Value Chains, Trade and Biodiversity

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Abstract

In Peru, there is a gradual appreciation of the articulation between emerging markets and national value chains linked to the sustainable use of biodiversity. Megabiodiversity and ecosystem services have contributed to a response to the opportunities offered by the international market.

This paper analyzes the economic importance of biodiversity, particularly in the development of value chains in different regions of Peru that are part of a diversified export supply.

Keywords: Agricultural exports, biodiversity, ecosystem services, product and market diversification, value chains

Acronyms

ACTO	Amazon Cooperation Treaty Organization
ADEX	Association of Exporters of Peru (Asociación de Exportadores del Perú)
CBD	Convention on Biological Diversity
Ceplan	National Strategic Planning Center (Centro Nacional de Planeamiento Estratégico)
Cites	Convention on International Trade in Endangered Species of Wild Fauna and Flora

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D. S.	Supreme Decree (Decreto Supremo)
D. L.	Legislative Decree (Decreto Legislativo)
PPEF	Production and ecosystem possibilities frontier
PPF	Production possibilities frontier
GHG	Greenhouse gas
HACCP	Hazard analysis and critical control points)
Inbio	National Biodiversity Institute (Instituto Nacional de Biodiversidad) (Costa Rica)
Minam	Ministry of the Environment (Ministerio del Ambiente)
Mincetur	Ministry of Foreign Trade and Tourism (Ministerio de Comercio Exterior y Turismo)
GDP	Gross domestic product
PromPerú	Peru Export and Tourism Promotions Board
Siicex	Integrated System of Foreign Trade Information (Sistema Integrado de Información de Comercio Exterior)
TEEB	The Economics of Ecosystems and Biodiversity
TIES	The International Ecotourism Society
UNCTAD	United Nations Conference on Trade and Development

INTRODUCTION

Around the world, biodiversity sustains production systems and contributes to human welfare; little value is placed, however, on investing in its conservation and sustainable use. In agriculture, investment in best practices for soil and water management, biological pest control and use of biopesticides, and other such practices help increase crop productivity and reduce production costs. For example, zero-tilling of corn in Mexico and wheat in Morocco led to a productivity increase of 29 percent in corn and 44 percent in wheat. Similarly, diversification of production and integrated farm management help increase revenues; for example, in Bangladesh, diversified farms earned an additional 29 percent in revenues compared to non-diversified farms (UNEP 2011).

The purpose of this paper is to provide evidence of the economic contribution of biodiversity, particularly to the development of value chains in different regions of Peru that are part of a diversified supply of exportable products. According to the Convention on Biological Diversity (CBD), biodiversity is defined as:

> [...] the variability among living organisms from all sources including, *inter alia,* terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystems. [...] «*Ecosystem*» means a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit (CBD Secretariat 2010).

The key point of this paper is that in Peru, biological megadiversity and the services provided by ecosystems have made it possible to respond to opportunities offered by the international market by developing and strengthening varied value chains.

The paper is organized in four sections. The first presents a review of the literature on economic aspects related to the use of biodiversity and economic growth and trade. The second analyzes the state of biodiversity in Peru and the world as well as trends in Peruvian exports of products derived from biodiversity. The third part describes progress in public policies aimed at strategically linking biodiversity with the growth of trade. The fourth section presents the main conclusions and recommendations.

1. ECONOMIC ASPECTS OF THE USE OF BIODIVERSITY AND ITS CONNECTION WITH ECONOMIC GROWTH

Literature on economic aspects of biodiversity draws on analysis from the Millennium Ecosystem Assessment (2005) and the economics of ecosystems (TEEB 2010). These

assessments coincide in noting that ecosystems provide varied services that benefit the population and the development of economic activities. Earlier, various authors (Barbier *et al.* 1995; Gowdy 1997; Pearce and Moran 1994; Pearce and Perrings 1995) noted that the decision to allocate resources is based on the anthropocentric value placed on such services.

The Economics of Ecosystems and Biodiversity (TEEB), meanwhile, specifies that the invisibility of various services that nature provides to the economy results in generalized denial of the contribution of natural capital, leading to decisions that degrade services provided by ecosystems. Economic incentives, including prices, taxes and subsidies, also play an important role in influencing the way in which natural capital is used. In most countries, these incentives do not consider the full economic value of ecosystem services, and in some cases, they have negative effects on natural capital (TEEB 2010).

The rate of biodiversity loss at the global, regional, national and local level is not reduced by limiting poverty-reduction strategies, as noted in the «Global Biodiversity Outlook 3» report (CBD Secretariat 2010), which concludes that as of 2010, the worldwide goal for biodiversity conservation had not been met. For example, between 1970 and 2006, the abundance of vertebrate species was reduced, on average, by one-third, and it continues to decrease globally. Addressing this requires policies that include measures that encourage conservation and the sustainable use of biodiversity (TEEB 2010).

A. Production possibilities frontier and opportunity cost

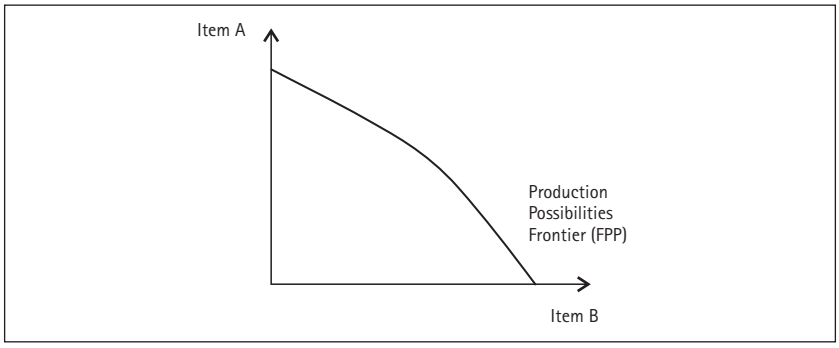
This section explains advances in the literature about the relationship between production and biodiversity, based on an extension of the production possibilities curve and opportunity cost. This is followed by contributions from various authors that provide a better understanding of market failures associated with the use of ecosystems and the services they provide.

For decades, the production of goods and services has been associated with the transformation of the habitat, driven by factors such as the expansion of urban areas, development of productive activities (such as agriculture), introduction of exotic species, and water and air pollution. Continued ecological degradation and unsustainable patterns of production and consumption will jeopardize the benefits that people derive from biodiversity (UNEP 2012). Biodiversity loss is the result of the complex and dynamic interaction of a series of social and economic factors that must be addressed appropriately (Dietz and Adger 2003; CBD Secretariat 2010).

