# IMPORTANCE OF BIODIVERSITY AND ECOSYSTEMS IN ECONOMIC GROWTH AND EQUITY IN LATIN AMERICA AND THE CARIBBEAN:

## AN ECONOMIC VALUATION OF ECOSYSTEMS

# LATIN AMERICA
## AND THE CARIBBEAN
## A BIODIVERSITY SUPERPOWER

## EXECUTIVE SUMMARY

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# AN ECONOMIC VALUATION OF ECOSYSTEMS

Andrew Bovarnick, Francisco Alpizar and Charles Schnell, Editors

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# LATIN AMERICA
## AND THE CARIBBEAN
### A BIODIVERSITY SUPERPOWER

The Latin American and Caribbean region is a biodiversity superpower. It has one of the greatest endowments of natural capital in the world, which is a source of economic growth and has the potential to become the world leader in offering the services its ecosystems and biodiversity provide, and in return receive new benefits from this conservation and sustainable management. The new policies recommended in this brief promise to transform the traditional model of development—one that often disregards environmental costs—into a new paradigm that recognises the value of services provided by healthy, fully functioning ecosystems.

The United Nations Development Programme launched an initiative to assess and communicate the economic contribution of biodiversity and ecosystems services to development and equity in the region. This effort involves a partnership with the UN Environment Programme, The Economic Commission for Latin America and the Caribbean, the Secretariat of the Convention on Biological Diversity and the UN Conference on Trade and Development.

Extensive collaboration has marked this process. A Commission for Biodiversity, Ecosystems, Finance and Development is guiding the Initiative from inception to fruition. A Technical Team produced a Report from robust data and analyses to make a compelling case for policy change. A Technical Advisory Committee of regional experts in economics and finance vetted the technical quality of the Report. In addition, national and regional representatives from the public sector, private sector, civil society and academia throughout Latin America and the Caribbean contributed first-hand input and suggested emblematic cases to enrich the Report and ensure that recommendations are as relevant and timely as possible. All in all, this Initiative and its report are the result of the efforts and inputs of more than 500 people throughout the region and the world.

The Technical Team produced a Report with chapters on primary sectors of the region's economies centered on biodiversity: agriculture, fisheries, forestry, hydrological services, protected areas, and tourism. Each chapter offers advice for integrating the economic value of ecosystem goods and services into decision-making for specific industry sectors. Additional studies on ethics and biodiversity, biodiversity and human health, biotrade, conservation finance and Reducing Emissions from Deforestation and Forest Degradation (REDD) have been prepared as part of the Initiative.

It is highly important to note that the cumulative value of ecosystem goods and services across all the sectors is orders of magnitude greater than any one sector in isolation. When the full consequences of various actions are totalled, the resulting aggregate value should be the figure used for comparison with the value generated by other uses.

# LATIN AMERICA AND THE CARIBBEAN
## A BIODIVERSITY SUPERPOWER

# I. INTRODUCTION

**Latin America and Caribbean Economies at a Crossroad.** The Latin America and Caribbean region (LAC) has grown its GDP continuously from 2002 to 2008; yet, 25% of its population still lives on less than $2* a day. For LAC to continue economic growth and persist in poverty reduction efforts, the region needs to remain competitive and position itself globally, based on its comparative advantages and assets. One major asset for the region is its enormous variety of ecosystems, endowed with high levels of biodiversity. With more than 40% of Earth's species, over a quarter of its forests, and many valuable fisheries, South America is the single most biologically-rich area in the world. These natural assets provide on going ecosystem services (ES) that input into key productive sectors in LAC economies. The ES include water availability, soil fertility, pollination, pest control, growth and reproduction of food species, as well as storm mitigation, climate regulation, waste assimilation, and many other services that are used in economic processes or provide conditions essential for the functioning of these processes.

Steady economic progress by conventional means has accumulated benefits, but has also led to considerable depletion of the region's natural asset base and the associated ES. Ecosystem services inputs into production processes in the region have been abundant and essentially free. Growth has led to changing conditions and now ES are becoming degraded, scarce, and costly to maintain. Negative side effects of degraded ES resulting from certain productive processes are becoming increasingly noticeable at the sectoral level within LAC countries. At the same time, consumers in major global markets — US, Europe, and Japan — are switching to sustainable products, i.e., goods produced without hidden costs to society. This demand-side pull toward good environmental performance is creating new opportunities. The side effects can no longer be left as externalized impacts and costs — these impacts and costs must now be accounted for.

The economic benefits of the sectoral outputs and growth are well documented and known, while the economic costs resulting from the negative externalities of the production processes generally go unseen and thus, are not considered in policy making and investment decisions. The costs of ES degradation are difficult to measure in economic terms. A gap, therefore, exists between the emerging body of economic data on the role of ES, on one hand, and the narrowly-focused economic information used by policy makers, on the other hand.

These significant changes raise urgent questions for policy makers throughout LAC:

> *Is the competitiveness of LAC countries at risk from rising hidden costs and missed market opportunities because current approaches to economic growth ignore ecosystem services? Can maintenance of ecosystem services and capture of their economic value strengthen LAC competitiveness and sustain growth?*

In order to answer these questions the relation between the provision of ES and economic growth and equity in LAC must be clarified. Doing so moves the issue of ES into the arena of economic policy and enhancement of competitiveness. In response to this need, UNDP's Regional Bureau for Latin America and the Caribbean has developed an initiative: "Latin America and the Caribbean: A Biodiversity Superpower" and has prepared this Report for the UN Year of Biodiversity. UNDP has partnered in this initiative with institutions including CBD, UNEP/TEEB, ECLAC, IUCN, WWF, CI, TNC, and CATIE, and has also received generous support from the government of Spain. Report preparation has engaged key political and economic leaders of the region through a UNDP-led Commission for Biodiversity, Ecosystems, Finance and Development, as well as by a series of consultations with national stakeholders, research institutions, and NGOs across the region.

It is not intended that the main Report be read straight through; most readers will have specific interest in one or a few sectors. Chapters have been made free standing, not dependent on reading in sequence. But it is advised to read the introduction and methodology prior to reading a sector chapter since the key concepts are described in these early chapters.

* Unless noted, the amounts in this document are presented in US currency of dollars and cents. 'Billion' means a thousand million.

Objective of Report: This Report aims to inform policy makers and businesses in LAC about the economic risks and opportunities of undertaking productive activities that impact on and are influenced by biodiversity and ecosystem services (ES). The Report is a tool to assist governments and stakeholders in analyzing the role of ES in order to incorporate these services into economic planning, policy, and investment at the sectoral level.

## II. BIODIVERSITY AND ECOSYSTEMS

**Definition of Biodiversity and Ecosystems.** The Convention on Biodiversity states:

> ***Biological diversity*** *is 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.*
>
> ***Ecosystems*** *are a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit.*

**Overview of Ecosystem Services.** The Millennium Ecosystem Assessment provides a framework to define different types of ecosystem services (ES). The list includes provisioning, regulating, supporting, and cultural services. Ecosystem services are derived from the native and managed biodiversity of a region. Typically, to be considered an ES, a flow of resources must result directly or indirectly in greater human welfare. Conceptually, healthy bio-diverse ecosystems generate greater amounts, higher quality, and more stable flows of ES over time.

The primary activity of many of the sectors analyzed in this Report is to maximize production of timber, food, fiber, and other biologically-based economic outputs. In the process, these desired outputs depend on a variety of supporting and regulating services, such as soil fertility, rainfall, and natural pest control. These supporting and regulating services determine the underlying biophysical capacity of human-made ecosystems. Thus, ES serve as inputs to productive sectors. Some of these natural inputs can be substituted for by human-made inputs (e.g., fertilizer, flood mitigation works); in other cases, no substitution is feasible, making ES not just inputs, but irreplaceable 'life support' facilities for productive activities.

**Biodiversity and Ecosystems in LAC.** The region includes five of the world's ten most bio-diverse countries — Brazil, Colombia, Ecuador, Mexico, and Peru — as well as the world's single most biologically-diverse area, the Amazon. South America alone has more than 40% of Earth's biodiversity and more than one-quarter of its forests. Yet, the region has only about 16% of the global land surface and 10% of Earth's human population.

Across Latin America, the ongoing loss of biodiversity and deterioration of ES is being driven by a complex set of interlinked factors. The immediate drivers of biodiversity loss and ecosystem degradation include: (1) habitat loss, conversion, and alteration (e.g., due to logging, fires, fragmentation), (2) overharvesting or unsustainable use of terrestrial and aquatic resources, (3) unsustainable land-management practices, (4) contamination of terrestrial and aquatic ecosystems from intensive economic activities, (5) the spread of alien, invasive species that impact the structure and functioning of ecosystems, and (6) climate change.

Of these, the loss of natural ecosystems and their conversion to productive systems is currently the most important driver of biodiversity loss and ecosystem degradation, with an estimated 4 million ha/year of tropical forest cleared in South America alone. These proximate drivers of biodiversity loss and ecosystem degradation, in turn, are driven by a combination of underlying demographic, social, political, economic, and cultural forces.

## III. APPROACH TO ANALYZE ES VALUE

The approach developed for this Report has two main elements:

- A sector-oriented approach, to parallel the perspective of policy makers, as opposed to an ecosystem-centered focus.
- Use of the "Business as Usual" (BAU) and "Sustainable Ecosystem Management" (SEM) analytical framework to highlight the value of ecosystem services and to facilitate analysis. Traditional data on the value of ecosystems and biodiversity to production is reorganized based on this

BAU/SEM framework. The values of biodiversity and ecosystems are not seen as static (time-bound) data points, but, rather, as variables that respond to degradation, sustainable management, and other interventions.

**Sectoral Approach.** To be relevant to policy makers, the Report takes a sectoral approach instead of an ecosystem-centric one. A range of sectors closely tied to renewable natural resources has been selected for analysis. This sectoral analyses draw on technically sound economic and ecological data from published material, mainly based on site-based studies (microeconomic data) as well as new case studies prepared for this Report.

Each sector analysis explores the economic relations between production practices, ES, other inputs, and sectoral outputs, as well as shows feedback loops (e.g., pesticide application to crops can damage pollinator populations, lowering pollination rates and agricultural output). Examples are given of ecosystem degradation that lowers outputs, and the costs associated with these lowered outputs are discussed. Then, management practices that avoid actions that damage ecosystems are identified and the economic benefits to the sector from maintaining ES are highlighted. This sectoral approach was developed to align the information gained through this BAU/SEM framework with the sectoral work of ministries and public agencies. This sectoral approach has some constraints: the approach disaggregates the economic value of each type of ES and fragments system-wide values to show specific sectoral inputs. The integration of the overall effects of ecosystems and their services on the economy as a whole is left to the conclusions chapter.

**The Analytical Framework.** Two generic concepts are used throughout as a basis for assessing the economic values of ES: Business as Usual (BAU) and Sustainable Ecosystem Management (SEM). The use of these generic terms provides a shorthand for grouping and analyzing information to simplify the analysis and presentation of findings.

The term BAU refers not to all current activities but those activities that damage or deplete ecosystem services. The BAU approach is characterized by a focus on short-term gains (e.g., < 10 years), externalization of impacts and their costs, and little or no recognition of the economic value of ES, which are typically depleted or degraded.

