

PROTECTION OF GLOBAL BIODIVERSITY

Converging Strategies

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Sustainable Development and North-South Trade

by Graciela Chichilnisky

The present acceleration of environmental destruction can be linked to the economic trading strategies that came into vogue after World War II. The theory of comparative advantages of trade, which recommends that developing countries emphasize resource exports and exports of labor-intensive products, has proven devastating to both the economies and environments of Latin America and Africa. In contrast, the Asian Tigers approach based on external economies of scale, has generated knowledge-intensive products where benefits spread across whole industries and whole economies, leading to more economic growth with much less environmental degradation. Such an approach should be promoted throughout the world trading system instead of the resource-intensive patterns of growth that continue to threaten our global environment. This is particularly important because other resource-conserving strategies, such as green accounting and property rights regimes, remain politically unattainable.

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The Global Environment Today

Human beings, or their close genetical relatives, have lived on earth for several million years. Yet it is only recently that human activity has reached levels at which it can affect fundamental natural processes, such as the concentration of gases (chlorofluorocarbon, or CFC, and CO₂) in the atmosphere of the planet, and the complex web of species that constitute life on earth. There is considerable uncertainty about the magnitude and impact of the changes that humankind is causing, but it is known that industrial activity has, for the first time in history, reached levels at which it can alter the planet's atmosphere and destroy its biodiversity. Incidents of destruction of particular species are recorded; however, the overall destruction of biodiversity on the planet is not (Kalin, Raven, and Sarukhan 1992). Some fear that humanity's survival may be at stake.

The June 1992 Earth Summit in Rio de Janeiro underscored this concern. In the United Nation's Agenda 21, 150 nations explicitly recommended new development

patterns based on the satisfaction of basic needs, a concept created and developed within the Bariloche model (Chichilnisky 1977a; Herrera, Scolnik, and Chichilnisky 1976). The summit chose three major areas in which concerted international action is urgently needed: biodiversity, climate change, and sustainable development. Two Framework Conventions were assigned the task of designing international policies that can avert damage in these areas. The areas are so closely connected as to be inseparable in real as well as conceptual terms.

Biodiversity cannot be seen in isolation, and the threats to biodiversity must be contextualized within the patterns of economic development. Most biodiversity loss is due to habitat destruction, for example through deforestation. Deforestation, in turn, is mostly due to the transformation of forested areas into agricultural sites for growing cash crops, or for exploring and extracting resources such as petroleum. The driving force behind most biodiversity loss is economic development based on the exploitation and intensive use of natural resources.

Often the exploitation of resources is for trade in the international market. Petroleum exploitation in the Amazon basin and copper extraction in Chile are good examples, and so are most cash crops grown in Central and South America and in Africa, such as sugar, coffee, and soya and palm oil.

This chapter examines the problem from a North-South perspective, focusing on patterns of trade between industrial and developing nations. It suggests patterns of sustainable economic development that are in harmony with the earth's resources. In the last 50 years, industrial society has developed a voracious appetite for the earth's resources, and in the midst of its "golden age," it is starting to bite its own tail.

Major changes in our understanding of economic development are needed to ensure the preservation of the world's remaining resources and its biodiversity. Economic development is not about doing more with more, but rather, doing more with less.

Major Concerns and Little Action

Three years have passed since the Framework Conventions were charged with their task at Rio's Earth Summit, but little action has been taken so far. Two major factors hinder the negotiations. The first is the differing perceptions of global environmental problems by industrial and developing countries. A second contributing factor is that our scientific knowledge of global environmental issues is poor.

Global environmental problems are relatively new; because they are global in nature, traditional physical sciences are ill-equipped for understanding them. However, scientific uncertainty about physical phenomena should not by itself detain the negotiations. After all, one often assumes decisions under uncertainty; in this case, under scientific uncertainty. It is the first problem—North-

TABLE 1 Share of Total World Carbon Dioxide Emissions, Population, and GNP Industrial and Less-developed Countries 1986

Countries	Cumulative CO ₂ Emissions	Current CO ₂ Emissions	Population	GNP
Industrial	70%	60%	23%	84%
Less developed	30%	40%	77%	16%

Sources: Author's calculations are based on Susan Subak, *Accounting for Climate Change* (Stockholm: Stockholm Environmental Research Institute, 1990).