Day (2007) and Bateman et al. (2011) include ecosystem services in the analysis of the production possibilities frontier (PPF), considering these services as a type of aggregate

good. According to Day, the conventional PPF shows the maximum production of two goods, with a given supply of resources and technology over a given time. This PPF illustrates relative scarcity, because it is impossible to attain combinations of the two goods beyond the frontier. The combinations of product quantity along the PPF are efficient, because production of a certain quantity of one good would be stopped in order to produce an additional amount of the other good. Inefficient production occurs when resources are unused or are allocated inefficiently. All choice along the PPF implies an exchange; producing more of one good or service means producing less of other goods or services. If we had two items, A and B, therefore, and wanted to produce more of A, given the supply of resources and technology, the only way to do so would be to forgo producing a certain amount of B (Graph 1). This shows the opportunity cost of the additional production of item A—that is, the benefit lost by not producing units of item B (Kafka 1981; Nicholson 2005; Tietenberg and Lewis 2012).

Graph 1
Production possibilities frontier

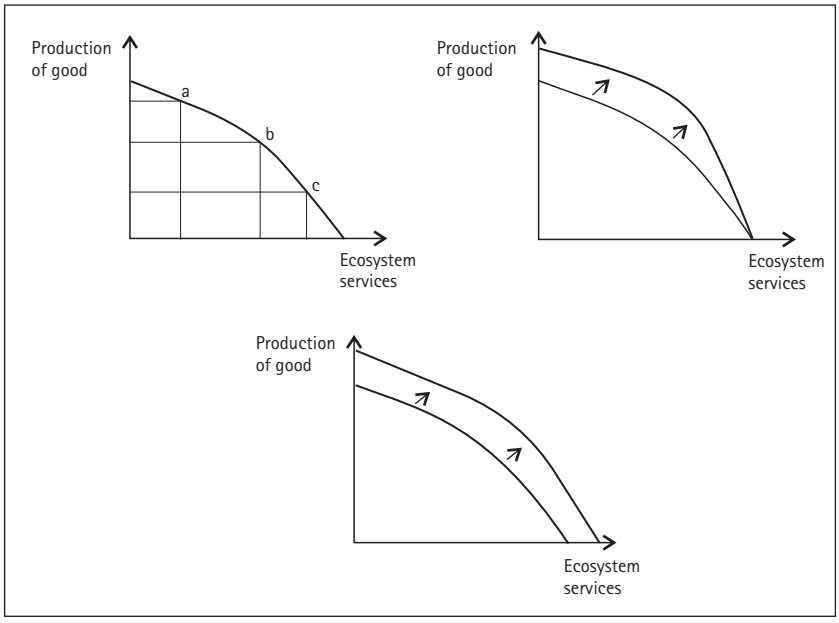


This case, however, does not consider the contribution of ecosystems and their services to economic activities and human welfare. Day notes that an economy produces not only material goods and services, but also ecosystem services, such as climate regulation, flood control, carbon storage, aquifer recharge and scenic beauty (Appendix 1). A PPF is therefore proposed that includes the production of ecosystem services; this is called the production and ecosystem possibilities frontier (PEPF). The PEPF shows different combinations of production and ecosystem services (a, b, and c) that can be attained if they are efficient. Those combinations are attainable because they can be produced with the given supply of resources and technology, and they are efficient because it is impossible to produce more without a loss of ecosystem services (or vice versa). For example, when the decision is made to change land use to increase farm production, the country accepts the lost benefit of the ecosystem services associated with the forest, in exchange for attaining greater agricultural production.

The rate of exchange between production of goods and ecosystem services is the marginal rate of transformation or the PEPF slope that shows the additional production of goods, given the reduction of a unit of ecosystem services (for example, one ton of carbon sequestered). The marginal rate of transformation is the opportunity cost of increasing the area of production (Graph 2). Technological changes allow the production of more goods with the same quantity of resources; therefore, a technological innovation that is neutral in terms of production of ecosystem services will cause a change in the PEPF. Technological innovations that take productive and environmental efficiency into account are also possible, so there could be an expansion of the PEPF. In that case, technological innovation would foster the recovery of degraded ecosystems and higher quality and greater availability of goods and ecosystem services (Day 2007; Bateman *et al.* 2011).

Complementing this, some authors (Ruijs *et al.* 2012; Bateman *et al.* 2011) note that analysis of the PEPF and the opportunity cost of decisions such as land-use change must consider spatial differences in the supply of ecosystem services and the comparative advantage of the provision of a particular ecosystem service. Ruijs' work offers an assessment of lost agricultural production when changes occur in ecosystem services, contributing to better decisions about land-use change.

Graph 2
Production and ecosystem possibilities frontier



The literature coincides in acknowledging the role that ecosystem services play in human welfare; there is therefore growing concern about the pressures to which those services are exposed, especially because of human activity (CBD Secretariat 2010; Bateman et al. 2011; Millennium Assessment 2005; UNEP 2012). Evidence shows that although ecosystem services are important, their economic value is not yet fully acknowledged.

There is also a debate between economists and ecologists about the concept of value. In economics, the value of a resource is based on the value of its marginal use in the production of goods and services. In ecology, the value of an ecosystem is associated with its contribution to stabilizing the system of life that makes human existence possible; in that view, its value is infinite when it is crucial for human survival. Daly (1996) and Khalil (2004), among others, note that the economy is organized by a production system that has benefits because it has technology and contributes to better economic organization and the formulation and adoption of consistent policies. A shift toward sustainable development therefore implies a complex economic analysis of technological improvements and adaptation to natural constraints.

Efforts have been made to build on and interconnect advances in the two disciplines: in economics, there is interest in understanding the economic importance of biodiversity and ecosystem services; in ecology, there is interest in understanding the rationale for and importance of the efficient allocation of resources through market mechanisms (Gowdy 1997; Bhattarai 1998). Despite debate about the limitations inherent in methods of economic valuation, their application must be improved to better assess the value of ecosystem services.

Finally, in the analysis of costs and benefits associated with investment in biodiversity conservation, the dimensions of space and time have economic importance. The benefits may appear at the global or national levels, but the costs are local. For example, forest conservation makes it possible to maintain the service of carbon sequestration, which generates global benefits, but the associated costs are borne at the local level. In the case of time, the benefits associated with forest conservation will be enjoyed by future generations, while the costs are borne by the current population (UNEP 2011).

B. Market failures

The literature points to a series of market failures conducive to the deterioration of services. The market fails to reflect the cost or benefit of ecosystem services. For example, the public good character of various ecosystem services (such as carbon sequestration, water and air purification, or soil protection), the characteristics of some free-access resources (such as fisheries and forests), externalities associated with the production of

goods and the definition of property rights, information asymmetries and non-competitive market structures all lead to economic decisions that limit social efficiency.