Under SEM, the focus is on long-term gains (> 10 years); also under SEM, the costs of impacts are internalized. Ecosystem services are maintained, thus generating potential for a long-term flow of ecosystem goods and services that can enter into decision making. Activities that are SEM practices tend to support ecosystem sustainability, not for ideological reasons, but, rather, as a practical, cost-effective way to realize long-run profits. Common SEM practices include watershed management, agroforestry and silvopastoral production methods, low-impact logging, nature-based income diversification, and organic farming.

## IV. OVERALL CONCLUSIONS

These overall conclusions are based on the evidence and analysis presented at the sectoral level. These conclusions reflect observations and trends across the sectors. Hence, not all sector-level conclusions will be aligned with these overall conclusions. However, these broad conclusions provide a framework for analysis at the sector level.

Across all sectors, the analysis and evidence supports that ES should be viewed as inputs into sectoral outputs. Figure 1 includes ES, along with standard production inputs. The ES input value is relative to the other inputs and is influenced by market, policy, and institutional factors; Figure 1 also illustrates the feedback relationship between production practices and the quality of ES as an input.

Sectoral outputs are dependent on a variety of ES inputs. For example:

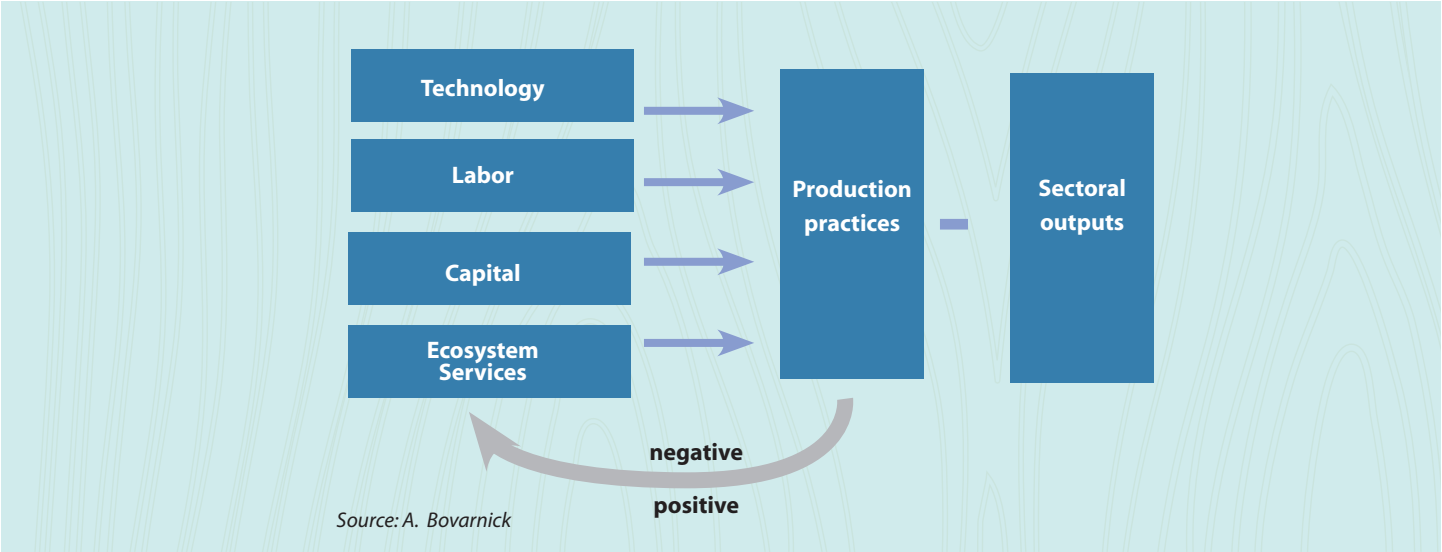
I. Timber and non-timber forest time products (NTFP) production in both natural forests and plantations depend on soil fertility, soil moisture, microclimate, photosynthesis and growth by using $CO_2$ and releasing $O_2$, biodiversity and gene pools, pollination and seed distribution, soil stabilization, and forest water cycles.

II. Productivity in agriculture depends, in fundamental ways, on the management and maintenance of certain ES: water availability, soil fertility, microclimate, pollination, and both pest and disease control. Agriculture uses 73% of all water abstracted in LAC. Furthermore, ES will build resilience of the sector to climate change, by protecting genetic resources, soil fertility, and water quality.

III. In tourism, the most valuable ES for the sector are water quantity and quality, beach material, attractive viewscapes, and biodiversity for recreational activities like bird and whale watching, or jungle treks.

IV. Fisheries are dependent on the provisioning and regulating ES. The most direct input of marine ES to fisheries is by providing fish habitats essential to the life stages of fish species, including the underlying food chains that supply energy. Of particular importance to fisheries are habitats crucial for spawning and/or recruitment, such as mangrove stands, seagrass beds, and coral reefs. Regulating and supporting ES (such as sediment retention, temperature control, water filtration, and nutrient-cycling) are essential to fisheries but difficult to value directly.

Figure 1. Production Practices Inputs and Feedback Loops




Additionally, the regulating ES are important when considering climate change in LAC. Hurricanes provide an extreme example of the role of ES in adaptation to climate change. Increasing storm frequency and intensity is predicted as a primary effect of climate change with potentially devastating impacts on Central America and the Caribbean. For example, Hurricane Jeanne hit Haiti in September 2004 with more than 2,000 dead and missing, whereas the adjacent Dominican Republic fared much better. Haiti, originally deforested for sugar cane monoculture, exemplifies ecosystem collapse with only 3% of its land under forest cover, compared to 28% in the Dominican Republic. No natural ecosystems were left to buffer the impacts of that hurricane event in Haiti.

The sector analysis provides evidence to suggest a strong contribution of ES to sectoral and overall economic growth in LAC. The sectoral analysis, also, has identified the various costs of ES degradation resulting from BAU production systems, as well as the various benefits from ES maintenance by alternative (SEM) production systems. The value of ES for different sectors is inferred by comparing those costs and benefits. Furthermore, sectoral changes are increasing the economic costs resulting from ES degradation and increasing the economic benefits of ES maintenance. While, in the past, maintaining ES was viewed as a barrier to economic growth, evidence suggests that conditions are changing: ES are important for sustained growth — by providing access to emerging green markets, avoiding damage costs, building resilience to climate change, and increasing the efficient use of scarce resources and, thereby, reducing production costs.

In some cases, short-term costs associated with the BAU to SEM transition need to be financed or otherwise mitigated to hasten the realization of long-run gains. Transitioning to SEM also poses trade-offs: in certain circumstances, continuing under BAU and accepting ES depletion makes economic sense. This circumstance will often be site-specific and depend on a variety of local and national factors.

Countries should concern themselves with the increasing and hidden costs of BAU resulting from particular sectoral production systems. If the transition to SEM does not take place in the present, the region faces the considerable risk that BAU will cause long-term damage that will hit economic growth in the future. This risk to economic growth is particularly true for ecosystems close to their ecological thresholds, which, once crossed, can result in heavy costs and even sectoral crashes. Early action is better than delay, so as to avoid ecosystem failure and irreversible loss of the dependent economic activity.

Countries can increase the economic benefits of ES and SEM practice through specific policy changes and by supporting particular production and supply chains in the transition to SEM (sector wide change is not needed all at once).

Firms respond to both policy and market incentives. Consumers, increasingly, want the natural resources that are used as inputs to be sustainably managed. There are signs of companies taking early mover advantage and positioning themselves in the marketplace based on sustainable practices. Access to affordable finance can also be an incentive. Several investment funds have been created to support sustainable ES use in LAC, including Root Capital, Verde Ventures, Futuro Forestales, EcoEnterprise Fund, and CAMBio. These funds have invested in numerous SEM enterprises in agriculture, forestry, and tourism.

Here are the overarching conclusions, generally across sectors, related to the following themes:

1. Costs of BAU
2. Benefits of SEM
3. Transition from BAU to SEM

## Costs of BAU

The main types of costs that sectors and countries face from ES degradation resulting from BAU production practices include:

*Reduced productivity from ES decline.* As ES degrade and substitution effects become more difficult (e.g., soil fertility and use of fertilizers), BAU costs will increase.

*Off-site or downstream costs.* Where BAU costs have no financial implications for businesses that externalize them (e.g., agricultural runoff of agro-chemicals into potable water reservoirs) there is no direct incentive for businesses to reduce such costs and for transition to SEM practices.

*Perverse subsidies and incentives.* Subsidies, other incentives, or lack of regulations (and enforcement) to prevent externalities can translate large BAU costs into small financial outlays, distorting market signals and prolonging or widening BAU practices beyond what markets need.

*Lost public-sector revenues.* This is the cost of certain subsidies and incentives, plus the loss of public funding foregone by low rates of taxation, usage and concession fees, and other tariffs.

*Future increase in costs.* Many BAU costs, where now small, will grow over time, making transition to SEM more costly in the future (such as sedimentation of dams from continued forest clearance); and, further, additional BAU costs may be imposed by irreversible collapse of an ES and associated products.

As these four types of BAU-costs situations show, certain resource-use patterns, while currently still generating net economic benefits, over time, will decline in economic efficiency and end up costing more than would potential investment in practices that maintain ES inputs today. There are also cases where one sector impacts the ES that affects a different sector — e.g., essential fish habitat may be degraded by activities originating outside of capture fisheries, including direct habitat destruction such as clearing of mangroves. Sectoral dependence on ES that, in turn, are impacted by other sectors shows the need for inter-sectoral collaboration and cooperation on ES management.