South differences—that hinders the negotiations. This point was underscored at a conference of the parties in Berlin in April 1995. The North-South differences go to the root of the global environmental problem, and lead us to question fundamental issues about economic development, international trade, and the distribution and use of resources on the planet.

North-South Issues

Developing countries view global environmental issues in a historical perspective, and observe that most of the damage to the global environment originates in the industrial countries. The industrial countries, for obvious geographical reasons, are called the North. For the same reasons, the developing countries are called the South.

Greenhouse gas emissions are a prime example. Carbon emissions arise from the use of energy: the more energy that is used, the more carbon that is emitted. Energy consumption is proportional to the level of production, and most production takes place in the developed countries of the North, which house about 20 percent of the world's population. Table 1 shows that 70 percent of the world's CO₂ and most of the CFCs are emitted by the industrialized countries, which have also substantially altered their biomass. In per capita terms, the emission of carbon is 10 times greater in industrial countries than in developing countries. Therefore, the North consumes most of the energy produced in the world.

By contrast, most of the biodiversity and forests remaining on the planet are in the South, home to most of the planet's people as well. The developing countries account for four-fifths of the total world population. From the perspective of developing countries, the North is fundamentally responsible for the current situation, and nothing short of changing the North's pattern of development and environmental use can change matters. The problem, of course, is that restricting emissions requires restricting energy use and output. Therefore, the North must decrease its use of resources to make a dent in the problem.

Industrial countries have a different perspective on global environmental problems: they focus not on the past or present, but on a long-run future. They fear

rapid population growth in developing countries and the damage that this could eventually produce on the environment. China and India, countries with enormously large populations and fast growth rates, also have large coal deposits. As their industrial growth proceeds, they are expected to burn coal and emit carbon into the atmosphere in substantial amounts. In the case of China, generally accepted projections indicate that it could approximate U.S. levels of carbon emissions in about half a century. At present, the United States emits around 25 percent of all carbon emissions and consumes approximately 25 percent of all petroleum produced, even though it contains less than 5 percent of the world's population. Replicating such a pattern could potentially predicate disaster.

Much rhetoric has focused on population growth as a source of environmental problems. In a sense, the issue is real: without humans, the problem that concerns us today would not exist. It is incorrect, however, to blame matters on population growth. Those regions of the world that have the lowest population growth, namely the North, account for most of the damage to the global environment. While this trend could, of course, be reversed in the future, global environmental damage has so far not been related to population growth.

Overconsumption and Overproduction

The world's energy use, and the concomitant use of the atmosphere to absorb carbon emissions, is symptomatic of a larger problem: the use of natural resources as a whole. Most exhaustible resources, such as minerals, and most of the renewable ones, such as wood and the agricultural products obtained from fertile land, are consumed in the North. To a large extent, most of these resources are overproduced in and then exported from the South. In fact, two-thirds of all Latin American exports are resources.

The interrelated overconsumption and overproduction of fossil fuel, for example, can be described as a North-South process. Most carbon emissions originate from the burning of fossil fuel, which is generally exported by developing countries to industrialized ones. Further, industrialized countries consume 160 gigajoules of fossil fuel per person as compared to 17 gigajoules per person in developing countries. For aluminum, the figure is 16 to 2; for copper, 16 to 1; and for beef and veal, 27 to 4.5 (WRI, UNEP, and UNDP 1995).

The most prominent fossil fuel is petroleum, and its overproduction and overconsumption clearly implicates the international market. The general consensus is that the world's rapid rate of consumption of fossil fuels is linked to low petroleum prices: the lower the price, the higher the consumption. Petroleum prices in the United States are 2.5 to 3 times lower than those paid by the German and Japanese consumer. Corresponding to this, the United States uses petroleum much less efficiently than Japan and Germany: a unit of GDP in the United States has approxi-

mately a 40 percent higher petroleum content. The United States imports its petroleum from Latin America—Mexico, Venezuela, and Ecuador—despite the fact that about 20 percent of the recoverable petroleum deposits in the world are in North America.

