the availability of domestic resources.

The direct influence of all or each one of these factors in sustainable development will depend on particular situations. Various examples exist in the region of economic policies with contradictory objectives. For example, while the coefficients of comparative advantages may suggest that a country should export a given industrial product, the external effects of the pollution associated with this product may suggest the opposite. Certain export-promotion policies may thus reduce the effectiveness of environmental policies. In other cases, however, policies aimed at improving economic efficiency actually lead to sustainable development. This would be true, for example, in the case of the removal of subsidies on pesticides or other contaminating inputs, which would help to enhance economic efficiency while at the same time cleaning up the environment (see box III-3).

It is useful to elucidate some of the relationships between economic and ecological systems. Three of them are particularly noteworthy in view of the magnitude and frequency of their secondary effects and externalities in the region, and also because they are important in evaluating national policies. These are *land use, investment and reinvestment incentives* and *the effectiveness of economic and environmental policy instruments.*

With respect to *land access and use*, note should be taken of its pressing importance to the agricultural and urban sectors, and to a lesser degree to coastal resources. Changes in economic policies –such as the establishment of systems of relative prices which enhance the efficiency of the farm sector– lead to profound changes in land use. In view of the multifaceted nature of this resource, its peculiar characteristics will determine its productive capacity within the framework of a given space and time. Thus, for example, idle land will be incorporated into cropland as a result of variations in the relative price of certain products, or significant changes in the alternative use of soils. One of the sectors most affected by these

**Box III-3**

## PESTICIDE SUBSIDY POLICIES

Many governments often provide direct or indirect subsidies for the production and sale of pesticides through tax exemptions, sale at prices below costs, access to foreign currency and credits on favourable terms, among other mmechanisms. Although these subsidies represent heavy outlays for governments, and in spite of the evidence of the harmful effects on health and the environment caused by the abuse of pesticides, there are still not enough systematic studies analysing the economic and environmental impact. Some of the questions connected with pesticide subsidy policies are set forth below.

*Economic and environmental aspects*

Estimates on pesticide subsidies carried out in respect of a group of nine developing countries showed that in 1982 the average level of subsidy came to 44% of the total retail cost of these products. In Honduras, Colombia and Ecuador, the level of the subsidy was 29%, 44% and 41%, respectively, representing a total annual subsidy of nearly US$70 million in Colombia, US$14 million in Ecuador and US$12 million in Honduras. In the case of the latter country, for example, this means a per capita cost of US$3 per year.*

Subsidies for pesticides take various forms. Thus, for example, importers of pesticides or of their ingredients can buy foreign exchange at a lower cost, enjoy favourable import duties, and also receive some tax exemptions.

The subsidy policies affect the decision-making process of farmers. By reducing the cost of pesticides, these subsidies encourage farmers to use more chemical products more frequently than if they were comparing the benefits with the non-subsidized prices. These subsidies also discourage pest control by methods that do not depend so heavily on chemicals, as well as discouraging the development and promotion of methods which could prove to be more effective.

Moreover, by promoting increased use and perhaps even abuse of pesticides, these policies increase the possibility that –through their secondary harmful effects on health and the ecological balance– these products may damage society as a whole. Such risks, needless to say, do not enter into the calculation of private costs and benefits. In this respect, various studies indicate that in Central America indiscriminate use of pesticides is one of the most serious problems with regard to health and environmental pollution. In many agricultural areas, especially in the cotton-growing regions on the Pacific coast, the levels of application of pesticides even exceed those recommended by the manufacturers themselves, so that in 1977, for example, an average of 6 kilogrammes of pesticides per hectare were being used in this area.