## Benefits of SEM

The sectoral analysis has identified many SEM practices that can be financially viable, particularly with changing markets. The main benefits are:

*Direct financial returns from increased productivity and lower costs*
*Payment for ecosystem services (PES) and carbon storage revenues*
*Diversified revenue streams*
*Expanded employment*
*Equity benefits*
*Reduced risk and avoided damage costs from natural disaster*
*New green market opportunities*

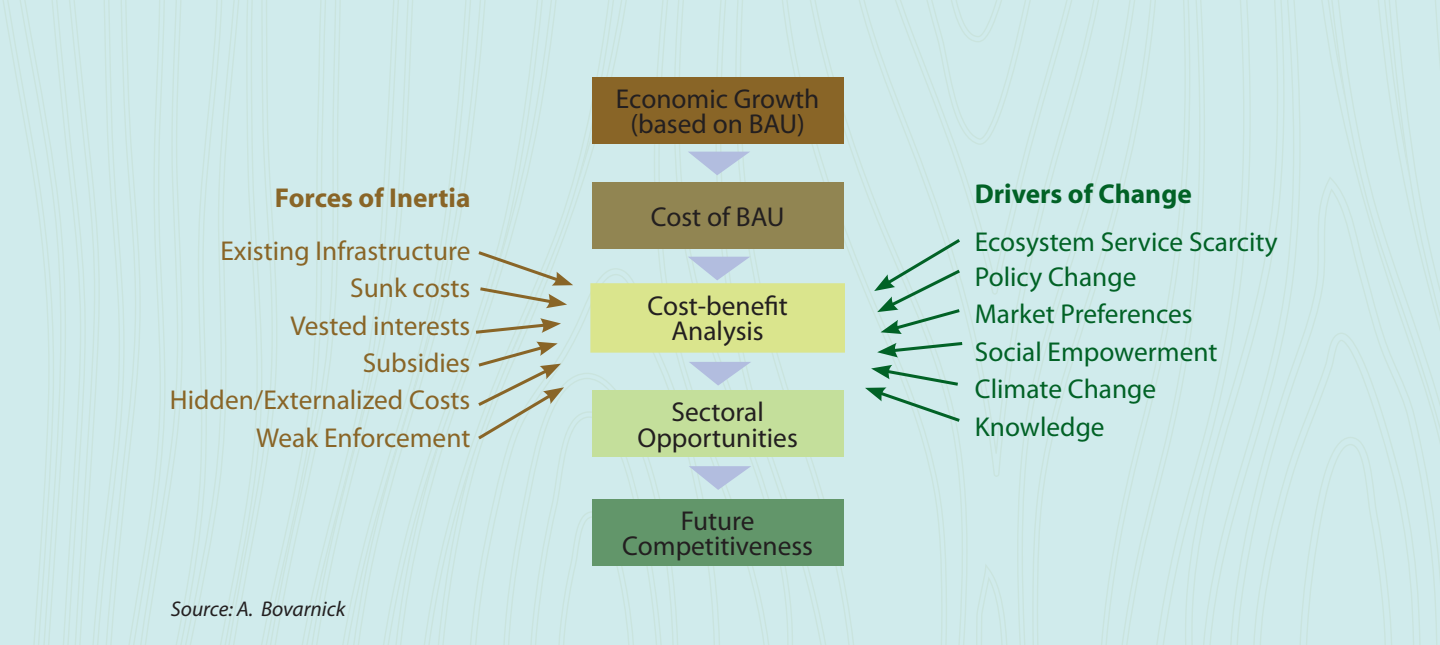
Typically, the poorer members of society — those least able to afford substitutes during times of crisis or ES degradation — rely most heavily on biodiversity and ecosystem goods and services. Indeed, biodiversity provides a primary safety net for rural populations in the LAC region and is one of the few key factors limiting malnutrition and large-scale urban migration. Degradation and the resulting loss of biodiversity and the weakening of ES hinders the ability of these vulnerable groups to cope with economic and environmental adversity, pushing them further into poverty. Hence, SEM practices are advantageous to low-income rural communities; these communities are more dependent on ES than other groups because they have limited access to substitutes (technology, capital) or alternative income sources should their ES-based production activities fail (e.g., from natural disasters). The poor are also more exposed and vulnerable to externalized costs, such as air and water pollution that effect human health, occurring in BAU conditions. Finally, the poor are less able to afford medical care.

**Transition from BAU to SEM.** The broad conclusions above indicate that the economic value of ES is relative and varies depending on geographic location, market conditions, policy frameworks, and the impact of alternate inputs — labor, technology, and capital. With time, costs and benefits from specific production practices (BAU and SEM) change. The interplay of external factors — *drivers of change* — combined with the baseline conditions and *forces of inertia* influence the relative economic value of ES and, hence, at what point in time SEM generates greater net benefits than BAU. Thus the economic rationale for maintaining ES and thereby for governments and business to transition from BAU to SEM will vary depending on the underlying conditions. See Figure 2 for some specific types of the forces of inertia and the drivers of change.

The policy environment can be a key driver in decisions for transition from BAU to SEM. Subsidies and their removal can have an important influence on the price of goods and services. Currently, most LAC policy frameworks support BAU activities; hence, BAU activities have an economic advantage and appear preferable to SEM practices. The profitability of BAU agriculture and fisheries, in particular, is often supported by incentives, which, if removed, would level the playing field for SEM practices. Widespread underpricing of forested land, water, and fertilizers promotes their overuse. On the other hand, incentives could also be put in place to support SEM in its initial phases, like tax breaks for certified products and payments for environmental services. For SEM to become more economically advantageous, policy will often need to change first. SEM-favoring policies will, then, influence BAU enterprises to shift to SEM practices.

Countering the *drivers of change* that reduce the 'traditionally-realized' economic benefits of ES are the *forces of inertia*. These forces increase the cost of transition from BAU to SEM and, hence, foster the maintenance of BAU practices. The interplay between baseline, drivers of change, and forces of inertia is represented in Figure 2. This figure is a diagrammatic representation of the stages experienced by sectors in relation to ES value as they move toward improved competitiveness.

Figure 2: Transition Rationale from BAU to SEM




Costs of transition include the costs of adoption of different technologies (e.g., alternative energy), training in new methods (conservation tillage or nature guiding), new infrastructure (processing plants for certified products), and new institutional arrangements (e.g., to manage PES). One of the biggest barriers to transition is this case of producers having to forego their regular income from BAU practices during extended periods, while waiting for the improved conditions under SEM to develop. Examples of transition timeframes run from several months to several years required for such advantageous conditions to develop: soils to improve, trees to grow, or fish stocks to rebound. Resolving property rights and institutional reform is also required in most countries to enable the monetization of ES and increase the market opportunities for SEM to generate revenues. In many circumstances, significant investment has been made for BAU, as in water treatment facilities or large-scale monoculture plantations. Such costs are sunk costs; combined with the cost of transition to SEM, existing conditions may well not make economic sense for change, at least for the moment.

The examples provided throughout this Report show that progress is already underway in different sectors and countries in the transition from BAU to SEM. These BAU to SEM approaches will likely increase in frequency because each sector has experienced changes to underlying conditions that are modifying the economics of ES in resource management practices and businesses, all making SEM more profitable and BAU less profitable.

Some of the policies that promote sustainable resource use include zoning, certification, PES schemes, improved access to green markets, territorial use rights in forestry and fisheries, support to SEM businesses during start-up, and shifting subsidies from yield optimization (BAU) to SEM.

## V. RECOMMENDATIONS

The Report concludes that many LAC countries are experiencing drivers of change that alter the trade-off between BAU and SEM and elevate the relative economic value of ES for many sectors and sub-sectors. The combined effect of these drivers is beginning to incentivize a transition from BAU to SEM.

National governments, business, and other stakeholders should consider the following recommendations to capture ES value in the policy, planning, and investment activities that support sectoral and cross-sectoral economic decision making. These six recommendations are not new concepts, but still need increased implementation in LAC to facilitate this transition from BAU to SEM. Now is the time to put them into practice at scale across the region.

1) **Sectoral plans should undertake trade-off analysis between maximization of short-term production and ES maintenance.**

The Report has shown that ES are an economic input into the production function within the sectors reviewed. A decline in ES levels can, under many circumstances, reduce production revenues and increase off-site costs. In some cases, the lost revenue will be marginal, with these conditions not being worth a change in management practices. In other cases, the losses can be substantial and likely to increase over time and thus merit consideration of remedies from an economic standpoint. Thus, actors must look carefully at the trade-offs associated with production and broaden investment planning to take these sources of economic loss into account.

Sectoral plans should broaden their purposes from production maximization to a more balanced goal of economic efficiency, input management, and long-term sustainability. Legislation should emphasize multiple priorities with clear guidance on trade-offs. The broad goals need to be translated into operational objectives, such as preventing resource depletion and realigning incentives.

Another national planning tool for increasing emphasis on economic analysis is in the National Biodiversity Strategy and Action Plan for each country, as developed under the Convention on Biological Diversity. These Plans could propose recommendations and monitoring of the transition to SEM, based on sectoral status assessment. Strengthened economic analysis and coordination with sectoral plans will, in turn, strengthen the effectiveness of these Strategies and Plans.

#### 2) Level the playing field and incentivize SEM

Governments should review policies to assure that their policy frameworks level playing fields and do not hide or externalize costs of BAU, which artificially make BAU activities more profitable than SEM. Governments should also consider options to catalyze interest in SEM, both for enterprises based on the BAU model and for new start-ups deciding whether to follow the route of BAU or that of SEM. The main tools are subsidy reform, tax breaks, and regulations. The regulatory framework should be extended to underpin development of PES and other private incentive schemes.

#### 3) Develop economic instruments and planning to reduce off-site degradation of ES

Policies should be designed to charge for off-site or externalized degradation of ES that, in turn, reduce the profitability of downstream activities or other enterprises in the same or other sectors. Charges should cover economic damages. Amounts collected for compensation should reflect the economic costs caused by the ES loss resulting from the BAU activity. This recommendation, essentially, builds on the polluter-pays principle. The policy will apply to all sectors, such as agriculture (e.g., agro-chemical pollution) and forestry (undue clear cutting), as well as to cases such as when tourism development impacts coastal resources valuable to the fisheries industry (mangrove cutting) or for tourism (turtle watching businesses spoiled by resort lights), or harvesting fish in ways that ruin a tourist attraction (coral reef damage, break-up of whale shark aggregations by overfishing prey).

Where activity in one sector affects activities in another ecosystem, coordination on ecosystem management between Ministries will be valuable. For example, when a Ministry of Tourism promotes a stretch of coast for development that will result in felling mangroves, the Ministry should undertake studies and consult with the Ministry of Fisheries to assess the resulting cost to fishermen. If development proceeds, compensation schemes can be developed that capture the true costs; the budget for such compensation can be internalized into the government decision making process.

#### 4) Increase the asset value of biodiversity and ES

Actors should raise the value of natural assets from the enterprise point of view by creating markets and developing economic instruments and technical assistance programmes to support development of biodiversity and ES business opportunities. This recommendation could take the form of policies that support certification schemes, a market-based tool, to assist in capturing the economic value of certain ES (particularly biodiversity, habitat, water, and soil) and of practices that protect ES (like reduced pesticide use). Such policies should also include market demand stimulation and assistance to enterprises, particularly small and medium enterprises (SMEs), to overcome the initial costs to adopt SEM. It may be cost-effective to focus assistance on new start-ups whose costs to develop SEM models will be less than for conventional businesses that already have sunk costs in BAU practices.

#### 5) Augment public sector revenues from use of ES

Increase revenues to the State and relevant public agencies from use of ES and resources that influence ES provision. The resulting policies should carefully take into account accurate pricing of natural resources. This recommendation can be accomplished through water pricing, stumpage fees, and fishery licenses, among others. This has the double benefit of signaling ES value and increasing revenues to the government to invest in ES maintenance activities. These activities will include increased monitoring, better enforcement to reduce illegal BAU activity, capacity building, and so on.

#### 6) Generate and capture economic data on ES

The recommendation calls for the gathering and use of economic data to show, more clearly, the past, current, and future economic costs of BAU and similarly, the economic benefits of SEM. Doing so will make clear the trade-offs between BAU and SEM growth models at the sectoral and enterprise levels. This information gathering and analysis should be done for all sectors.