While this North-South pattern of resource use has been known for some time, it has not been considered a problem until recently; in fact, many economists view this pattern as a manifestation of the efficient functioning of markets.

What is less clear is how this situation of overproduction and overconsumption beyond the point of sustainability evolved. Many of us have been considering this question for the last 20 years.¹ But it seems fair to say that many have not thought about this question often, because it does not fit easily with traditional economic views of the world, and in particular, the standard vision of economic development and international trade based on resource-intensive exports by developing countries.

Economic Causes and Ecological Consequences

The environmental question is difficult because it falls in the gap joining several different disciplines: economics, biology, and earth sciences. In simple terms, the causes of the phenomenon that we face are economic: we destroy biodiversity and its habitat, the forests, for economic reasons. For example, 90 percent of the deforestation that takes place in the tropics, which house 60 to 70 percent of the world's biodiversity, is to the land to grow cash crops, most of which are for the international market. The Amazon forest is being cleared in Ecuador for the exploration and extraction of petroleum by U.S. companies, despite protests from indigenous people; oil accounts for 50 percent of Ecuador's exports. In Brazil, the Amazon forest is used as a source of wood, such as mahogany, of which 50 percent is exported to Britain; it is also cleared to grow coffee and soybeans, again for international market. The Korup forest between Cameroon and Nigeria—at 60 million years old, the oldest forest in Africa—is used as a source of palm oil, also sold in the international market. Therefore, although the causes are economic, the results are biological and physical.

This often means that one discipline—economics—observes the causes, and others—such as biology and geophysics—observe the results. Yet each misses a crucial side of the equation. One can only deal with the global environmental dilemma by looking at both sides of the equation. This requires interdisciplinary cooperation, a subject that does not come easily in our traditional university system.

The Postwar World Order

Why is it that after millions of years on the planet, humans now perceive a global environmental crisis that could threaten the species survival? Have matters really changed in recent years?

Most scientists now agree that they have, and they give a date for the onset of today's global environmental problems. The last 50 years are seen as the period when most of the damage to the planet's biodiversity and the change in atmospheric concentration of greenhouse gases has occurred. There is wide agreement that the emission level of greenhouse gases in the past half decade has exceeded the extent of emissions in recorded history. Indeed, biologists claim that today's devastation is only comparable to four or five main incidents of global biodiversity destruction, such as the fall of a meteorite held to be responsible for the disappearance of the dinosaurs. What happened fifty years ago?

Fifty years ago, World War II was won by the Allies. For the first time, the United States of America, which led the victory, dominated the world economy, producing 40 percent of the world's products as a consequence of the war's destruction of the Japanese and European economies. Today, the United States is back to a much lower level, approximately 25 percent of the world economy measured in terms of the Gross National Product (GNP).

After the war was won, a new world order emerged with its norms punctuated by the creation of four major international organizations: the United Nations, the International Monetary Fund (IMF), the World Bank (WB), and the General Agreement on Trade and Tariffs (GATT). These organizations followed and implemented the leading country's vision of economic growth: an extremely resource-intensive growth corresponding to a rapidly expanding frontier economy, with an enormous consumption of resources, and the domination of nature through rapid technological change.

In the last 50 years since the end of the war, the world has grown at a rapid pace. Yet, international trade has grown much faster: in fact, three times faster than the overall growth of the world economy during the same period.