Market failure is characterized by a divergence between the social cost and the social benefit associated with the use of ecosystem services because the market is unable to reflect them. The greater the divergence between social value (cost or benefit) and private value, the greater the likelihood of deterioration of biodiversity and ecosystem services (Bhattarai 1998; Khan 1995; Tietenberg and Lewis 2012).

Ecosystem services tend to be public goods, and various meet the criteria of being non-excludable and non-rivalrous. In other words, it is not possible to exclude any user from enjoyment of the ecosystem service (non-excludable), and the availability of the service is not reduced when it is used by an additional user (non-rivalrous). National efforts to conserve forests and biodiversity therefore allow global enjoyment of the benefits of those efforts (such as carbon sinks and water and climate regulation services) (Bhattarai 1998).

One key factor that encourages appropriate management of biodiversity is the clear definition of property rights, particularly in the case of freely accessible natural resources, which are non-excludable and rivalrous in consumption. Taking fisheries as an example, this means that some users cannot be excluded from access to the resource; in other words, everyone can go out to sea and fish, but extraction by some users reduces the availability of the resource to other users.

Stavins (2011) summarizes the importance of property rights in showing that their appropriate definition with regard to the use of non-renewable natural resources has allowed their appropriate use over time. In addition, the prices of non-renewable resources (oil, coal, gas) reflect their relative scarcity, which has stimulated exploration, as well as technological development and the appearance of substitute products. Despite their finite supply, therefore, there has been a moderate shift in the use of non-renewable natural resources, and they have not experienced over-exploitation or collapse. In contrast, renewable natural resources (for example, forests and fisheries) have shown increased scarcity. That is, despite their ability to regenerate naturally, they have become relatively scarcer and in some cases have become extinct (Stavins 2011; Tietenberg and Lewis 2012; Khan 1995).

The concept of externality makes it possible to identify the cost or benefit that the decisions and actions of one economic agent have on the welfare of another that is not reflected in the price of the factors of production or the price of the end product. The effects produced could be positive or negative and can stem from consumption or

production decisions. For example, the owner of an orange grove improves the welfare of a neighboring beekeeper who raises bees and produces honey. The beekeeper also creates a positive externality for the orchard owner, because his activity contributes to the pollination of the orange trees.

In contrast, a farmer who uses agricultural chemicals intensively has a negative effect on the production of a neighboring organic farmer by contaminating his field with chemical residues because this affects the productivity and quality of the organic crops. At the global level, economic decisions that do not take into account external costs, over both the short and long term, contribute to an increasing reduction of biological diversity as well as to climate change, thinning of the ozone layer, and the consequent costs and benefits associated with those global environmental problems (Kolstad 2000; Tietenberg and Lewis 2012; Trucost 2013).

In addition, economic agents generally make decisions based on the short-term maximization of benefits. So the absence of information about the long-term benefits of biodiversity and about instruments conducive to the use of the benefits in the long run is a disincentive to private investment in biodiversity conservation.

The existence of market failures, therefore, hinders the efficient allocation of biodiversity and ecosystem services. As a result, public policies as market-oriented tools play a key role in providing incentives for internalizing external costs and reducing the profitability of activities that pollute. One way of strengthening the market-oriented approach is by promoting value chains based on products derived from biological diversity that are appropriately positioned in the international or national market.

C. Green economy, value chains and biological diversity

The opening of trade and changes in patterns of production and consumption have created opportunities for the development of novel value chains based on products derived from biological diversity – meaning those made in production processes that use various components of biodiversity – which has promoted their sustainable use.

The green economy approach acknowledges the value of natural capital (biodiversity and ecosystem services) and the importance of investment in its conservation, given its contribution to economic activities and human welfare. This approach shows that the relationship between economy and environment has not been clearly understood over the decades, from the standpoint of development planning or public policy design.

The green economy guides the allocation of scarce resources to foster improved human welfare and social equality, reducing environmental risks. It is characterized by being low in carbon emissions, making efficient use of resources and being socially inclusive (UNEP 2011).

The green economy concept makes sustainable development operational, organizing incentives so that economic agents' decisions enable them to reach their goals and ensure that the path of growth and development minimizes the risk of harm from local, national or sub-national environmental problems.

Regarding the relationship between international trade and biodiversity, external trade is seen as contributing to greater efficiency and the creation of wealth (IISD-UNEP 2005) in the following way:

- **Efficient allocation:** trade encourages specialization based on a country's comparative advantages. This fosters greater production of goods and services at the global level. When production is subsidized and greenhouse gas (GHG) emissions are not controlled, however, the result is economically inefficient and environmentally harmful.

- **Efficiency associated with competition:** trade exposes domestic enterprises to international competition, encouraging innovation to increase efficiency. Providing telecommunications services and infrastructure, therefore, contributes to greater competition. Where market failures occur, however, domestic producers may face competition from enterprises that have international market power.

- **Efficiency and imports:** opening up to foreign investment and importing technology help increase efficiency in production processes, because of both the inclusion of modern machinery and equipment in production processes and the adoption of efficient administrative and management systems. Some multinational companies help improve compliance with international quality standards. But there are also companies that can negatively affect efficiency by the use of obsolete or less-efficient technology in countries where health, industrial safety and environmental protection legislation and regulations are lax.

In general, analysis of international trade that promotes greater production and efficiency considers assumptions about competitive markets, meaning the absence of externalities, complete information, many buyers and sellers, etc. Inter-temporal analysis should also be included for consideration of inter-generational externalities, however, because decisions

made today can create costs in the future. The expansion of international trade amid a lack of definition of property rights to freely accessible natural resources (such as fisheries or forests), as well as the existence of pollution havens, leads to more rapid over-exploitation of natural resources, loss of biodiversity and deterioration of environmental quality (Tietenberg and Lewis 2012).

Value chains increasingly include the management of economic, environmental and social components, because otherwise the loss of markets, reputation and brand value is imminent. A recent study by the United Nations Conference on Trade and Development (UNCTAD) highlights the importance of a value chain approach, given that it essentially promotes trade relations and coordination among actors involved in the process of production and consumption of a good (UNCTAD 2012).

The entire value chain thus encourages the establishment of strategic partnerships among producers, processors, distributors, exporters and regulatory and supporting institutions. These stakeholders share a common vision and a goal-oriented work agenda, allowing them to maximize benefit by designing joint strategies for reaching target markets and satisfying consumer needs.