### Way Forward

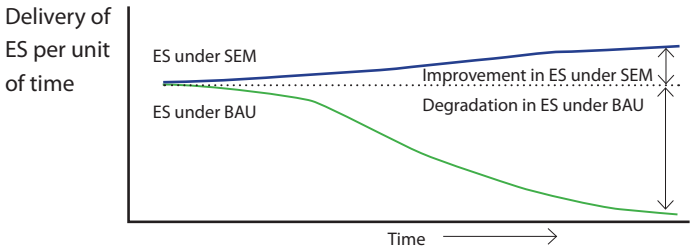
Ecosystem services have provided valuable sectoral inputs for substantial economic growth in the region. Countries in the LAC region now need to consider the balance between short-term needs and maintenance of ES to support long-term economic growth. The region faces many opportunities and challenges in accessing new markets and responding to increased global demand for ES and environmentally-friendly products. Time is critical: action is needed now to transition from BAU to SEM.

This Report offers a perspective on the situations, production practices, and actions that are feasible to put into practice and that can make SEM a profitable path to the future. Most importantly, due to the variety of situations faced, the Report has constructed a way of comparing production practices between BAU and SEM within a framework for analysis and decision making in a given situation. This Report issues a challenge: now governments, business, NGOs, and research institutions must elaborate on and continue such economic valuation analysis, feeding this information into policy dialogue and outcomes within countries across the region.

### Analytical Methodology

Graph 1 shows the delivery of ES under BAU declining because of resource degradation. For ES under SEM the line maintains its level, or rises in response to maintenance or improvements in the natural resource base under SEM. In specific cases, the ES being delivered might be measured in $m^3$/hour of sediment-free water, number/night of egg-laying turtles available for watching, or tons/year of seafood biomass produced. Depletion of such resources under BAU leads to lower net revenues in Graph 2 below. The curves in these graphs are for representational purposes only; the exact nature of change will be site specific. The variables influencing the curves are elaborated in the main Report.

Graph 1. Changes in Ecosystem Services (ES) under BAU and SEM

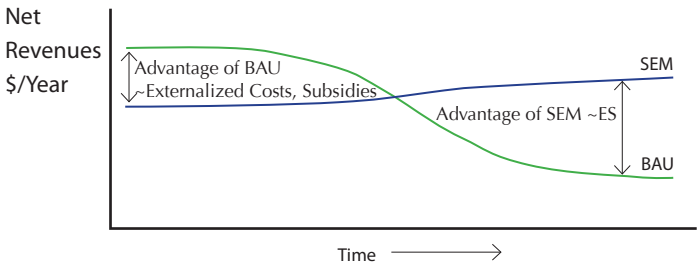



Ecosystem services are viewed as one of several inputs required for production, along with labor, technology, and capital. They both affect and are affected by BAU and SEM production practices.

Rather than attempting to isolate the input function of each ecosystem service and its resulting economic value — e.g., a hectare of forest supports X pollinators that increase by Y% the yield of nearby coffee crops, resulting in a gain of $Z — the difference between BAU and SEM is used to infer the approximate economic value of ES inputs into production. Certain production practices maintain and use ES (grouped under SEM), while other practices degrade ES and externalize costs (i.e., BAU). If studies show that coffee farms with SEM practices have higher net revenues, while those using BAU practices have lower net revenues, the inference is drawn that this result is due in substantial part to the maintenance of ES under SEM. The amount by which benefits are greater under SEM is understood as a rough indicator of the magnitude of the ES involved — even though the analysis recognizes that other variables are also at play.

This net benefit of SEM over BAU in an enterprise setting can be illustrated graphically. Graph 2 shows the hypothesis that under BAU, net revenues decline over time, while those revenues of SEM may start lower, but remain constant or rise. This leads to a point at which SEM replaces BAU as the optimal management approach. The initial advantage of BAU corresponds to its externalization of costs, both current and future; other factors may also come into play, like subsidies. The later advantage of SEM is based on its maintenance or improvement of ES, though other aspects may also influence, like better coordination among stakeholders or the use of subsidies to facilitate transition.

Graph 2. Evolution of Net Revenues under BAU and SEM




Clearly, this approach is an approximation of ES value since other variables are at play, differentiating BAU and SEM. However, the BAU and SEM concepts enable a framework for economic analysis and an approximate assignation of value to ES — i.e., the BAU/SEM framework provides a practical way to bridge the disconnect between ES values and the arena of planning and policy decision making. This approach and framework structure the subsequent sector analysis, conclusions, and recommendations of the Report.

## VI. SECTORAL ANALYSIS AND FINDINGS

The following sections summarize the sector findings. Each paper was researched and written by a team of specialists in that field; methods and approaches varied somewhat, though all researchers used the BAU/SEM analytical framework. Key results, conclusions, and recommendations are sector specific, based on the evidence found in each field.

# VII. AGRICULTURE SECTOR

**Economic Importance of Agriculture in LAC.** Across LAC, the agricultural sector makes a significant contribution to GDP, export revenues, employment, and rural livelihoods. From 2000 to 2007, agriculture contributed, on average, 9.6% to regional GDP, while agricultural exports were 44% of total LAC exports in 2007. About 9% of the region's population is employed in agriculture, the primary source of income for rural households. As the leading employer in rural areas, the sector is central to tackling poverty; at least nine LAC countries have rural poverty levels above 50%.

**Role of ES in Sector.** Agriculture's role in economic production depends on ecosystem services (ES). About 73% of water use in LAC is for agriculture; 8.5 million ha of crops in the region require irrigation, making water supply critical. Nutrient cycling, microclimate, soil formation, pollination, and pest control are examples of other key natural services. Critical ES cannot be easily replaced. Many ES are free inputs to farm production; yet, their quality and quantity depends on management of natural and artificial ecosystems. If degraded or lost, ES must be replaced by technology such as agrochemical, mechanical practices. Yet, some ES cannot be substituted cost effectively. Without ES, agriculture systems are liable to lose productivity or even collapse.

Agriculturally-valuable ES influence where and how people farm. For example, all the major cereal-producing regions of the South American pampas are located on deep topsoil with high organic matter and good water-holding capacity. Provision of ES to agriculture is affected by a variety of agricultural and non-agricultural land-use practices. There is broad scope to increase provision of ES, by changing the way in which production systems are managed.

## Costs of BAU

Certain practices that do not take into consideration the maintenance of ES impose costs on farms and society, like fertility loss, habitat depletion, water pollution, and sedimentation. Poor agricultural practices diminish ES, which in turn undercuts agricultural potential, reducing future returns. Costs and trade-offs are explored in five areas that have characterized BAU agriculture in LAC. Each area exemplifies different aspects of ES degradation: extensification in the cattle sector, soil erosion, agrochemical use, and export-crop plantation agriculture.

**Cattle.** Over half the forest lands cleared for cattle have later been abandoned, their ES severely degraded (e.g., fertility, carbon storage, dry season water flow). A comparison of net present value of different land-use practices in the Amazon showed that pasture is less profitable than agricultural crops and actually produces negative returns under BAU. Sustainable intensive methods offer the best pasture management returns and are more profitable than logging, but less so than agricultural crops. Intensive cropping also creates more employment.

**Soil Erosion.** The impacts of land degradation and the depletion of soil resources have profound economic implications for low-income countries, threatening prospects for economic growth. On-site costs of soil erosion include increased expenditure on fertilizers, pesticides, equipment, labor, and a loss of crop output. In Costa Rica, yearly erosion from farm and pasture land removes nutrients worth 17% of the crop value and 14% of the livestock product value. The associated costs of BAU land management are partly externalized, as downstream sedimentation; the resulting loss in fertility affects farmers directly. As a result of BAU practices, 38% of Ecuador is considered to be at high risk of degradation. Losses in soil fertility have resulted in the required purchase of costly imported agrochemicals. In Guatemala, BAU agriculture is estimated to generate 299 million $m^3$/year of soil loss. This soil loss has resulted in sedimentation of waterways and high levels of eutrophication. The cost to recover just two lakes used for tourism — Izabal and Atitlan — exceeds $653 million. These lake recovery actions are externalized costs of BAU. In another study, the cost of soil nutrient depletion on agriculture was estimated at $169/ha/year.

**Agrochemical Use.** Agrochemical use has contributed greatly to increases in per-hectare productivity; for example, cereal yields in LAC have tripled since 1960, driven, in part, by pesticide and fertilizer use. However, this increase in productivity, realized by greater purchase of inputs, comes with some important hidden costs. One example of a hidden cost is the economic burden of illness from pesticide poisoning in highland Ecuador. In 50 reported cases in the Montufar region, the estimated average treatment cost was approximately $17/case, which was 11 times the daily agricultural wage at the time. The agricultural workers affected tend to be very poor, with the cost of treatment representing a heavy financial burden.

**Export Plantations.** Agricultural crops make a significant contribution to export earnings, but unsustainable management can lead to externalized and hidden costs. Soybean is a major crop; yet, the industry has been associated in the past with several problematic practices: destruction of natural habitat to increase cultivated areas and to develop the infrastructure required, as well as other externalized costs such as agrochemical pollution. For instance, paving the Cuibá-Santarém road would reduce transport costs enough to increase the soybean cultivation area by 70%. Private economic benefits for farmers are estimated at $180 million, while the real economic cost, considering environmental damage, would reach from $762 million to $1.9 billion. Examining these two figures suggests the magnitude of some externalized costs under BAU.

Table . Examples of Ecological and Economic Benefits of SEM in Farm Practices

| Farm practice | Ecological benefits | Economic benefits |
|---|---|---|
| Organic production | Reduces environmental risks by reducing use of chemical inputs<br>Demands less energy per unit of area<br>Lower green house gas emissions | - Raises, stabilizes income to poor farmers: Nicaragua – certified organic coffee producer income increased by 40%<br>- Enhanced food security and independence from imported food sources & expensive agricultural inputs<br>- Certification leads to market share, price premium |
| Agroforestry / Silvopastoral systems | Carbon sequestration<br>Water provison<br>Biodiversity protection<br>Soil improvements<br>Crop pollination | - Central America: 90% of agroforestry systems showed higher returns than traditional cultivation—e.g., NPV of $2,863 (over 10 years) compared to $1,423 obtained from contour planting BAU and $764 from woodlot<br>- Systems in Belize shown to be more profitable than traditional systems<br>- Timber and fruit products for domestic consumption and /or sale |
| Soil management & conservation tillage | Soil fertility; improved physical, chemical & biological soil properties<br>Reduced soil degradation and loss<br>Reduced carbon emissions | - Widespread increased net returns to farmers<br>- Southern Brazil: better soil management and greater use of green and organic manure increased total farm income by $98,460/yr for maize, $56,071/yr, soy, $12,272 / yr, beans, and $10,730/yr, tobacco |
| Organic composting | Adds nitrogen to soils<br>Reduced soil erosion<br>Improved water retention<br>Increased agro-diversity | - Honduras: maize productivity doubled to 1.9 t/ha/year from 0.95t/ha/yr for traditional corn production |
| Crop rotation, polyculture, & crop diversification | Biomass production increase<br>Soil quality preservation<br>Natural control of pests, weeds, disease<br>Higher crop resilience; reduced risk | - Mexico: maize productivity increased between 47% and 74% with respect to monoculture when combined with beans and squash<br>- Increased farm productivity. Brazil: higher, less variable income |
| Integrated pest management | Minimal use of chemical pesticides<br>Better overall control of pests | - Widely proven cost effective in increasing productivity in crops such as maize, coffee, rice, cassava, and many others |

The banana industry is a source of revenue and employment in several LAC countries. Environmental and health issues associated with this export crop include deforestation, changes to hydrological systems, agrochemical damage, biodiversity loss, pest and disease infestations, and waste generation. To maintain banana production rates, significant amounts of fertilizer are needed; it is estimated that 30 kg/ha/yr of pesticides are applied to plantations in Central America, ten times the level used to farm in industrialized countries. In some places, such as the Pacific lowlands of Costa Rica, the land has been so poisoned that alternative agricultural use is impossible. Sediment and agrochemical runoff from banana plantations is a factor in the destruction of about 90% of the coral reefs along Costa Rica's Caribbean Coast.