At the same time that these four major international organizations were created to implement a new world order, two major theories of trade and growth were developed and implemented. One was the neoclassical theory of optimal economic growth, originated in the United States, which views as a long-run steady state a path of development with exponential rates of population growth and correspondingly exponential increases in the use of resources. This theory ascribes to unlimited expansion in terms of the economy and of its use of resources, paralleling the pattern of development in the United States. The second economic theory was complementary to the first, and originated in Sweden, although it was also widely applied and developed in the United States. This is the theory of comparative advantages in international trade, which recommends that developing coun-

tries emphasize resource exports and exports of labor-intensive products, and in turn, trade these for capital- and technology-intensive products produced by the industrial countries. The vision of development that these theories advanced was one based on unlimited and inexpensive resources. Even today, this view is prevalent in the United States: inexpensive oil is seen as the basis for healthy economic growth, almost a birthright of its citizens, a right for which wars can be, and are, fought. Any rational attempt to redress this view meets with political failure.

These two theories of growth and trade, which have prevailed since the 1950s, have had major implications for the way we use and trade resources. These theories were implemented by international organizations such as the WB and IMF, both of which provided strong incentives to developing countries to follow resource-intensive development patterns, and recommended exporting more and more resource-intensive products as a precondition for loans and other important economic incentives. At least as important, economists and civil servants from developing countries under the influence of the United States were imbued with a sense of finality in the way things are: developing countries are only good for resources, cash crops, and cheap labor products. This proposition is largely uncontested today in Latin America and Africa, the two areas that have fallen behind in terms of economic growth over the past two decades. It underscores the heavily resource-intensive patterns of production and exports in these two regions.

Why do developing countries overproduce and overexport resource-intensive products such as cash crops, which require extensive land clearing, and minerals such as petroleum, which also affect the health of many forested areas? Why do developing countries export environment-intensive products at prices below the social costs? Is it true that developing countries have a comparative advantage in environment-intensive products, such as cash crops, minerals, and dirty industry, which use clean air intensively? If so, doesn't efficiency dictate that this comparative advantage be exploited, and shouldn't this lead to everyone's gain? In sum, is there a fundamental contradiction between economic gain and environmental preservation?

The answer to this latter question is "no," and it leads to a new theory of why countries trade (Chichilnisky 1994a, 159–69; 1994b). All this is found by analyzing the behavior of competitive international markets, taking into account important institutions, such as property rights for common property environmental resources, which are typically different in industrial and developing countries.

Property Rights and International Trade

Before industrialization, many traditional societies had long managed their common property resources, such as fisheries and forests, using various forms of local governance. *Common property* is a term that refers to shared group ownership, rather than individual ownership. An example is Valencia's *Tribunal de las Aguas*,

a local 1,000-year-old Spanish court, which still meets today on a weekly basis to administer costs and allocate the use of the region's water network. Other examples are the Iriaichi system of managing common lands in Japan, and Bahia's system of sea tenure in northeastern Brazil (Chichilnisky 1994b). These traditional systems, however, require a population that is both stable—in the sense that successive generations remain in the same area—and not too large—so that penalties from antisocial use of resources can be administered effectively and, if necessary, across generations (Stone, this volume).

Such systems of resource management tend to break down during periods of industrialization, when outsiders move into the common property area, and can easily move out to avoid penalties. During the process of industrialization, then, populations become large, mobile, and unaccountable. Well-managed common property is treated as unmanaged "open access" resources, which can be had for the taking. A "first come, first serve" system prevails.

In many of the now-industrialized countries, industrialization was preceded by the privatization of common property resources. For example, in the United Kingdom, industrialization was preceded by a major change in property rights: the privatization of the commons. With large and mobile populations, private property regimes often work better in the conservation of local resources than do common property regimes; the privatization of oil in the United States, the "Hot Oil Act" of 1936, is an example. The United States extracts little oil compared with the levels of extraction in developing countries with less well-defined property rights on this resource, such as Mexico. This is true even though the United States has enormous deposits, while Mexico does not.² The fact that the United States uses its local oil resources more carefully, however, does not mean that it consumes less oil: the difference between production and consumption is made up by imports, and the United States economy is today the largest single importer of oil in the world.