The levels were particularly high in El Salvador and Guatemala, and it is estimated that in the latter country a total of 80 kilogrammes of insecticides are used annually on each hectare of cotton, which represents an extraordinarily high figure by world standards. Likewise, it is estimated that in 1975 El Salvador used 20% of the entire world production of parathion, representing an average of 5.15 kilogrammes per hectare harvested. Finally, excessive pesticide use in Central America has been responsible for serious contamination of the human and animal population. Numerous cases of poisoning of human beings (especially agricultural workers) have been reported, and there are many indications of excessive levels of pesticide residues in samples of milk and meat, together with contamination of the land and water resources.**

*Final comments*

Although pesticide subsidies involve heavy costs for governments in terms of lost income and direct budgetary outlays, there have been few systematic appraisals of the benefits of these policies and the desirability of their continuation. In many cases, there is a shortage of precise information on the real effectiveness of these subsidies and their impact on resource use and production. Moreover, the question arises of whether there may not be less costly alternatives for pest control and other ways of increasing agricultural production and profitability. Finally, the benefits which a generous subsidy policy may at present be providing for agricultural production should also be appraised in the light of their impact on such variables as health and the environment.

---

*Based on Robert Repetto, *Paying the Price. Pesticide Subsidies in Developing Countries*, World Resources Institute Research Report, No. 2, Washington, D C., World Resources Institute, 1985

**H. Jeffrey Leonard, *Natural Resources and Economic Development in Central America*, New Brunswick: Transaction Books, 1987

changes is forestry where, in order to profit from price increases, thousands of hectares of forests are cut or burnt down. In many cases, it is impossible to recover these soils for any kind of productive activity.

The big cities in the region tend to suffer from a shortage of land, frequently because of poor regulation of the real estate market. This leads to all kinds of problems in formulating human settlement policies that are environmentally sustainable. Moreover, where there are deficiencies in the rights to land ownership and in the quality of land registers, an irrational competition takes place for the occupation and use of these lands. This situation has a significant impact whose consequences are paid by the lowest-income strata of the population. Furthermore, the lack of planning of basic services leads to prohibitive costs for the execution of infrastructural works requiring major investments, which only serves to exacerbate the vicious circle (see box III-4).

With respect to the *investment and reinvestment incentives*, it is worth noting in the first place, that most approaches conceive of natural and environmental resources as consumer goods and not as investments. This approach results in the rapid degradation of natural capital. It should come as no surprise, then, that the countries of the region, on the basis of market signals, have increased the rate of extraction of their resources. Land is a case in point: in many areas there is no interest in maintaining it, and even less in increasing its fertility. What typically happens is that land, once exploited, is

**Box III-4**

**EFFECTS OF URBAN EXPANSION ON THE CITY OF LIMA**

The city of Lima serves as a dramatic example of the problems in terms of water supplies and the availability of farmland which are created by uncontrolled urban growth. The city lies in the two valleys –veritable oases within the coastal desert– formed by the Rímac and Chillón, and to a lesser extent the Lurin, rivers. From 1535 to 1920, when Lima had a population of about 200 000, the city covered scarcely 10% of the valleys' total estimated area of 32 000 hectares. Between 1920 and 1964, the amount of unoccupied land which was devoted to agriculture decreased from 29 067 hectares to 27 275 hectares (84.6% of the valleys). Between 1964 and 1979, when Lima's population reached the four-million mark, urban sprawl cut the figure to just 9 064 hectares. Today, virtually no farmland is left (less than 8 000 hectares), the irrigation system has been abandoned, and, along with it, the practice of watering the city's public parks.

The city's explosive growth and the loss of prime farmland have been accompanied by alarming changes in the area's surface water and groundwater systems as a result of the heavy demands placed upon them. Between 1970 and 1979, Lima's consumption of surface water climbed from 6.8 $m^3$/sec to 11 $m^3$/sec. The valleys' agricultural zones, which required 6.5 $m^3$/sec, also served as a recharge area for the groundwater aquifer, but they have since ceased to perform that function. Since the Rímac River provides scarcely more than 15 $m^3$/sec, by 1979 there was already a deficit of 1.5 $m^3$/sec. This shortfall was covered by pumping as much as 9.5 $m^3$/sec of groundwater when the river was low. Today, the average level of the water table is 20 metres lower than it was when this practice was begun.