**Subsidies.** Use of subsidies to support BAU agriculture has been widespread. Many of these subsidies qualify as 'perverse' subsidies, which distort markets and encourage externalities. Such subsidies often have been used to support conversion of forest to cattle lands and to promote agrochemical use.

## Benefits of SEM

Numerous studies have found that specific SEM practices, such as crop rotation, low-impact tillage, crop residue management, and other forms of conservation agriculture have positive effects on ES. But the financial cases, first, at the farm gate and second, the broader economic case for conservation agriculture are less well documented. Based on available evidence, the economic benefits of specific farm practices that maintain ES are presented; these practices are exemplified in the Table above.

## Certification

Organic, Fair Trade, Rainforest Alliance, and other eco-certification labeling programs increase returns to farmers, expand market access, and encourage environmental stewardship. Most certification contracts improve not only agricultural practices, product quality, and prices, but also working conditions.

Consumers are prepared to pay more to support certified growers, provided the production system is transparent. For instance, Canadian consumers were shown to value food, including beef, produced with attention to the environment. Respondents, self-identified as environmentalists, offered to pay 15% more for beef raised thusly. In Nicaragua, Fair Trade-certified farms receive average prices that are 5% higher, plus a price premium paid to the managing organization to be used for collective purposes like loans to women´s groups and for scholarships.

Coffee farmers benefit from certification schemes that allow better coordination between actors in the value chain such as roasters, traders, and growers. In Peru, no income differences were identified between certified and non-certified organic producers, but certified farms had higher levels of farm assets, suggesting that improved household conditions are associated with certification.

Consumer preference expressed through corporate buyers has also pushed growers to change to certified bananas. Chiquita was the first major banana producer to certify production, spending a million dollars to improve and certify its Costa Rican facilities. To comply with certification standards, Chiquita installed solid waste traps in packing facilities to reduce river pollution, rebuilt warehouses for chemicals, reforested riparian corridors, and began to monitor water quality and to compost organic waste. While agrochemicals are still used, pesticide use has been targeted and automated, showers have been installed so workers can wash after contact with chemicals, and safety training is given.

Fair Trade bananas in Peru, Mexico, and Ecuador have increased farmer income and raised labor productivity. In Ecuador, certified organic banana producers used farming practices and management skills to increase ecological efficiency, mitigate resource degradation, and lower environmental risk, while also enhancing worker living conditions.

### Conclusions and Recommendations

Sustainable farming practices to maintain ES can be financially viable. There are many examples of the economic benefits of sustainable farming practices such as agroforestry and organic production that can raise productivity and sales. Environmentally-friendly production practices, such as conservation tillage and agroforestry, provide higher returns than BAU practices. Ecosystem services degradation implies costs both to farmers (e.g., through increased fertilizer use) and society (e.g., silt removal for hydropower generation). Agricultural land not only provides food, but if well managed can deliver services such as carbon sequestration, water quality regulation, and biodiversity conservation. Payment for ES (PES) and certification for organic and fair trade products are ways to increase returns from SEM, thus facilitating uptake of such practices.

SEM is not as widely practiced as the approach might be due to high start-up costs, long lead times, lack of funding or technical skills, and other barriers.

Successful SEM requires a compatible policy environment. Existing policies often encourage or subsidize overuse and degradation of ES. The external impacts of agriculture on ES are seldom taken into account. Long-term agricultural yields can be improved by adopting policies to encourage SEM. That includes enforcing those that level the playing field between BAU and SEM, thus freeing the latter to compete. In particular, this means ending hidden costs and perverse subsidies. Governance for optimal management of ES requires co-ordination because ES are also affected by off-farm practices. Management of surrounding landscapes will affect agricultural productivity and benefits to society. Better inter-agency coordination, stakeholder engagement, and involvement of civil society are needed.

## VIII. FISHERIES SECTOR

**Role of Fisheries in Economic Growth.** The fisheries sector is economically important in LAC, contributing to employment, domestic income, foreign exchange earnings, fiscal revenues, food security, and social safety nets. In 2004, four countries derived more than $2 billion annually from fisheries, with five countries over $100 million. Fisheries earn foreign exchange (over $7 billion in 2007), play a part in industrial development, and provide 1% of the region's employment. Fisheries are especially important to the livelihoods of the poor.

**Role of ES in Fisheries.** Fisheries depend on natural ES, from provisioning of the habitats critical to each life stage of targeted species and the food chains that sustain them, to regulation and maintenance of ambient conditions and essential metabolic, growth, and reproduction processes. Marine ecosystems (like estuaries, mangrove stands, seagrass beds, coral reefs, diverse bottom communities, the continental shelf, and the ocean) provide a wide range of ES that support economic production. The provisioning services are underpinned by regulatory and support ES, like sediment retention, water filtration, and still other ES that ensure stock health and survival of gametes and fry; likewise, the health of sensitive organisms like corals, while minimizing accumulation of pollutants up the food chain. Degradation or loss of these ES contributes to fisheries depletion or collapse, especially with overfishing, and the economic activities that depend on them. Disruption of nutrient cycling services may lead to low oxygen conditions and dead zones. Fisheries management may maintain natural capital, erode this capital through resource depletion and ES degradation, or build this essential natural capital by investment in sustaining or rebuilding fish stocks and safeguarding essential fish habitats.

### Costs of BAU

Production in marine capture fisheries has probably reached a plateau, despite increased fishing capacity. Of 49 fish stocks in LAC for which data are available, only 2% are considered under-exploited and 10% moderately exploited, with some potential for increased production. About 30% of stocks are moderately to fully exploited and, thus, close to their maximum sustainable limits. A further 12% is fully- exploited-to-overexploited. About a third (35%) of fisheries are overexploited or depleted, while 10% are recovering.

Further development and stabilization of fisheries is likely to be attained by rebuilding depleted fisheries, restoring critical habitats, and raising economic efficiency. Recognizing this need, some countries have begun to reorient their fisheries towards SEM practices.

A major challenge for LAC is that many economically-important fisheries are comprised of large numbers of small vessels targeting multiple species, launching out of many ports. The intervention tools that have been developed to manage industrial fisheries are less suited to these small-scale fisheries, some of them community-based. Several countries in LAC are testing new approaches to address these challenges and to develop a set of tools that are effective in these smaller scale and community contexts. Examples of these tools include catch shares, community co-management, territorial use rights in fisheries, and individual transferable quotas, among other instruments.

BAU fisheries tend to deplete fish stocks by overfishing, damaging essential fish habitat and key ES, and practices that produce high levels of discards, by-catch, and waste: all leading to loss of economic value. The same yields could be captured with less effort, freeing up capital and other resources. Depletion and fisheries collapse can incur high costs in terms of lost yields and greater travel costs because in response to deterioration, fisheries move offshore after depleting inshore resources. Negative feedback loops are set up that undermine the productivity of the resource and threaten future yields of the exploited stocks and others.

When fishers' future access to fisheries resources is insecure, they have strong incentives to maximize short-term profits. This situation often leads to overfishing, development of overcapacity, and a 'race to fish'. The Peruvian anchoveta fishery, for instance, had 60%-80% more investment in fishing fleets and processing plants than needed to handle the Total Allowable Catch; the Argentinean hake freezer fleet was estimated to be 120% above the required capacity. Overcapacity implies that the effort per unit catch is greater, raising costs and greatly lowering economic returns. Overcapacity also creates pressure to allow overfishing. These types of situations are fostered by national subsidy levels averaging about 20% of the total catch value in LAC.

Typically, fisheries resources under BAU are exploited at levels that undermine their productive potential, lead to overexploitation, and prevent recovery. Fisheries depletion imposes economic costs on society via lost yields, higher costs, and reduced employment, income, and food security.

The main causes of resource depletion in BAU fisheries are fishing fleet overcapacity, subsidies that underwrite development of excess fishing effort (including overcapacity), and a failure to control illegal, unregulated, and unreported fishing. All three serve to distort production incentives.

## Benefits of SEM

SEM in fisheries provides for maintaining ES, safeguarding critical life stages and essential habitats, enhancing the resilience of fisheries to high levels of fishing effort, and maintaining marine biodiversity. Under SEM, these practices — the rebuilding of fish stocks, the reduction of fisheries capacity to levels that match the productivity of the resource, a reorientation of subsidies, and an elimination of the race to fish — all serve to increase returns on investment over the long-term, allowing SEM fisheries to reduce fishing effort, increase catch per unit effort, and improve their economic efficiency. Maximizing economic rather than biological yields will require larger stock biomass; hence, economic and ecological objectives coincide in maintenance of larger, more stable stocks. With most fishery resources fully- to over-exploited, options to improve economic performance lie primarily in restoring depleted stocks and harvesting all stocks more efficiently.

Catch shares, territorial use rights, and related management systems are designed to provide individuals or groups with greater security over access to the resource in the future, by granting rights to a share of the Total Allowable Catch. These systems create incentives to maximize fisheries revenues over a longer timeframe by investing to maintain or restore fish stocks and improve economic efficiency.

Several countries in LAC have started to tackle the challenges presented by BAU practices, adopting strategies to increase the economic yields of their fisheries and to preserve the ES that underlie them; in these ways, countries are making progress towards SEM. The LAC region is home to a wide variety of catch share systems, with examples in Argentina, Chile, Mexico, Brazil, and Peru among other countries. Implementation of these SEM approaches often requires legislative change but early results from the region show increased catches and improved economic performance.

The Peruvian anchoveta fishery is the largest single-species fishery in the world, but has long been characterized by extreme variability and occasional collapse. To address these conditions, fisheries managers set the Total Allowable Catch each year at levels designed to allow a fixed biomass of fish to escape. In addition, fishing is banned during the two main reproductive seasons and when a high percentage of juveniles are found in the catch. Industrial fishing is also banned within five miles of the coast to protect anchoveta spawning and the habitat of other commercially-valuable species. Together, these measures have avoided resource depletion in recent years and reduced the risk of collapse, and, thus, already represent substantially progress towards SEM. However, catch limits have also stimulated an economically inefficient race to fish and massive fishing overcapacity — both economically wasteful and destructive of ecological services. In 2009, individual catch shares were introduced to address these issues (to companies, by vessels). Without reducing total landings, catch shares effectively eliminate the race to fish, increased the length of the fishing season, reduced the percentage of juveniles in the catch, and improved the quality of fish landed.