Why do property rights matter? When a pool from which a resource is extracted, such as a forest or a lake, is treated as open access, only the cost of actually extracting the resource, such as a tree or fish, is computed. The responsibility for the cost of managing the system, which is often substantial, is not computed. In such cases, noncooperative systems of exploitation emerge: at each market price, more is extracted under open access regimes than under traditional managed systems or private property regimes. The resource is overextracted, and can dwindle or even disappear (Dasgupta and Heal 1979; Chichilnisky 1994b).

Private goods are goods whose consumption is rival, in the sense that what one person consumes, others cannot. Furthermore, the levels of consumption can be chosen independently by each person. Examples of private goods are eatable products. Public goods differ from private goods in that they are available to everyone in about the same amount, and within limits, are not rival in consumption—for example, a road, a bridge, or an army. Moreover, with public goods, one person's

consumption need not detract from others'. A good example is knowledge: one may share knowledge with others without losing it oneself. (Of course, knowledge should not be identified with the financial gains that can be obtained from it.)

Classic public goods are supplied by governments. Biodiversity or greenhouse gas concentrations in the atmosphere are public goods, but not in the classical sense. They are produced by each individual in the economy, rather than by governments. For example, carbon emissions are "produced" by each person or firm privately when they drive their cars or burn fossil fuels to release energy. These are private activities that a government does not generally regulate.

The trading of private goods is very different from the trading of public goods. In markets with private goods, efficiency is divorced from equity in the sense that under any distribution of property rights, a competitive market with private goods achieves an efficient outcome at a market equilibrium. This is not true in markets with public goods. In such markets, there is a relation between efficiency and equity. A rigorous, general equilibrium treatment of markets in which some of the goods are private, and others are privately produced public goods, such as property rights on emission of carbon dioxide, is in Chichilnisky 1994a, Chichilnisky and Heal 1994, and Chichilnisky, Heal, and Starrett 1993. These papers show that certain property rights regimes on the use of global environmental goods are consistent with the efficient operation of competitive markets, and others are not. A certain "equity" is needed for environmental markets to operate efficiently.

It has been shown that if a traditional economy treats a pool from which a natural resource is extracted as open access, then at each market price it will offer more of the resource, leading to an *apparent* comparative advantage in resource-intensive products even where there is none. More resource-intensive products will be produced at each market price than is socially optimal. In particular, more is available for export at each price.

A typical example of this phenomenon emerges in societies where resources are unregulated, national property effectively treated as open access. Besides apparent comparative advantages, it also leads to apparent gains from trade, even in cases where they are losses. For example, Honduras exports mahogany to the United States even though it has no comparative advantage in wood products. Mexico exports petroleum to the United States even though it has small reserves.

Resource-intensive products are exported at prices that are below social costs. They are overconsumed by the countries with well-defined property rights and overproduced by those with ill-defined property rights. Moreover, export countries do not compute the cost of replacing the stock of trees harvested for wood or the cost of the depleted resource in a case of oil. Finally, the world economy as a whole consumes an inefficient quantity of resources, because it does not take into account the costs to the world economy of the resource overuse.

It is remarkable that all this happens even while markets are perfectly competi-

tive. Of course, monopolistic practices may exist, but we need not invoke them in any way to explain these inefficient patterns of consumption, production, and trade. The overuse of resources, and the inefficient market solutions just described, do not derive from market imperfections. Rather, they derive from a defective system of property rights as the world economy moves away from traditional forms of resource management into industrial societies. The process of industrialization itself leads to the patterns of North-South trade that we observe, and that are at the core of the environmental dilemma today.

Green Accounting

A proposal currently being considered by the United Nations would modify the system of national accounts followed by all countries to formally incorporate environmental costs. Green accounting is the practice of deducting environmental costs from the computation of the GDP. For example, the national accounts would depreciate the value of the stock of forests or minerals extracted, much in the same way that private individuals and firms depreciate the value of their own stock when reporting their personal or corporate income.

Green accounting can indeed help to reduce the overuse of resources, as well as excessive extraction and trade, by correcting the miscalculation described above. It can make a large difference in reporting economic performance based on GDP in resource-intensive countries. For example, the GDPs of Costa Rica and Mexico were recomputed using this practice, and dropped to a fraction of their former level as computed by standard practices.