The international market in the 21st century demands innovative trade mechanisms and promotes coordination to obtain timely commercial, technological and financial information to improve competitiveness and access to dynamic emerging markets. For these reasons, the value-chain approach is appropriate and necessary.

2. FOREIGN TRADE, VALUE CHAINS AND BIODIVERSITY

The goal of this section is to show the magnitude of biodiversity reduction in the world and the effort Peru is making to conserve it and promote its sustainable use, although major challenges remain. It also analyzes the expansion of value chains linked to products derived from biodiversity and their contribution to the diversification of the supply of export goods and markets.

A. Biodiversity reduction and value chains

The «Global Environmental Outlook» report, GEO 5, concludes that there is an alarming upward trend in biodiversity loss in the world. The main negative pressures on biodiversity have led to loss of habitat and degradation of ecosystems. Those pressures mainly include unsustainable farming practices; infrastructure development; water, soil and air pollution; introduction of exotic species; and overexploitation of species. As a result, the loss of

biodiversity is evident throughout the world (UNEP 2012) in:

- 100 million hectares of forest lost between 2000 and 2005.
- Loss of 95 percent of wetlands in some regions.
- 38 percent reduction in coral reefs since 1980.
- Fragmentation of two-thirds of the longest rivers with the construction of dams and reservoirs.
- 30 percent reduction in vertebrate population since 1970.
- Two-thirds of species threatened; the greatest loss of species is in the tropics, in freshwater areas.
- Transformation and/or degradation of 20 percent of natural habitat since 1980.

As a result, the benefits that people receive from biodiversity are at risk. Interventions to improve human welfare without considering inter-temporal external costs increase the vulnerability of the population. For example, land-use change for unsustainable agriculture may result in an increase in farm production, but it reduces other services, such as carbon sequestration, flood control and soil protection. Poor people are most affected because they depend directly on local ecosystems and have little capacity to respond to possible changes (UNEP 2012; UNDP 2010).

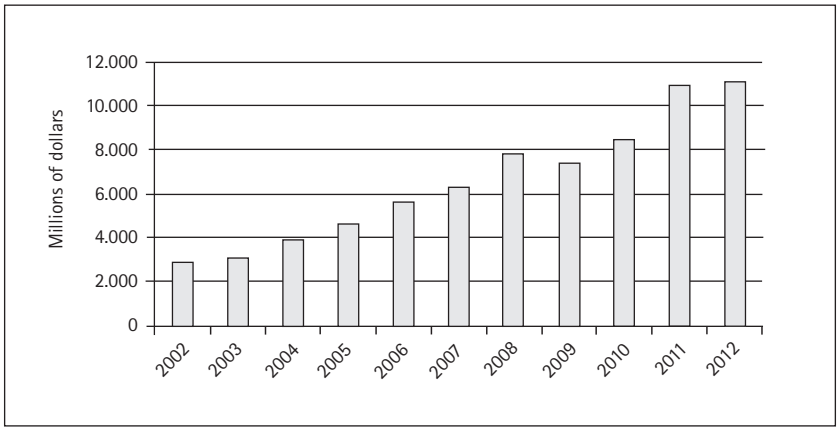
Because biodiversity is threatened, it is important to recognize its economic contribution to various economic activities (TEEB 2010); for example:

- Conservation of forests absorbs GHGs worth USD 3.7 trillion. Reducing the rate of deforestation by 2030 would decrease greenhouse gas emissions by between 1.5 and 2.7 gigatons of CO_2 annually, which would avoid harm associated with climate change valued at USD 3.7 trillion. This amount does not include the co-benefits of ecosystem services provided by forests (Eliasch 2009).
- Green products and services represent a new market opportunity. Global sales of organic products are increasing by USD 5 billion annually. In 2007, they were worth USD 46 billion. The market for certified seafood products also grew between 2008 and 2009. Ecotourism is currently the tourism sector that is growing the most rapidly; spending on ecotourism is estimated to be growing at 20 percent annually (TIES).
- Planting trees in urban areas improves quality of life. Authorities in Canberra, Australia, planted 400,000 trees to regulate the microclimate, reduce pollution and improve air quality in the city, and decrease energy costs because of less use of air conditioners. These benefits resulted in savings for the city of between USD 20 million and USD 67 million between 2008 and 2012 (Brack 2002).

Peru is one of the 17 most megadiverse countries in the world, ranking first in butterfly species, with 3,700, and fish, with 2,100 species. It has the second-largest expanse of tropical forests in Latin America and the fourth-largest in the world. Its ecosystems are varied and valuable, supporting economic activity and human welfare. Some of those ecosystems are fragile, however, meaning that they are threatened by anthropic (human) actions and have limited ability to recover and return to their original state. Fragile ecosystems include deserts, drylands, mountains, swamps, alpine wetlands, high Andean lakes, coastal hills known as «*lomas*» and cloud forests (Minam 2011).

In economic terms, Peruvian products derived from components of biodiversity account for 22 percent of national GDP and 24 percent of the value of total exports. Between 2005 and 2012, their export value grew by 13 percent annually, reaching USD 11.1 billion in 2012 (Graph 3). The export value of products derived from biodiversity includes the value of farm, fishery and timber product exports, as well as tourism revenues.

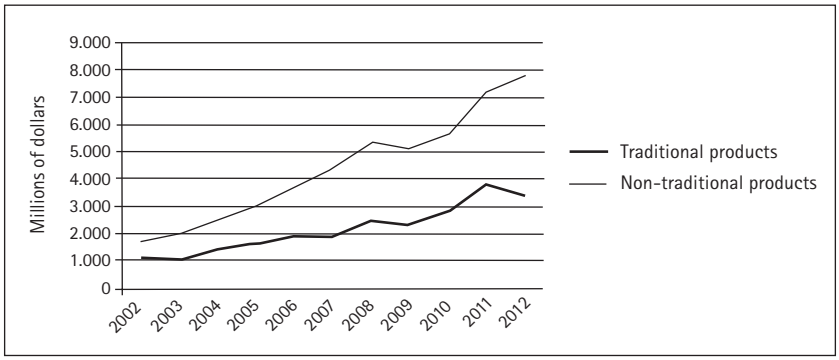
Graph 3
Exports of products derived from biodiversity, Peru, 2002-2012
(millions of dollars)



Source: Central Reserve Bank of Peru (2012).

Non-traditional export products derived from biodiversity have gained a greater market share, increasing from 65 percent of the total value of this group of products in 2005 to 70% in 2012. This group grew at an annual rate of 14%, while traditional exports grew by an average of 11% annually between 2005 and 2012 (Graph 4).

Graph 4
Exports of products derived from biodiversity: traditional and non-traditional, Peru, 2002-2012 (millions of dollars)



Source: Central Reserve Bank of Peru (2012).