## Conclusions and Recommendations

Fisheries under BAU methods have been depleted but they can still transition and be rebuilt under SEM. Production is higher following rebuilding (near maximum sustainable levels) and risks of collapse are lower than during the overfishing phase. Returns on investment will tend to rise under SEM as economic yields are maximized, by reducing fisheries overcapacity and over-investment, and by avoiding the self-defeating race-to-fish competition. Fisheries with

overcapacity that shift to transitioning to SEM may see an interim reduction followed by restructuring to fewer but more permanent, stable jobs with long-term catch. Fiscal impacts can be favorable, depending on government initiatives to recover fisheries management costs and to capture part of the increases in economic rent. Equity will be increased by greater stakeholder engagement under SEM, with clearer resource rights under catch share systems.

This analysis supports the recommendation to re-orientate fisheries towards SEM to improve and sustain yields, while safeguarding the capability of ecosystems to provide the ES upon which production processes depend. Responsible management of single and multi-species fisheries is a first step towards broader ecosystem management. These actions build on the FAO Code of Conduct for Responsible Fisheries and the Ecosystem Approach to Fisheries, widely accepted as the appropriate framework to manage marine capture fisheries. Certification schemes for SEM fisheries can facilitate access to high-value markets and enable fishers to differentiate their product in return for commitment to responsible fisheries management and reduced ES impact. Some large retailers purchase only certified product; two LAC fisheries have been certified by the Marine Stewardship Council (MSC), with three others in process of certification.

# IX. FORESTRY SECTOR

**Role of Forestry in Economic Growth.** LAC contains the world's largest block of rainforests as well as extensive temperate forests — some 22% of forests globally. Within LAC, about 90% of the forested area is in South America, 9% in Central America and Mexico, and 0.4% in the Caribbean. In the Amazon basin alone, 25% of 675 million ha of natural forest are considered to be production forests. About 1.4% of the forests in LAC are plantations. Forestry production represents about 2% of GDP for the region, a total of $40 billion in 2006. Employment in roundwood, pulp and paper, and wood processing industries reached 1.5 million in 2006, 0.75% of the regional total. Counting all activities, timber and non-timber, formal and informal, in 2001 the forestry sector provided more than 8 million jobs, of which 2.7 million (32%) were formal. This suggests a strong contribution to poverty alleviation since forestry activities occur in rural areas.

**Role of ES in Forestry.** Forest-based production processes require growth of timber and non-timber forest products (NTFPs). These two classes of forest products, in turn, depend on ES inputs: water as precipitation and soil moisture, nutrient cycling, soil fertility, pollination and seed distribution, and pest control. Other ES, essential at the ecosystem level, include genetic diversity, waste assimilation, and storm mitigation. Few of these ES can be replaced easily; if degraded, forests may change in character, lose productivity, or be lost. Forests not only use ES but also provide many of the same ES for downstream uses, if properly managed. For example, forests not only receive water as rain, runoff, groundwater, and vapor, but also store and recycle water. The same can be said of many other ES: for instance, those related to soil fertility, pollination and seed dispersal, microclimate, and biodiversity maintenance. These self-maintaining systems are vulnerable to disturbance and degradation.

## Cost of BAU

Current patterns of forest use are largely unsustainable: extraction rates exceed regeneration capacity. Degradation of ES used by forests is a common cost of BAU practices. Conversion of forest lands to other uses often targets soils that cannot sustain those uses and are soon abandoned, reverting to degraded forest. For instance, weeds and soil degradation in Brazil typically reduce cattle stocking rates from two head/ha during a pasture's first four years to only 0.3 head/ha a few years later. This six-fold fall in pasture productivity reflects the costs of BAU forest resource utilization. But, this observed lost is only partly accounted for because even much more fertility was lost earlier in the conversion to pasture.

BAU clear-cutting practices generate short-term income but, over the long run, are less financially attractive, leading to diminishing returns and higher net costs. On degraded humid tropical lands, farming, ranching, and forest plantations following BAU practices are marginally profitable, if at all. Harvesting under BAU is done by conventional logging (CL), resulting in damage to residual stands, erosion and compaction of soils, and sedimentation of waterways. Land holders often contract with logging companies, seeking a low-cost route to short-term revenues and/or to land tenure via forest clearing. Logging operations tend to use older, inefficient machinery, and to lack planning and business skills, and have little control over impacts on the land or the concessions. Forest products from rural and indigenous communities may be sold at prices below market, with the profits accruing mainly to large companies.

Overharvesting of NTFP is chronic under BAU, with products extracted at higher rates than that of natural replacement. For example, palm heart overharvesting has been shown to underlie the decline in palm heart production from forest-growing species observed over the last 30 years.

Low public revenues from forestry-related taxes and fees perpetuate BAU practices. Even where the state has ownership or control of forests, private interests, rather than the public sector, may benefit from revenues on forest resource extraction. Low returns to governments from taxes, fees, and concession charges are common in LAC. Illegal timber extraction is common, sometimes depleting the more valuable species and undercutting markets for legitimate timber. This situation undermines public finance

and support for transitioning to SEM. Further, the situation also reinforces treating forest resources as free goods, sending the wrong market signals.

### Benefits of SEM

SEM for forestry aims to obtain sustainable benefits from forest resources, while conserving the biodiversity and ecological balance of the forest and maintaining ES provision. Typically, SEM brings creation of stable forest industries, long-term jobs, increased gender and economic equity, and income-generating activities for local communities. Examples include certification of forest products and adoption of improved harvesting practices, such as reduced impact logging (RIL), innovative business models for non-timber forest resources (NTFR), carbon markets, and payments for ecosystem services (PES). These business models combine natural resource conservation with economic and social development, engaging many stakeholders, from local communities to private and public entities.

**RIL techniques** greatly decrease damage to the residual stand, the amount of soil disturbed by machinery, and the volume of wood residues left in the forest. Operations use pre-harvest planning and selective, low-impact harvesting techniques that minimize logging footprints. Certification fosters entry into market niches that exclude products from unsustainable sources; certification may also bring a price premium.

**NTFPs.** In Brazil, Bolivia, and Peru, brazil nut production provides direct employment to 15,000 people. In Bolivia, brazil nuts constitute 45% of the country's forest-related exports, contributing $70 million/year. The main Amazon NTFPs in volume traded, value, and involvement of local actors are brazil nuts in Bolivia, and palm hearts in Brazil and Peru. Where forests are cleared these forest crops become foregone income flows.

In 2005, sale of NTFP in Peru generated over $14 million, including products such as *algarrobo* (6.5 million kg/yr), *cat's claws* (0.5 million kg/yr), *tara* (3.9 million kg/yr), *sangregado* (1.1 million units/yr), palm heart (0.2 million kg/yr), and a large number of medicinal and aromatic plants. One of the recently emerging products in this country is *camu-camu,* promoted for its high vitamin C content; *camu-camu* is now grown in plantations, another example of domestication of a successful NTFP, in addition to rattan, palm heart, and rubber.

Practices based on SEM provide many options for forest-based communities, from wood products to NTFP, PES, and ecotourism. Initiatives like the Maya Nut Program show that, by recovering traditional knowledge of native tree use and exploring new markets, local actors can conserve threatened ES while improving income and food security in rural communities. Likewise, a concession model with Forest Stewardship Council (FSC) certification in the Maya Biosphere Reserve has also proved useful in conserving forests that benefit indigenous communities.

**PES and REDD+.** Payments for environmental services (PES) often support SEM forestry practices to protect soils, watersheds, water quality, and storm mitigation capacity. Carbon storage and Reduction in Emissions from Degradation and Deforestation-plus (REDD+) provide forest owners access to revenues from global markets for standing forests. A 10% reduction in annual deforestation rates in LAC from this scheme could generate between $600 million and $2.5 billion annually. A growing number of voluntary transactions bring revenue streams to the region for carbon sequestration. However, regulations for the REDD+ market are not yet defined and actual revenues remain uncertain.

### Conclusions and Recommendations

BAU forestry practices in LAC grew out of specific conditions: relative abundance of forest resources, limited governance in forested areas, illegal logging, lack of well-defined property and land tenure rights, perverse subsidies, and market failures such as imperfect information on the real cost of forest degradation. As forest resources became scarcer and externalization of hidden costs less acceptable, SEM approaches have begun to emerge as successors to BAU and thereby, begin conserving ES. However, a barrier to the transition to SEM is the need to forego regular income during extended periods while waiting for the improved conditions under SEM to develop. Several years may be needed for trees to grow so that forestry projects can mature into net income sources.

Successful market-based drivers of SEM are currently being explored. Possible drivers include PES, certification of sustainability in the production of wood products and NTFP, and carbon storage and avoided $CO_2$ emissions (REDD). Certification is essential to formalize the sector, improve governance, opt for sustainable forest resource management, and open new markets for value-added products.

Data gathering and use on forest management, economic processes, and their relationsip to ES needs improvement, if the sector is to harness optimal benefits from forest resources in the future. Forest use if not planned, implemented, monitored, and controlled adequately using SEM principles, may not be able to compete with alternative land uses such as agriculture or settlement.

## X. TOURISM SECTOR

**Role of Tourism in Economic Growth in LAC**. In terms of scale and continued growth, as well as influence on the development patterns of countries and regions, tourism is one of LAC's salient economic activities. LAC accounts for about 5% of the world tourism market, earning $9 billion in 2007 from international tourism, with growth rates on the order of 4.5% (2010) — higher than those of most of the rest of the world. Tourism's input to GDP ranges from about 2% in South America to almost 20% in the Caribbean. The tourism sector includes the conventional recreational (sun and sand)

tourism, and the burgeoning nature-based category, in which tourists spend more per stay and have a greater multiplier effect in local economies.

**Role of ES in Tourism.** Both kinds of tourism depend on healthy biodiversity and maintenance of ES. Clean beaches and waters, healthy reefs, white-water rivers, birdlife, fish, whales, forests, and similar natural features are used as attractions to drive demand. Fresh water supplies, seafood at beach sites, and congenial microclimates are other provisioning and regulatory ES.

## Cost of BAU

Mass-tourism models such as in the Caribbean, represented by large hotels and resorts, cruise ships, and vacation home development: all are linked to unsustainable aspects characterized by BAU. Typically treated as externalized costs, these factors threaten the success of the BAU model: overconsumption of fresh water, inadequate treatment of wastewater and solid waste, serious impacts on coastal ecosystems from overdevelopment and crowding, and massive imports, with consequent high leakage from host economies.

In the Dominican Republic, large, all-inclusive beach resorts and hotels have been the fruit of public policy and direct private foreign investment; the two major tourist hubs have their own international airports and concentrate 78% of the country's hotel rooms, most in resorts of over 400 rooms. This enclave model, which seeks to exploit the mass sun and sand markets with economies of scale, has produced significant economic results: tourism's input to GDP climbed from 1% in 1980 to 8% in 2003.