Green accounting can only help indirectly, however, by deducting the depreciation of the stock of exhaustible resource or the cost of replacing the stock of renewable resources from the GDP. It is an indirect mechanism in that it can only induce growth-oriented politicians to follow more environmentally sound policies if they perceive their political target as the maximization of national economic growth. If a politician's reelection depends on the measure of national economic growth, and it often does, Green accounting could be helpful in reorienting environmental policy.

The Asian Tigers, Latin America, and Africa

After disclosing the negative impact that North-South trade has had on the global environment, the natural question that arises is whether a solution can be found that does not conflict with free markets. Some policymakers, for example, advise import substitutions, tariffs, or other practices that restrict trade. It is true that in emergencies, a ban on the trade of certain species that are close to extinction may be necessary: examples include trade in elephant tusks, tigers, and more recently,

in the United States, box turtles. Humans' irrational cruelty to animals admits on occasion to no other redress. The problem, however, goes beyond the restriction of animal trade: the overexploitation of minerals and forestlands inflicts damage not only to their producers, but also to their consumers.

Yet it is possible to reorient patterns of trade and development without hindering or interfering with international trade (Chichilnisky 1992). A positive example of such a strategy is offered by the Asian Tigers, while Latin America and Africa serve as negative examples. The former are export oriented, but have moved swiftly away from traditional comparative advantages—such as labor-intensive and resource-intensive products—into knowledge-intensive products. Such products include microprocessors, consumer electronics, financial products, and other sophisticated, technology-based products. The term *economies of scale* refers to the fact that such products are produced more efficiently at larger scale levels. An example is provided by the well-known concept of “learning by doing,” where the more one produces, the more productive one becomes. This means that their prices drop as their supply increases: a typical case of economies of scale is the computer industry.

External economies of scale is a term used to characterize production processes where efficiency gains at larger scales are not restricted to one firm. They are, instead, distributed throughout the whole industry or economy. In other words: the more that is produced, the more productive all producers are. Such external economies of scale are typical of industries that require knowledge as an important input. For instance, a better-trained labor force benefits all firms, not just one of them. Knowledge diffuses across a whole industry. Examples include electronic products, hardware and software, biotechnology, and electronic-based services such as data communication, consumer electronics, and financial services, all of which are based on knowledge. These are the most dynamic sectors in the world economy today.

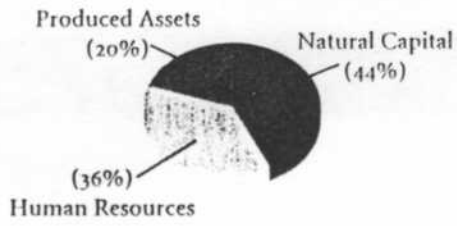
An important aspect of external economies of scale is that they are not connected with monopolistic behavior, require neither large capital outlays nor large-sized plants. To the contrary, external economies of scale typically occur in industries with many competitive firms.

The type of skilled labor required for industries with external economies of scale is available in many developing countries. Mexico is currently a producer of electronic products such as microchips and software; India is becoming one of the largest exporters of software in the world, having produced the software that manages the entire United Kingdom train system. Since software production is labor intensive, and does not require large capital outlays, it fits the Indian and Mexican economies quite well.

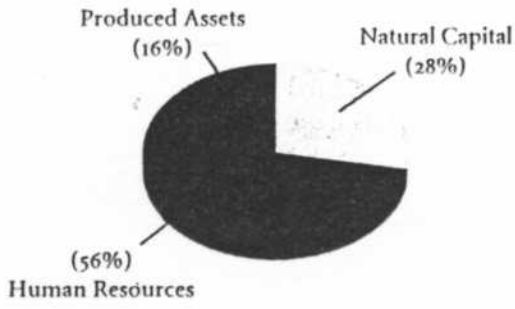
Many authors are concerned that educational conditions in developing countries such as the Caribbean would not allow the transition from resource-intensive production to knowledge-based production in the near future. However, the most