The country's megadiversity is found in various ecosystems, especially forests, high mountains, drylands (on the coast) and the coastal marine ecosystem. Biodiversity, however, faces serious threats such as deforestation for land-use change, unsustainable extractive activities, water and air pollution, and climate change (Minam 2010a). Other threats include illicit activities such as illegal logging, drug trafficking and production of coca for illicit purposes, and illegal mining. As a result of economic and social decisions that do not acknowledge the economic importance of biological diversity, the number of species classified as threatened to some degree has increased (Table 1).

Table 1
Number of species classified as threatened to some degree, by type of animal, Peru, 1977-2004

Category	Year			
	1977	1990	2000	2004
Mammals	55	62	73	65
Birds	32	69	86	172
Reptiles	17	25	44	26
Amphibians	—	14	18	38

Source: Minam (2010a).

Biodiversity is being affected, and with it, ecosystem services; although policies and other measures have been implemented, they are limited in comparison to the magnitude of the problem. It is therefore important to recognize the development of value chains based on products derived from biodiversity and aimed at foreign markets.

B. Exports and value chains

Trade with countries that demand environmentally friendly products also helps promote the sustainable use of biodiversity and ecosystem services. The concept of sustainable trade refers to the process of exchange that takes economic, social and environmental factors into consideration in decisions about what to produce, how to produce and to whom to sell.

Sustainable trade promotes collective, coordinated action among economic agents and helps improve productivity based on the optimization of processes, the adoption of appropriate technology, the reduction of information asymmetry and the promotion of responsible and ethical corporate behavior. It also assumes sharing the responsibility and commitment to manage eco-efficient systems of production and consumption that minimize the use of resources (such as water and energy) and conserve the quality of soil, air and water.

Sustainable trade also responds to the demands of consumers who are better informed and concerned about the environmental impacts associated with the production of the goods or services they consume. This is reflected in the results of a survey carried out in North America, which indicates that the majority of North Americans believe that industry must take energy efficiency and clean production into account. For example, 86% say industry should provide high-quality, safe products; 84% that industry should provide a safe workplace; 80% that natural resources should be used efficiently; and 71% that the creation of waste should be minimized (EPA 2010).

It is useful to distinguish among several concepts that are often confused: trade in products derived from biodiversity, trade in organic products, and biocommerce or sustainable trade. Trade in products derived from biodiversity refers to the export of any product derived from flora or fauna species, appropriately prepared in accordance with the demands of the destination market; one example is hearts of palm. Trade in organic products refers to products that result from a production system that is free of industrial chemical substances; examples include organic coffee and organic bananas.

In contrast, biocommerce refers to a production system that includes gathering, production, transformation and commercialization of goods and services derived from **native biodiversity** (including, for example, sacha inchi, camu camu, tara and carob) in a way that is economically, socially and environmentally sustainable. For biocommerce, diversified value chains are being developed that promote the participation of small-scale producers and poor families. In Peru, five products account for 92% of biocommerce exports:

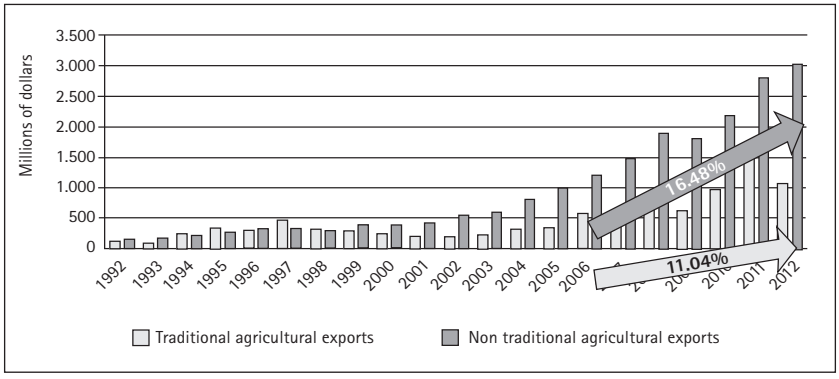
cochineal, tara, Brazil nuts, achiote and quinoa. Other, lower-value export products also show significant growth rates, however; these include goldenberry (88%) and huito (570%) (PromPerú-Siicex). Biocommerce guarantees compliance with the following principles:

- Conservation of biodiversity.
- Sustainable use of biodiversity.
- Fair and equitable distribution of benefits from the sustainable use of biodiversity.
- Economic viability.
- Compliance with national and international legislation.
- Respect for the rights of the stakeholders involved.
- Clarity about land tenure and use of and access to natural resources and biodiversity.

In Peru, sustainable trade or biocommerce has mainly focused on the development of diversified value chains, contributing to the development of the country's export products.

The following is a brief analysis of the relationship among foreign trade, value chains and biodiversity, which will focus on export agriculture. First, export agriculture represents 9% of the total value of exports in Peru, and in 2012, sales reached USD 4.122 billion. That value represented 37% of exports of products derived from biodiversity, an increase from 2005, when they accounted for 29%. Second, non-traditional export agriculture has been dynamic, with an annual average growth rate of 16%, compared to 11% for traditional export agriculture (Graph 5).

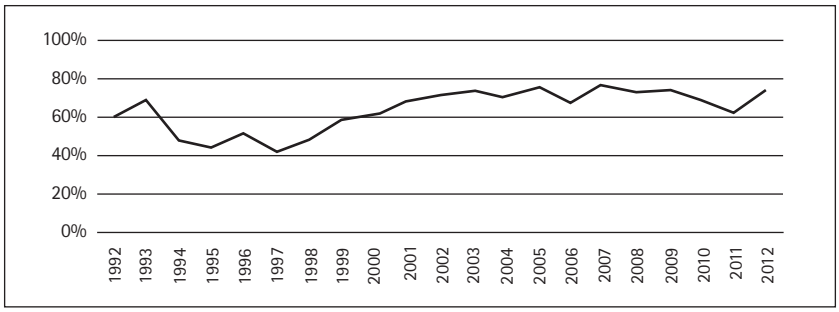
Graph 5
Traditional and non-traditional agricultural exports, Peru, 1992-2012 (millions of dollars)



Source: Central Reserve Bank of Peru (2012).

Third, non-traditional agricultural exports, on average, currently represent 74% of the total value of the country's agricultural exports (Graph 6). The makeup of groups consisting of non-traditional and traditional export agriculture products varies significantly. Non-traditional export agriculture consists of more than 60 different value chains, while traditional export agriculture includes just three products (coffee, sugar and cotton). The detailed analysis below will therefore focus on non-traditional export agriculture, explaining the variety of products, their main production centers and the destination markets.