Yet, several indicators show this tourism model is not sustainable. Coasts, beaches, and reefs — the principal attractions for the industry — are degrading due to the effects of tourism. About 30% of coastal pollution is from hotel sewage that is dumped in the basins and coasts. Coral reefs are degrading from groundwater pollution by the fertilizers and pesticides used on golf courses and from sedimentation caused by creation of artificial beaches. Freshwater is used inefficiently, at 412 gallons per guest/night, 2.8 times the Green Globe 21 best practices standard. Golf courses consume about 8 million $m^3$ yearly — twice the amount used by the industrial sector. The intensive water usage is dramatically depleting reserves and competes directly with local usage. Energy use per guest/night is 33.5 kW, 5.5 times higher than the best practices standard.

In coastal vulnerability to storms, the BAU recreational model externalities include coastline alteration, beach mining, dredging, draining wetlands, mangrove destruction, and environmental carelessness when extending beaches and building hotel complexes. As a result, the vulnerability of these investments to extreme weather events has increased. A financial consequence of BAU tourism-induced habitat loss is a rise in insurance premiums for coastal hotels and resorts; hurricanes, now freed of the protective influence of healthy mangroves and shore vegetation, have led to loss of the very beaches that attract tourism. The impact of beach loss has been extended by mining sand in other places to replace lost beaches. Mangrove forests have been cleared for resort development, leading to the losses of important seafood sources, commercial fisheries, and coral reef attractions. Loss of mangrove stands has also exposed coastlines to the full force of hurricanes with increasingly expensive impacts of human suffering and commercial loss.

**External Control**. Based on a business model that brings high volumes of visitors at low profit margins, BAU tourism is dominated by a small number of high-profile transnational firms. This tends to promote loyalty to brands rather than to particular destinations. Tourists travel with the same firm to different places each year; the company is able to switch investment and promotional efforts from one destination to another, according to where margins can best be maximized at a given time. This puts immense pressure on destination countries to lower tariffs and other costs to maintain their competitive stance.

**Cruise Ships.** A particularly questionable policy issue in the Caribbean and Central America is the enticement of cruise lines to make stops at destinations via tax breaks and other financial incentives. Competition between countries is intense, yet, the economic benefit to these economies, as a whole, from cruise tourism is very limited, possibly not even compensating the financial incentives offered to compete with other destinations. In Belize, 77% of all visitors are now cruise ship passengers, yet their spending amounts to only 18% of the country's tourism revenues.

**Public Investments** in the provision of basic services (water, power, waste disposal) and infrastructure (airports, highways, marinas) are a powerful incentive to induce firms to settle on a given destination. All too often these take the form of subsidies to the tourism industry. In the Caribbean, tourist demand for potable water per capita ranges from 3 to 10 times that of domestic residential users. Meanwhile, the ability of ecosystems to provide this water (a service) is diminishing due to pollution of inland aquifers.

## Benefits of SEM

**Mainstream SEM Tourism.** In the traditional sun and sand recreational model, given the scale of negative externalities already generated in many places under BAU, the transition to SEM often requires large investments to restore natural capital — beach, reef, and mangrove habitats — and to reduce the environmental footprint of the facility. Initiatives such as Green Globe, Blue Flag, Rainforest Alliance, CAST, and others are working with the tourism industry to achieve lower footprints. Currently, less than 1% of tour operations are certified as sustainable; critical mass has yet to be attained. The process-to-date illustrates that tourism's relationship to biodiversity and ES is not necessarily static but, rather, dynamic. Demand for sustainable products is growing, and the industry will continue to evolve.

The Turks and Caicos Islands had success at attracting high-end BAU recreational tourism (resorts, vacation homes). But this success generated a number of problems, especially in coral reef degradation, which threatened to undercut arrivals of wealthy tourists. Studies comparing the impact of BAU and SEM practices showed that healthy reefs generate $35 million annually in GDP (15.3% of total GDP) through fisheries, diving and

other tourism uses, and coastal storm protection. An additional $13 million contributes to local residents' quality of life, but does not enter into GDP. A relatively small reduction in the condition and services provided by reefs could quickly result in annual losses of tens of millions of dollars to the islands' economy. Such figures may very well make it worth investing several millions in achieving SEM to avoid such a situation.

Overall, more tourists are selecting holidays that feature local cultural experiences. Also, more tourists are attaching importance to ethics and the corporate social responsibility of an operator. The Thompson Holidaymaker Report and a recent Mintel Survey both found that mainstream tourists want travel experiences consistent with the SEM model. This consumer preference creates a range of opportunities to move large conventional operators from BAU toward SEM, as shown in the following instances.

**Hotel Industry Movement Toward SEM** is evident, if partial. The International Tourism Partnership links major chains including Hilton, Taj, Marriott, Accor, and Intercontinental, comprising over 11,000 hotels and 1.8 million rooms, to establish environmental guidelines for the industry and increase awareness. Many hotel chains are setting targets to show commitment to various aspects of sustainability. For example Fairmont Hotels and Resorts are targeting a 20% reduction in operational $CO_2$ emissions by 2013; NH Hotels is aiming for a 20% reduction in water, waste, and energy by 2012; Marriott is reducing its carbon footprint 25% by 2017 through energy conservation; Whitbread has pledged to reduce carbon emissions 26% by 2020; IHG looks to achieve energy savings of up to 25% across its hotels globally; and finally, Starwood has announced a 30% reduction in energy use and a 20% decrease in water consumption by 2020.

**Nature-based Tourism** enterprises can be an important tool to generate employment and income in underdeveloped, biodiversity-rich areas where few job options exist. These enterprises can be achieved with comparatively small investments. Moreover, many more people participate in tourism through micro, small, and medium size enterprises: selling crafts, food, or drink; providing cultural services such as displays, dancing, or traditional village visits; and supplying locally-produced food to guest facilities or transport services to visiting groups. Poor people also receive other benefits related to tourism, including enhanced infrastructure and services in the form of health facilities, water systems, local security and communications, increased community income, and organizational skills to promote local change.

A significant development in the last few years is the establishment of voluntary environmental initiatives by hotel chains, tour operators, and other actors, including green certification systems, conservation awards, and eco-labels. NGOs such as the International Ecotourism Society, Tourism Concern, Center for Responsible Tourism, and other entities focus on consumer awareness. Online portals such as Planeta.com, Ecoclub, and others build awareness of the links between conservation and tourism.

**Certification.** Rainforest Alliance showed that of 14 hotels in Costa Rica, Nicaragua, Belize, Guatemala, and Ecuador, 71% reduced operating costs and improved profits on achieving certification. All hotels reduced water usage, saving on average $2,700 yearly. Almost all lowered energy consumption even with expanded operations; annual savings averaged $5,300. Reduction in solid waste through recycling led to savings of $3,600/year. Almost all hotel proprietors said their support for biodiversity conservation made their hotels more attractive in the market and improved their competitiveness. To certify such hotels costs 1%-3% of operating expense.

Community-based tourism enterprises have emerged in natural areas including parks in recent years. Ecuador, particularly, acts as a laboratory of indigenous community-based tourism. There and in Costa Rica, studies show that communities near protected areas have incomes higher than those far away.

### Conclusions and Recommendations

Models of SEM tourism are in high demand. Growth in SEM tourism is widely predicted to continue to outstrip that of BAU tourism for the foreseeable future. This demand will provide significant business development opportunities throughout the LAC region. As natural capital continues to be eroded by BAU tourism, actors in the segments of key markets, investors, and the media are increasingly seeking alternative SEM tourism opportunities. Niche markets that depend on biodiversity health, such as whale, bird, and reef fish watching, are large and growing rapidly with higher per person spending and higher local economic gains than BAU tourism. However, these markets are extremely vulnerable to deterioration of ES.

There is a notable absence of data on the value of SEM tourism and the (often hidden) costs of BAU, or more broadly, on the comparative costs and benefits of these two models. If information were readily available, such specific findings would likely further catalyze a transition from BAU to SEM tourism.

## XI. PROTECTED AREAS

**Role of ES from PAs in Economic Growth.** Protected Areas (PAs) range in type from untouched wilderness to managed resource areas that facilitate the use of timber and other resources. The region has over 4,400 PAs that cover some 5 million km$^2$; about 22% are marine PAs. Countries in LAC establish PA systems to protect viable populations of diverse species and representative ecosystem samples, as well as to maintain vital ES.

Existing PAs and the conservation of ES therein contribute to the economies of LAC countries through benefits to agriculture, fisheries, forestry, and tourism:

*Agriculture*: low-sediment irrigation water, genetic resources, pollination, economically-important wild species

*Fisheries*: essential habitat for breeding, nurseries, and juveniles; no-take areas to rebuild stocks and diversity; protection of vulnerable habitats like coral reefs, mangrove stands

*Forestry*: timber and NTFP concessions, carbon storage, revenue flows that sustain conservation

*Nature-based tourism*: water for consumption, attractive natural features, wild species to watch, local job and income creation, fiscal and foreign exchange revenues

*Urban settlements*: drinking water, disaster mitigation, hydropower

These PA systems are variously threatened by encroachment, timber extraction, hydrological changes, pesticides, agrochemical run-off, fire, soil erosion, poaching, and road building — to name a few. To address these threats, PAs need strong management, which requires government expenditure financed by government budgets and revenue mechanisms. Deciding whether, when, and how to transition to SEM requires balancing that transition expense with the costs of externalized impacts, resource depletion, and lost opportunities under BAU.

Unfortunately, most PA systems in LAC are experiencing financing gaps and, hence, have BAU management models. The 18 largest countries in LAC spend $382 million/year on PAs, but that is only 55% of the minimum level of funding required to operate basic conservation programs. This underfunding and its impact on PAs and their ES characterize BAU for most PAs. Well-funded and managed PAs are taken as SEM in character.

## Cost of BAU

Underfunded PAs that face severe threats tend to not be able to provide basic protection to biodiversity and ecosystems. In the BAU scenario, domestic funding for PAs is often stagnant, with obsolete legal and regulatory frameworks, little transparency, inefficient use of resources, and poor accountability. Planning and management functions, typically, lack essential resources. Conservation goals are poorly linked to programs and revenues; existing budgets are not tied to programme priorities. This makes it difficult to measure effectiveness, estimate needs, and determine financial gaps. In consequence, ES become progressively degraded: valuable species and habitats become depleted, water resources deteriorate, forests are overexploited, and erosion and sedimentation rise, impacting downstream water and irrigation infrastructure.

**Low and Poorly-diversified PA Income.** Most PAs in LAC have been dependent on insufficient government investment and funding from trust funds and international projects, with extremely low private-sector participation. For example, public expenditure on PAs across 19 countries accounts for just 0.006% of GDP. This level of investment averages $1.18/ha/year. By comparison, European and North American nations spend, on average, 0.08% of their national budgets on PAs, about $28/ha/year.

The Brazilian Amazon shows how direct costs, already high and largely unmet under BAU, pose a challenge to the transition toward SEM. Although State governments in the Amazon expanded the land under protection in recent years, PAs still lack capacity and resources to carry out effective protection. The shortcomings of Brazil's PA system revolve around underfunding: only 44% of basic needs are being met, leaving a $169 million annual gap. This leads to under-staffing and limited protection for PAs. WWF Brazil has reported that 23% of Brazil's PAs are at extreme risk and 20% at high risk. Illegal logging is one of the biggest sources of that risk.