FIGURE 1 Composition of World Wealth (Percentage of Total)

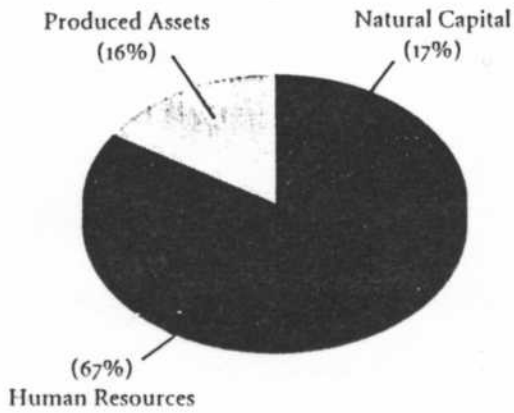
Raw Material Exporters (4.6%)



Other Developing Countries (15.9%)



High-income Countries (79.6%)



important aspect of knowledge-intensive forms of development, as far as this chapter is concerned, is its low impact on the environment. Knowledge-intensive growth is not only more successful in pure economic terms, it is also more compatible with a sustainable global environment. Recent empirical work at the Inter-American Development Bank in Washington, D.C., belies this view for the Caribbean region as well. Harris (1994) established that the initial conditions found in Caribbean countries 20 years ago, in terms of education and the general satisfaction of basic needs, matched those of the East Asian economies at the same period. Since then, the East Asian countries have moved rapidly toward technology-intensive practices with success. The Caribbean countries, and indeed the whole of Latin America, instead emphasized resource-intensive growth, losing ground. Today, Barbados is redressing this policy and attempting to make a swift transition toward an information age society (Fidler 1995). Mexico and India have active and outward-oriented computer hardware and software sectors.

Some say that the loss of biodiversity might be slowed for a while in countries following the path of the Asian Tigers, but eventual development—including high-class housing, more cars, and roads—may renew the threats to biodiversity while increasing other types of environmental degradation. This is not a foregone conclusion, however. Knowledge-intensive growth need not degenerate into resource-intensive growth. The idea that it must misses an essential point in the argument. Knowledge-intensive growth, if it occurs, is less dependent on resources than resource-intensive growth—initially and forever.

Indeed, the industries that use knowledge most intensively need never revert to resource-intensive production. The information revolution has led to forms of communication and production that decrease, in absolute terms, the need for roads and cars. Computers and communication networks have decreased the need to travel to a workplace. Heating and power managed by computerized systems is more efficient in the use of fuels. The products as well as the processes of the information society are much less intensive in the use of the atmosphere as a sink for emissions than is the industrial society, and of many other resources. The only resource whose demand has increased in recent years in industrial societies is paper, mostly due to the low price of trees for wood pulp.

Can the Asian Model Be Generalized?

The answer is “yes.” The whole world can become knowledge intensive. There are certainly skeptics to this view, and until it happens, this point cannot be proven. But a simple analogy explains how this can, and potentially will, happen.

In the last 100 years, the nations of the North shifted to industrial societies. At the beginning of this process, large parts of their economies were related to the agricultural sector, directly or indirectly. At that point, it would have seemed im-

possible that the agricultural sector would shrink simultaneously in all of them. But it happened. Today, for instance, the United States has at most 2.5 percent of its GDP in the agricultural sector, and most Organization for Economic Cooperation and Development (OECD) nations have similar proportions. The same process is occurring throughout the South today.

Where will all the food come from when the process of industrialization is completed in the whole world? Can the whole world turn into an industrial society? The answer is "yes, it can." Industrial societies will keep producing food. In fact, they produce even more food today than agricultural societies because they are much more efficient at it. Currently, the industrial countries of the OECD have a more or less permanent surplus of food, while the agricultural societies of the South have deficits. An industrial world need not have a food deficit. The problem with industrial countries is not lack of food; it is, as already discussed, overexploitation of the global environment.

The same argument can be used to understand the transformation process of industrial societies into knowledge-based society that will take place in the next few decades. Ultimately, time will tell.