Graph 6
Non-traditional agricultural exports as a share of total agricultural exports, Peru, 1992-2012 (percentage)



Source: Central Reserve Bank of Peru (2012).

In 2012, non-traditional agricultural exports grew by 7.7%, even though the total value of agricultural exports fell by 8.5% from 2011 levels. The growth of non-traditional export agriculture has expanded in the 21 departments where different value chains have been formed and promoted.

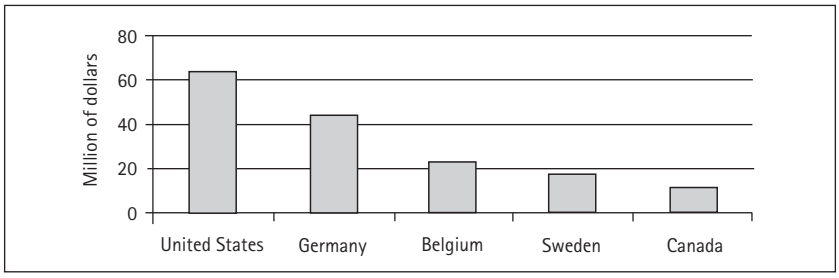
The areas with the greatest export value are fruits and vegetables (67%) and the most noteworthy products include asparagus, grapes, avocados, mangoes and paprika. Ica, La Libertad, Lambayeque, Piura and Arequipa stand out for the diversification of their portfolio of export products. One consideration highlighted in recent literature is the spatial dimension – the characteristics and supply of ecosystem services in the various areas; and, additionally, the availability of transportation and communications infrastructure, which facilitates logistics for convenient access to markets.

The way to capitalize on competitive advantages provided by ecosystem services in a particular place, therefore, is through a comprehensive evaluation of the conditioning factors and the costs and benefits associated with the development of a value chain; this can minimize productive, commercial, social and environmental risks.

One characteristic of this process of commercial expansion of products derived from biological diversity has been the public and private effort and support from international cooperation to diversify the supply of export products and destination markets. The main markets for non-traditional agricultural exports currently include the United States, the European Union, China, Japan and some Andean countries.

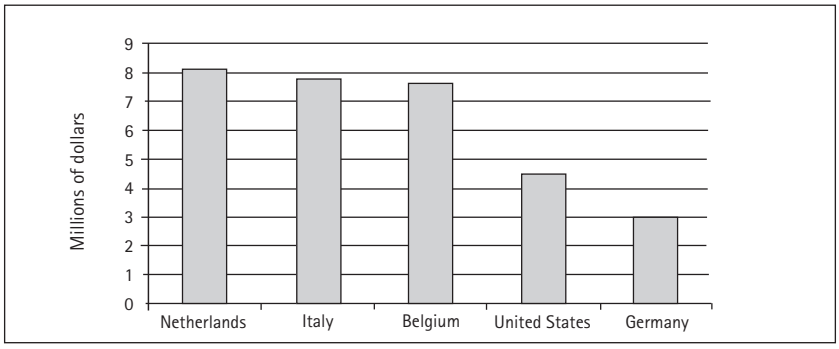
Exports of organic products have also increased; primarily coffee, banana, cacao and Andean grains, particularly quinoa. This growth, according to officials from the Association of Exporters of Peru (Asociación de Exportadores del Perú, ADEX), responds to the interest of consumers in destination markets in healthy food that is produced in harmony with the environment. For example, coffee and cacao have both diversified areas of production and diversified markets (Graphs 7 and 8). Coffee-producing regions include San Martín, Cajamarca, Cusco and Puno; the most important regions for cacao are San Martín, Amazonas, Cusco, Ucayali and Junín.

Graph 7
Main destination markets for organic coffee, FOB value, Peru (in millions of dollars)



Source: PromPerú-Siicex.

Graph 8
Main destination markets for cacao, FOB value, Peru (in millions of dollars)



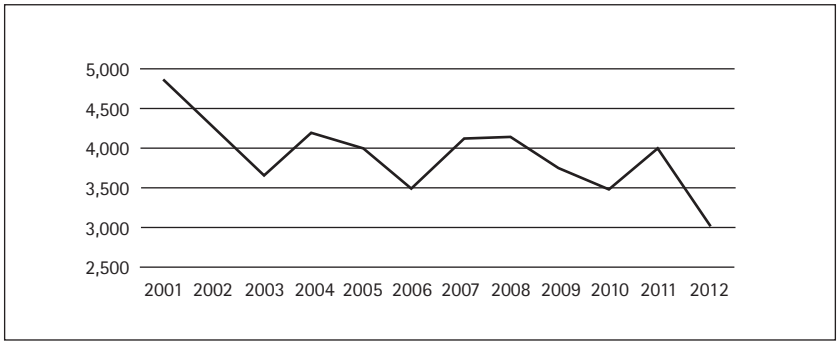
Source: PromPerú-Siicex.

Also worth noting is the advance in biocommerce in Peru and its contribution to the creation of opportunities for small, rural producers who can meet market demands. Biocommerce promotes a culture of competitiveness and development based on linkage with dynamic markets, solidarity, and economic, social and environmental sustainability, as noted above; it has also encouraged value chains that now reflect the benefits that small producers can enjoy with hard work.

There are 45 value chains in the country that are involved in biocommerce, not only promoting economic activity in various regions, but also encouraging the participation of small farmers in different parts of the value-chains strategy. Seven products (annato or *achiote*, cochineal, mace or *maca*, giant corn, Brazil nuts, quinoa and tara) have annual exports worth more than USD 10 million and represented 91% of the total biocommerce export value in 2012. That group of products also accounts for 8% of the value of non-traditional agricultural exports. Meanwhile, 31 products have an export value of less than USD 1 million, but have shown significant growth since 2011 (for example, cherimoya, 181%; passion fruit or *granadilla*, 76%; giant arapaima or *paiche*, 107%) (PromPerú-Siicex).

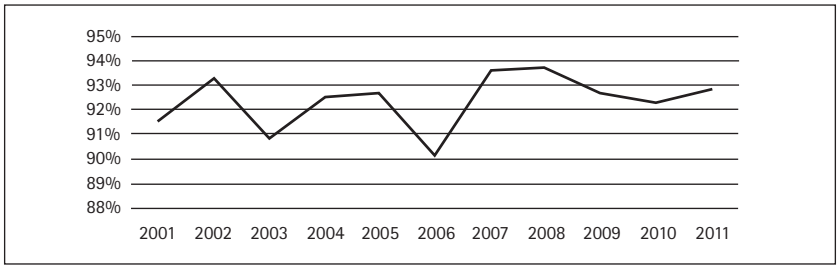
To understand the diversification of exports of organic products, an evaluation was done using the Herfindahl index (Graph 9) and the CR4 concentration index (Graph 10); in both cases, although they show concentration, that tendency has decreased in the past three years.