The tourism industry has been bringing visitors to PAs, particularly in the Caribbean, Central America, and the Andes. Under BAU, PAs charge little but maximize visitation to raise revenues, which leads to degradation of PA assets and, in turn, risks reduced visitor enjoyment, lower visitor flows, and declining finances.

## Benefits of SEM

Under SEM, PAs sustain assets and, hence, future visitor and revenue streams. Important economic benefits come from forest use and nature-based tourism in PAs, as well as from high-quality water produced in them for irrigation and other agricultural uses, hydropower, and human consumption.

**Agriculture.** Cases in Colombia, Peru, and Venezuela show that PA ecosystems are vital to water quality provided for irrigated agriculture. For example, the Colombian National Park System feeds four of the country's six most important water systems; 12 major agricultural districts use water from the parks to irrigate 200,000 ha. Water supply in two districts depends on sources from Paramillo and Las Hermosas Natural Parks. Those districts account for 37% of Colombia's rice production, valued at $193 million in 2000. In Peru, the value of agricultural production in irrigation districts linked to PAs has been estimated at $514 million/year. In Venezuela, 450,000 ha or about 20% of the area under irrigation depend on national parks.

**Forested PAs under SEM** provide opportunities to generate income both for private enterprise with sustainable harvesting and for the public sector from concessions, fees, taxes, and PES. Concessions for controlled harvesting of timber and NTFP or for attending tourism, user fees and taxes on enterprise earnings, and income flows from PES for watershed protection, carbon sequestration, and other ES can make state-owned forests

and forested PAs self-sustaining revenue centers, able to contribute to the budget of the PA system as a whole. The concession schemes in Brazil's national forests (FLONAS) are good examples.

**Hydrological Services.** High-quality water resources from PAs for irrigation, hydropower, and consumption are critical to large populations in LAC. Relying on SEM can secure savings in water infrastructure operations (avoided replacement costs); for instance, in Venezuela, about 73% of electricity generated in 2007 came from hydropower plants with catchments in several national parks.

The benefit derived from watershed protection for the Caroní River Basin's hydroelectric production in Venezuela was assessed in a detailed cost-benefit analysis. Studies showed that power generation would be reduced 10%-15% by silting if moderate deforestation occurred. The hydroelectric system has an expected life of 60 years, with the loss of power generation occurring by the dam's midlife. The cost of recovering the capacity lost in this (BAU) scenario is much higher than the cost of protecting the watershed from deforestation. The replacement investment would need to be applied beginning in year 25 to be ready in year 30, at an estimated cost of $90 million-$134 million. This investment scenario contrasts with the cost of protection against deforestation in the PAs that feed the dam, which would be less by two orders of magnitude.

**Tourism.** PAs in Peru generated an estimated $146 million of tourism-related economic activity in 2005. Studies show that introduction of SEM practices in those PAs can boost current tourism-based revenues. For example, four Peruvian national parks, currently under BAU, generate $600,000/year. With no shift to SEM, they may reach as much as $1.2 million, with a high risk of decline due to wear and tear. However, with a shift to SEM practices, revenue could rise to $4.3 million/year in five years.

Tourism generates employment around PAs. Venezuela's Morrocoy National Park receives some 1.5 million visitors annually, who spend an average of $135 locally, for an annual total of $203 million. About 5,000 permanent jobs have been created in areas adjacent to the national park, half the employment in the locality; 80% of the area's tax revenues come from tourism-related activities. Similarly, the other most-often visited PAs in the country provide 30%-50% of local jobs. Venezuelan PAs generate many service sector jobs, increasing household income mainly via tourism-related businesses. During the high season, households can double their incomes. In Canaima National Park, monthly household incomes go from $103 to $246 in high season, and at Morrocoy from $207 to $606. PAs contribute to the well-being of local populations in many countries by providing opportunities for jobs and seasonal income, particularly in nature-based tourism and NTFP collection and processing.

**Disaster Mitigation and Prevention.** Well-managed PAs with intact forests regulate run-off, slow flooding, reduce landslides, help contain pest outbreaks, and, potentially, can mitigate climate change. These qualities are most important to the more vulnerable sectors of the rural population, who tend to live and work on lands more exposed to such risks.

**Importance of PAs to Equity and Poverty Reduction.** In the LAC region, PAs commonly overlap with indigenous and settler communities. These populations may be affected in both negative and positive ways. On the negative side, they may be displaced or suffer a reduction in access to natural resources, with little or no compensation; such outcomes are often associated with BAU practices that externalize such costs. On the positive side, under SEM, they can participate not only in protection of ecosystems of value to them that might otherwise be depleted, but also in sustainable income-generating activities.

### Conclusions and Recommendations

The region's PAs provide economically-valuable ES to a variety of sectors — agriculture, fisheries, forestry, hydropower, and nature-based tourism. At the same time, both terrestrial and marine PAs provide restricted-take zones where biodiversity can re-build and heavily fished or hunted species can recuperate and re-stock neighboring areas.

Growing biodiversity and ecosystems markets will provide significant benefits to PA-related business. Nature-based tourism in PAs has driven income growth and foreign exchange earnings, while bringing jobs, local development, and relative prosperity to many remote sites, thereby contributing to GDP and public-sector revenues (taxes, concession fees).

Transition from BAU to SEM in PAs is often feasible and cost effective, based on hidden costs of BAU and the options for cost recovery under SEM; yet, barriers to this transition are often significant. Stakeholder involvement, empowerment of local actors, and transparency are keys to success in SEM, and in transitioning to this model.

## XII. HYDROLOGICAL SECTOR

### Introduction

This chapter synthesizes available information — conceptual and empirical — on the relations between land management, hydrological services, and human welfare, with emphasis in the LAC region. The text addresses an opportune question: can SEM improve water supply and quality, compared to conventional approaches to land and water stewardship under BAU.

Hydrologic function is seen as a series of cascading relationships — from the headwaters to the sea — in which ecosystems in conditions that vary

from pristine to heavily modified interact with built infrastructure and human activity across the landscape. Considerable scientific and economic work has been done on watershed management, the role of forests, and downstream ES.

Economic uses of water can be divided into classes of hydrological services. Many uses involve direct collection, harvesting, or enjoyment of water. These ES can be grouped as uses of *ecosystem water*. A second category refers to water uses provided through water resource infrastructure, *value-added water*. Finally, there is a set of *water-related services*, also provided through infrastructure, including hydroelectric power and flood control. All these ES can be seen as benefits derived from use of water.

Hydrological ES originate naturally in ecosystems, but are then improved by application of human labor, technology, and physical capital. Ecosystems and infrastructure play complementary roles in providing ES. On the ecosystem side, a series of processes produce water and its related services. These involve interaction between geologic, hydraulic, chemical, biological, and ecological functions that determine how, when, and in what quantity and quality precipitation percolates through or runs off to become available as soil, ground, or surface water.

Land management affects these natural processes and changes the water cycle, principally by altering vegetation cover and soil properties, shaping the water ES. Land management affects two main hydrologic aspects:

> *water quantity*: amount precipitated, annual water yield, seasonal flows including dry-season base flow, groundwater recharge, flood flows
>
> *water quality*: erosion, sediment loading, run-off and leaching of pollutants, sedimentation, aeration, filtration, microbial action, and other natural purification processes

Two contrasting land management approaches vie for approval by policy makers: BAU and SEM. Trade-offs between hydrological services produced under the BAU and SEM paradigms are identified. Benefits and costs are compared across a series of economic activities (irrigation, hydropower, etc.). Policy response and decision making options are explored in the light of case studies from LAC.

## Costs of BAU

Business as usual (BAU) is the practice of developing water-related ES without taking into account off-site effects, typically leading to downstream impacts from forest conversion and erosion. The focus is on the net benefits to the enterprise. Little or no attention is paid to the effects of resource use and infrastructure development on other human and ecological uses of the hydrological system, including effects like raised sediment loads, higher nutrient and chemical levels, changes in annual water yield (surface and ground waters), possible local increase in flood flows, and changes in dry-season base flow. A decision on whether to produce more water by deforesting an upstream watershed, for instance, would consider only the net gain to be obtained by the enterprise promoting the action but not the cost of sedimentation to downstream actors nor the impact of biodiversity loss on the public interest.

These BAU practices typically cause off-site impacts, including upstream land clearance, poor soil management, use of agrochemicals, discharge of untreated human or animal sewage, release of industrial effluent, excessive water withdrawals, modification of the hydrological regime, in-stream barriers, channelization of waterways, and poor riparian management. From a policy standpoint the concern is that hydrological ES may not be produced or used in ways optimal for society as a whole. This applies to services where production costs are not borne by beneficiaries. Such external costs can lead to classic market failures, where the optimal level of services is not produced by free market exchange.

## Benefits of SEM

In contrast, SEM aims to optimize use of ES over the entire watershed, taking downstream effects and stakeholders into consideration in decision making at each level. Typically, SEM promotes maintenance of intact headwaters ecosystems and low-impact agriculture. Under SEM, the focus is on improving long-term outcomes on a wider scale. Land, water, and other resources are employed in conjunction with physical capital to maximize economic benefits across the watershed. This is achieved by internalizing relevant upstream/downstream impacts in the financial calculations of planners, landowners, and firms, as well as by diligent public and non-profit management of key natural assets, including lands, streams, wetlands, lakes, rivers, and estuaries.

Moving toward SEM involves finding ways to translate changes in downstream economic welfare into an effective inducement for changing upstream behavior. In the past, government was seen as responsible for structuring incentives for the land manager. The evolution of market systems for PES has challenged that; the merit of finding ways to tap into the pockets of those who are directly impacted — the downstream economic agents — is now emphasized.

## Conclusions and Recommendations

Water quality is the main hydrologic aspect improved by SEM. The effects of change in land-management practices on downstream water quality impact economic production. Sediment load, agricultural run-off, and human or animal sewage commonly affect water quality. Water quantity is much less impacted.

Hydrological ES produced in a given watershed depend on specifics: the natural elements that condition hydrological functions — like climates, soils, and basin shapes — and the investment in water-resources infrastructure and existing management regimes. While a few general rules apply, their combined effects in particular situations are complex, making necessary case-specific analysis.

Payment for environmental services (PES) is an important policy tool. Off-site impacts of hydrological ES should influence economic decision-

making by upstream land managers, but only do so when links like PES are in place. In recent decades, the LAC region has helped develop the environmental policy field by innovative experimentation with PES in many countries.

Risk aversion is a primary concern. In intact headwater catchments, the default option is to maintain forest cover to protect downstream economic uses of water and physical infrastructure.

Infrastructure is a key factor. In degraded headwater catchments, maintaining the productivity of existing infrastructure is a primary concern; caution should be exercised before investing in land-use change.

SEM can support pro-growth policies. Considering overall net benefits under SEM can lead to continuing lucrative economic activities begun under BAU, such as in the case of sediment-causing activities in which the benefits of the activity outweigh the costs of sedimentation.

SEM is likely to benefit the poor, remote, and marginal segments of society, since the benefits of BAU and of water development infrastructure accrue more often to urban populations and wealthy sectors. The benefits of SEM are often realized by those without access to infrastructure or to a social safety net, while the costs of BAU are often visited on the poor, rural, and marginal groups, in the form of degradation of water quality and other externalized costs.

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