In any case, there is no reason to believe that the South must follow the North's process of industrialization. The whole point of this chapter is to recommend that it should not. The South should move directly from an agricultural society to a knowledge-intensive society. Examples of agricultural societies that have bypassed heavy industry abound. The area surrounding Chicago is one; a wheat and beef economy was turned into financial products and services. Other examples include India, which is becoming a major software exporter, and Barbados, which intends to become an information society within a generation.

NAFTA, EU, and WTO

External economies of scale can also play a positive role in reconciling potential conflicts between regional trade agreements (such as the North American Free Trade Agreement [NAFTA] and the European Union [EU]), and the liberalization of world trade (the World Trade Organization [WTO], formerly the General Agreement on Tariffs and Trade [GATT]) (Chichilnisky 1992).

These conflicts can be summarized as follows: a region with more market power has generally more incentives to raise tariffs on outsiders, because it is in a better position to win a "trade war." This means that a regional trading block such as NAFTA would typically conspire against the overall liberalization of the world's trade.

Yet this traditional proposition breaks down with external economies of scale, which take the wind out of the protectionists' sail (Chichilnisky 1992). This happens because anything that restricts trade, such as tariffs, also decreases efficiency

and increases domestic costs of production when there are economies of scale. Therefore, a major incentive to raise tariff barriers is gone.

It is widely believed that the main rationale for the formation of the EU was the exploitation of economies of scale among European countries: the fact that each producer could be more efficient when producing for the whole European market than when planning production for their smaller, domestic market. Yet none of this has permeated the logic of NAFTA, which is solidly based, instead, on traditional comparative advantages.

The complete mobility of labor in the EU is a clear indication: it demonstrates that the EU trading block does not see its gains in trade of labor-intensive goods from labor-rich countries, such as Portugal, against capital-intensive goods from capital-rich countries, such as Germany. In contrast, NAFTA does, and again, the lack of mobility of labor within NAFTA is an indication of this fact.

Another negative aspect of regional trade blocks is that they can induce *diversion* of trade, which means that they may lead a country to purchase from a higher-cost producer within the region, rather than from a more efficient, lower-cost producer outside the region. This occurs simply because the outsiders have tariffs on their products, which makes them appear less competitive.

However, economies of scale can also defeat this problem. The higher-cost producer within the region may be so because it produced for a small market, and did not benefit from economies of scale: by offering an opportunity to produce in larger scale for the whole region, the regional trade block may change matters. The high-cost producer can turn into an efficient, low-cost producer. If so, there is no trade diversion.

Conclusion

Biodiversity cannot be seen in isolation. It is inextricably connected with economic development, as most biodiversity destruction arises from the loss of habitat for economic purposes. A move away from patterns of development and North-South trade based on resource-intensive traditional comparative advantages toward knowledge-intensive patterns of trade and growth is essential. Resource-intensive growth has shown itself to be unsuccessful during the last 20 years, and threatens to destroy our global environment.

Economic growth and trade based on external economies of scale, and on knowledge-intensive products, has proven itself successful in the East Asian economies during the last 20 years, and is more consistent with the environment. Our international organizations (the IMF, WB, and WTO) must evolve to regard knowledge-intensive patterns as a major goal of development.

Biodiversity is hostage to our backward mentality about economic development. Only a fundamental and swift change in our vision, and corresponding

changes in our practice of development and trade, can ensure the survival of the planet's remaining biodiversity.

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Notes

- 1 For this purpose, I introduced and elaborated the idea of development based on the satisfaction of basic needs (Chichilnisky 1977a, 1977b, 1982) within the context of the Bariloche global model (Herrera, Scolnik, and Chichilnisky 1976), which provided an empirical examination of patterns of trade and development in five continents that could be consistent with environmental preservation. The concept of basic need recently became a cornerstone of the definition of sustainability in the Brundtland Report.
- 2 The United States has about 2 percent of all the world's known recoverable oil deposits (WRI 1994), while Mexico's resources are expected to be exhausted early in the coming century (Chichilnisky and Heal 1993).

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