By 1979 the city was aware that a crisis was brewing. The only option was to bring water from the Mantaro river basin, which is located approximately 150 kilometres from the capital city at about 4 000 metres above sea level. Unfortunately, the main channel of the Mantaro River is severely polluted by the tailings that have accumulated over the years along its bed and in the ponds that empty into it, and this made it necessary to design systems to draw off water from its tributaries. However, the high cost of the project (which has been further increased by the need to build special works for the catchment of unpolluted water), coupled with the complications created by the country's economic situation, has thus far thwarted efforts to complete its construction. In consequence, Lima suffers from serious water shortages which it is not going to be able to solve in the short term.

---

**Source:** Axel Dourojeanni, "Gestión de recursos hídricos en el Perú: Restricciones y soluciones", *Debate Agrario*, No. 4, Lima, October-December 1988.

abandoned. The same occurs with many other ecosystems (see box III-5).

Moreover, the *effectiveness of economic and environmental policy instruments* is minimal in very low-income areas. Where economic policies are designed to maximize their impact on the market, they cease to be relevant for those living on the periphery of that market. More finely tuned

**Box III-5**
**COTTON IN CENTRAL AMERICA**

The development of the cotton industry in Central America shows how the overabundance of financial capital (intensive application of insecticides, fertilizers, machinery and equipment, as well as investment in infrastructure) subjected the natural capital (land) to intensive exploitation which, in addition to reducing its yield, had a series of severe external effects. In such a situation, the country's Integrated Pest Control Programme was able to help to establish a more balanced relationship between the various forms of capital required by this crop.

In 1940 cotton was mainly consumed domestically and exported occasionally when prices were particularly attractive. Over the years, however, this product has become one of the principal export items of Central American countries, particularly Nicaragua, El Salvador and Guatemala.

The land was fertile, the rainy season made irrigation unnecessary and the dry season permitted the cotton to ripen: thus, the natural conditions were ideal for its expansion. To this advantage was added an abundance of cheap labour. However, the humidity and heat of the region also favoured the proliferation of insects which could not be controlled using traditional chemical compounds, since the tropical rains rapidly neutralized their effect, resulting in low yields or the intensive application of chemicals, thereby reducing profits

The discovery of DDT in 1939, however, revolutionized the situation: insoluble in water and practically insensitive to the sun, it was ideal for application on the Pacific coast of Central America. This situation led to the rapid expansion of the cotton industry, at a time when favourable prices prevailed on the international market.

Generally speaking, the process of financial capital formation began with the application of new technologies, and then extended to the use of fertilizers and machinery at the same time as physical capital was being formed through the construction of roadways.

However, after four or five years of insecticide use, soil fertility declined, leading to the application of fertilizers. In view of the flatness of the coastal land, the fertilizers were spread by tractors, whose introduction was facilitated by favourable credit conditions. Thus, in the late 1960s and early 1970s the main cotton-producing departments (provinces) in El Salvador and Nicaragua were using 50% and 90% of the tractors in the entire country, respectively.

Financial capital formation during the 1950s and 1960s was facilitated by channelling resources, at subsidized interest rates, either through development institutions or commercial banks –with special facilities granted by the Central Bank–, which furthered the expansion of a crop which, by its very nature, requires a high credit component. Multilateral and bilateral financial institutions, for their part, supported the construction of an extensive network of roadways which enabled the plantations to have access to equipment and inputs and facilitated the transportation of cotton to ports. In this way a complementary relationship developed between financial and physical capital.

The clearest evidence of a profoundly unbalanced process of capital formation was probably the application of insecticides. With the passage of time, pests developed that were resistant to DDT, to toxaphene and similar compounds, and new pests appeared. In response, different varieties and greater quantities of pesticides were applied. This coincided with a drop in cotton prices on the international market and with an increase in production costs, owing to the oil crisis. Over the past decade, the reduction in the international price of cotton was aggravated by severe financial imbalances and devaluations which made even further cuts in the profitability of this product.