Graph 9
Diversification of organic products, Peru, 2001-2012 (Herfindahl index, in dollars)



Source: PromPerú-Siicex; compiled by the author.

Graph 10
Diversification of organic product exports, Peru, 2001–2011 (CR4 concentration index, in percentages)



Source: PromPerú-Siicex; compiled by the author.

One of the goals of export diversification is to reduce the vulnerability associated with dependence on a limited number of destination markets and commercialized products. Diversification also helps expand opportunities for enhancing the multiplier effects of production and employment (Samen 2010).

Peru is one of ten countries that trades products in the global solidarity (fair trade) market; examples include value chains for carob, sacha inchi, tara and organic cacao (Box 1).

The expansion of export agriculture is an opportunity that has been capitalized over time and responds to trends in consumption patterns. International consumers now prefer healthy products with convenient packaging (size, shape); consumption of organic products is also growing.

The following are some Latin American examples that illustrate the relationship between trade and environment in both public policy and business practices. These examples also show how countries are strengthening their competitive advantages based on the use of products derived from biodiversity.

In Brazil, there is a value chain based on natural ingredients for the food, cosmetics and pharmaceutical industries that receives support from the Brazilian foundation Funbio and the Amazon Cooperation Treaty Organization (ACTO), among others. One company in the cosmetic industry that is noteworthy for the sustainable use of natural ingredients is Natura, with its Ekos line. This company is committed to sustainable business practices, preserving and disseminating Brazil's environmental and cultural heritage.

In Costa Rica, the National Biodiversity Institute (Instituto Nacional de Biodiversidad, Inbio) was established in 1986 and has successfully combined conservation goals with the

distribution of benefits and transfer of technology to benefit various stakeholders. Inbio's connection with the users of genetic resources has led to the improvement of scientific and technical capacity as well as the development of a catalog of samples of genetic resources, giving the country a competitive advantage in the negotiation of agreements with foreign users about access to genetic resources.

Box 1
Biocommerce in Peru

In 2004, the National Program for Promotion of Biocommerce was approved in Peru. The program's goal is to promote the development of value chains based on products derived from native biological diversity, with criteria related to economic, social and environmental sustainability. This program is guided by the objectives and guidelines of the National Biological Diversity Strategy.

It is a tool for creating local development opportunities, increasing the income of small rural producers based on the sustainable use of biodiversity and thus contributing to poverty reduction. It is also a platform for compliance with the country's international commitments under environmental conventions to which it is a signatory (Convention on Biological Diversity [CBD], Convention on International Trade in Endangered Species of Wild Fauna and Flora [CITES], Ramsar Convention, etc.).

In 2006, the National Biocommerce Commission was created and the National Biocommerce Strategy for 2007-2011 was approved. This strategy includes four components: access to markets, development of competitive supply, promotion of research and political-institutional strengthening.

In 2010, Phase II of the Biodiverse Peru Program was established as part of the implementation of the National Program for Promotion of Biocommerce, with the goal of «increasing the volume of trade in products derived from biological diversity that comply with the principles and criteria of biocommerce». This program has three components, each with various action areas: a) access to markets (international, gastronomy and hotel industry); b) competitive supply and innovation (productivity and quality, applied research and technological innovation); and c) regulatory framework and political advocacy (legal framework, regulations, dissemination and awareness raising).

The program has been implemented in Piura, Cajamarca and San Martín, and the priority products are sacha inchi, tara, carob, goldenberry, cacao, camu camu and maca. It operated from October 2010 to June 2013, with a budget of USD 3.24 million, and financed by Swiss Cooperation-SECO (69%) and German Cooperation-GIZ (31%). Mincetur-PromPerú and Minam were the Peruvian partners.

In 2012, the export value of biocommerce products increased by 13% over the preceding year, with 28 companies participating, 1,818 beneficiary families, 1,496 hectares managed according to biocommerce principles, and eight public-private partnerships established. That year, six additional companies achieved HACCP certification, with combined exports totaling USD 7.7 million.

Sources: Ingar (2010); PromPerú (2012); PromPerú-Siicex.

In Ecuador, the Jambi Kiwa company, which is dedicated to the transformation of medicinal and aromatic plants, received business management guidance, technical assistance and monitoring of activities as part of the Biocommerce Program. As a result, the company has positioned itself in the market with quality certifications and biocommerce practices and is recognized as a high-quality provider of medicinal and aromatic plants. This business model worked for indigenous producers, strengthening local culture and safeguarding of the environment.

These examples show that sustainable trade is a way of carrying out the exchange of goods and services in which economic, environmental and social factors are considered in decisions about the choice of strategies related to market penetration, technologies and content for capacity building, and maximization of benefits stemming from trade. These considerations also illustrate the role of the state in setting long-term goals, the benefits of commercial partnerships between private enterprises, the need to incorporate sustainability criteria into the planning of investment in megainfrastructure, and the support of multilateral cooperation agencies for the identification of new sustainable trade value chains.

3. PUBLIC POLICIES: TRADE AND BIODIVERSITY CONSERVATION

The formulation and implementation of public policies and their consistency with economic, environmental and social regulations, in the context of liberalized trade and sustainable development, are crucial. For example, if the goods that a country trades in the international market are based on natural resources or generate intensive water or air pollution, without adequate public policies and effective regulation, the result will be greater contamination and overexploitation of natural resources (for example, fisheries and timber).

In Peru, progress has been made in public policies for development and the opening of trade, with equity and environmental safeguards. These public policies stem from provisions of the National Accord (Acuerdo Nacional) forum, the National Center for Strategic Planning (Centro Nacional de Planeamiento Estratégico, Ceplan), the National Plan for Competitiveness, the National Biodiversity Strategy, the National Strategic Plan for Exports, the National Agenda for Competitiveness and National Environment Policy, among others (Table 2).

Table 2
Regulatory framework for the development of trade, value chains and sustainable use of biodiversity

Regulation	Year
- Law Nº 26821. «Organic Law for the Use of Natural Resources»	1997
- Law Nº 26839. «Law on Conservation and Sustainable Use of Biological diversity»	1997
- D.S. Nº 068-2001-PCM. «Implementing Regulations for the Law on Conservation and Sustainable Use of Biological Diversity»	2001
- D.L. Nº 757. «Framework Law for the Growth of Private Investment»	
- D.S. Nº 102-2001-PCM. National Biodiversity Strategy	1991
- D.S. Nº 105-2002-PCM. State Policy Nº 19: Sustainable Development and Environmental Management	2001 2002
- National Strategic Plan for Exports 2003-2013	
- D.S. Nº 057-2005-PCM. «National Plan for Competitiveness»	2003
- D.S. Nº 012-2009-Minam. National Environment Policy	2005
- D.S. Nº 014-2001-Minam. «National Environmental Action Plan 2011-2021»	2009
- «Bicentennial Plan»	2011
- Competitiveness Agenda 2012-2013	2011 2012

This legal and institutional framework has contributed to the dynamism of value chains associated with products derived from biological diversity, particularly driving agricultural exports that have diversified over time. With the stimulation of biocommerce, this was followed by the promotion of sustainable productive chains.

PromPerú has played this type of role in the development of value chains and their promotion in destination markets. The establishment of the Peru brand *(Marca Perú*) as a synonym for quality has sparked interest in Peru and motivated the discovery of the country and its varied gastronomy. Private investment has also played an important role in the diversification of the supply of export products and access to new markets.

Because of market uncertainties, climate risks and information asymmetries, among other factors, the formulation of public policies related to trade, value chains and biological diversity requires a flexible, integrated approach that allows for timely adjustments to ensure that objectives are met.

This involves the analysis of scenarios for planning public policy implementation. Decision makers should consider the following elements (Swanson 2009):

- An integrated approach to thinking about biodiversity and ecosystem services, to better link contradictory and incomplete information.
- A better understanding of the dynamics of change to be addressed.
- Familiarization with the timing and nature of key moments of change, where one scenario becomes more likely to occur than another.
- Understanding formative forces to increase the ability to identify a broad range of opportunities that could emerge.
- Transparency in decision-making.
- Thorough risk analysis.
- A set of strategies that have more capacity for adaptation to change and flexibility.

In Peru, progress in the expansion of trade, formation of value chains and improvement of biodiversity conservation has been led by actions to promote value chains and generate income. It is possible to continue developing an approach that promotes inter-institutional action that is coordinated and monitored. To accomplish this, actions should fall within the framework of the Strategic Plan for Biological Diversity (2011-2021), the National Biodiversity Strategy, the National Strategic Plan for Exports and the Agenda for Competitiveness, among other instruments.

Strategic planning is necessary not only for achieving significant goals for the expansion of trade, sustainable use of biodiversity and consolidation of value chains, but also for improving conditions for addressing climate change, to which the country is vulnerable.

The mechanisms and instruments that are designed should also be aimed at stimulating public and private investment, for the development of both bioenterprises and other value chains aimed at the sustainable management of biodiversity. This requires:

- Disseminating criteria for biocommerce, such as green labeling and environmental certification of exportable products, among other things.
- Promoting environmental and social certification of goods and services for international markets, monitoring compliance with requirements.
- Promoting eco-efficiency, environmental quality and social responsibility in business management.
- Promoting private investment in productive processes that use clean technologies and inputs.

4. CONCLUSIONS AND RECOMMENDATIONS

A. Conclusions

- In Peru, the economic contribution of products derived from biodiversity is reflected in their 22% share of GDP and 24% share of the total value of exports. The export of products derived from biodiversity originates in a variety of decentralized value chains that operate in various departments of the country. Rich biodiversity and private-sector investment have helped strengthen an export sector that provides a diversified supply of products to diverse markets. For example, thanks to investment and the sustainable use of biodiversity, commercial risk has been reduced.

- Despite the economic importance of biodiversity and ecosystem services, especially in the diversification of the supply of exportable products, incentives exist for their overexploitation and inappropriate use. The economic literature points out that the limited value placed on biodiversity and ecosystem services encourages their inefficient use. Inter-temporal external costs are not considered. This behavior is due to various market failures (nature of public goods, free-access regime and lack of property rights), asymmetrical information and the creation of externalities, among other factors.

- The CR4 index and Herfindahl index show a slight improvement in the diversification of biocommerce exports.

- To appropriately assess the production and ecosystem possibilities frontier and the opportunity cost associated with changes in the production of goods, recent literature recommends analysis by zones, because each has particular characteristics related to the supply of biodiversity and the functioning of ecosystem services.

- Trade policies and the strategy of demand-based promotion of exports has made it possible to capitalize on consumer preferences for healthy products and various markets for organic products. This has created incentives for investment in sustainable production systems and good agricultural practices, among other things; it has also created incentives for the sustainable use of biological diversity.

B. Recommendations

- The reduction of biodiversity, despite its contribution to the functioning of economic activities and human welfare, makes it necessary to design and implement information systems based on reliable, systematic data. The limited availability of such data about the state of biodiversity limits the effectiveness of public policies.

- Given the importance of biodiversity for human welfare, it is necessary to allocate resources for evaluating, monitoring and communicating its role. Evaluations should include the costs and benefits associated with ecosystem services for various areas of society.

- The promotion of sustainable trade based on biodiversity and ecosystem services is a way of creating efficient value chains that encourage appropriate management of biodiversity. For the replication of these experiences, it is necessary to have an assessment or evaluation that demonstrates the factors that contribute to success and barriers; this will make it possible to design instruments that contribute to greater diversity and promote diversified production.

APPENDIX

Ecosystem services and human welfare

Ecosystem services are the benefits that people derive from the functioning of ecosystems. They are classified as: provisioning services, regulating services, cultural services and supporting services. These services contribute to human well-being (Millennium Assessment 2005, Table 1a).

Table 1a
Types of ecosystem services and their characteristics

Type of ecosystem service	Characteristics
Provision	Fruits, wood, fibers, water
Regulation	Climate regulation, water regulation, carbon sequestration, self-purification of air and water, flood control, pest and disease control, pollination, soil protection
Cultural	Scenic beauty, cultural values, traditional knowledge
Support	Soil nutrient cycling, soil formation, production of atmospheric oxygen

Source: Millennium Assessment (2005).

Components of human welfare are: access to basic material for a good life, health, security, stable social relationships and freedom of action and decision (Table 1b).

Table 1b
Components of human welfare and their characteristics

Components of human welfare	Characteristics
Access to basic material for a good life	Good lifestyle, sufficient nutritional food, shelter, access to goods
Health	Strength, well-being, access to clean air and water
Social relationships	Social cohesion, mutual respect, ability to help others
Security	Personal security, secure access to resources, security in the face of extreme events (minimization of risks)
Freedom of action and decision	Opportunity to develop capacities that make it possible to achieve what the individual values doing and being

Source: Millennium Assessment (2005).

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