In contrast with the investment in inputs, equipment and infrastructure, the deterioration of natural capital was accelerated for a number of reasons. Firstly, the control of insects required cotton plants to be removed at the end of the harvest –during the dry season– by plowing the soils, thereby leaving the soil vulnerable to wind erosion. Further, in preparing for sowing, the land was plowed in the rainy season, thus creating the risk that rainfall and run-off water might cause further erosion on an even greater scale. Finally, cotton tended to make particularly intensive use of nitrogen, phosphorous and other soil nutrients. Rivers and mangrove swamps were also polluted by wastes and pesticides.

The problems resulting from international price fluctuations, new pests and increasing cost of applying insecticides lead to sharp declines in exports in some years during the 1960s and 1970s. In the 1980s, however, the crisis in the cotton sector in Central America, which was also associated with financial imbalances and political turmoil, was particularly acute, as illustrated in the following table.

**COTTON EXPORTS**

*(Thousands of quintals)*

| | 1983 | 1985 | 1988 |
|---|---|---|---|
| Guatemala | 1 214.1 | 1 253.6 | 638.1 |
| El Salvador | 769.7 | 513.8 | 20.3 |
| Honduras | 64.8 | 111.0 | 16.1 |
| Nicaragua | 1 726.0 | 1 460.0 | 765.5 |

Source: Central American Monetary Council, *Statistical Bulletin, 1988*, San José, 1989.

The problem of sustainability is evident: for the four countries taken together, production fell in 1988 to a little over one third (1 440 000 quintals) of its level five years previously (3 774 600 quintals).

One response to the problem created by the increasing use and cost of pesticides and fertilizers has been the Integrated Pest Control Programme. This is a system aimed at optimizing the control of pests while taking into account economic and ecological factors, and based on a scientific knowledge of the crop and of its pests and natural enemies, as well as its economic and social rationality, including incentives and restrictions deriving from the economic, political and social regulations and values.

The Programme included: a) prohibition of the use of synthetic pesticides; b) return to the use of organic pesticides such as calcium and lead arsenate; and c) the introduction of biological methods of control, including the elimination of a second crop (the likelihood of reproduction of certain pests would otherwise increase), the establishment of uniform dates for sowing, the distribution of the natural enemies of pests (particularly other insects) and the interspersed sowing of other crops such as maize and wheat to facilitate the development of populations of natural enemies of pests. Seven years after the launching of the Programme, the application of pesticides (mineral and natural) had been reduced to a little over two per year, cotton pests had been virtually eliminated and both the production and quality of cotton had increased.

intervention policies need to be designed for such cases, including policies on income and income redistribution and direct intervention policies such as the regulation of tenure and the classification of property rights.

Finally, if there is some lesson to be learnt from this situation, it is that there is an infinite number of relationships between economic policies and natural resources, and that these need to be more carefully studied. The region, however, does not have enough background information on this subject, owing to the absence of scientific research and the complexity of certain ecosystems. Getting down to the task of comprehensive research into these links is another challenge to be faced by the region in the present decade.

## 4. Macroeconomic policy and its environmental impact

Macroeconomic policies are generally evaluated according to their impact on the main economic aggregates, i.e., according to the primary or direct effects of such policies. At the same time, macroeconomic policies lead to significant secondary or indirect effects. By way of example, investment in one sector of the economy may attract idle resources from another sector. Or a specific investment may lead to technological innovation (see box III-6).

These indirect effects of macroeconomic policies are felt at certain levels –either productive or environmental– which are outside the institutional framework of those who originally designed and applied the policies. In other words, the impact of certain policies is felt by certain countries, sectors or forms of capital which were not taken into account in deciding how resources would be allocated. The Systems of National Accounts, for example, do not consider natural resources as capital goods subject to depreciation.

Variations in the supply of natural capital, or the availability of natural resources, are another aspect to be considered. Economic policies affect the stock and exploitable flow of resources, especially since they modify the comparative advantages of exploitation. Thus, an export promotion policy, for example, stimulates the exploitation of mineral, fishing or forestry resources. This attitude cannot be criticized as