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Although greater attention and resources are now being directed at increasing the sustainability of forests, recent deforestation, especially in the humid tropics, constitutes the fastest land-use change of its scale in human history. In the absence of greatly expanded efforts for better management, many of the world's forests appear likely to decline at even more rapid rates.

This article appraises the forest situation from both a natural and social science standpoint, arguing that deforestation results from a lack of sufficient scientific and economic understanding of forests' contribution to human welfare, as well as a lack of recognition by policy-makers that deforestation is principally driven by non-forestry factors. The recently established World Commission on Forests and Sustainable Development and the Intergovernmental Panel on Forests constitute institutions that can work to bridge these gaps in understanding and policy.

What is at Stake

Forests offer an "exceptional array of goods and services" that "should be reckoned amongst our most valuable stocks of natural resources." (157) However, forests are among the least developed of all natural resources, insofar as they are not often managed in sustainable ways to serve the long-term interest of all human communities concerned. Many forests are exploited for only a few products, with "disregard and adverse repercussions" for their many other potential and actual outputs.

Among the good and services supplied by forests are:

• **Commercial timber**: Commercial timber products are worth over US $400 billion annually. However, this income is expected to decrease as timber stocks, especially in tropical moist forests, are increasingly over-harvested.

• **Fuelwood**: Three billion people worldwide depend on fuelwood for almost all their household energy, but to do so, half of them must over-cut tree stocks, which greatly curtails regeneration.

• **Non-wood Products**: These include wild fruits, latexes, essential oils, waxes and medicinals, among many others. If subsistence and non-marketed items are included, the value of the world's non-wood products may amount to as much as $90 billion annually.

• **Biodiversity and Genetic Resources**: Tropical forests contain about 50 percent and possibly 80 percent of the earth's species. Not only does biodiversity have scientific, aesthetic and ethical value, but they provide higher medicinal resources. Preliminary estimates of the potential worth of all tropical forest plants range from $420 to $900 billion per year. Additionally, by far the most abundant form of biodiversity, insects assist material welfare by facilitating essential ecosystem processes such as pollination and control of pests.

• **Environmental Services**: Forests stabilize landscapes, protect soils by helping them to retain their moisture and store and cycle nutrients, and serve as buffers against the spread of pests and diseases. They also preserve watershed functions, helping to regulate the quality and quantity of water flows, and modulate climate by regulating rainfall regimes.

•**Climate Regulation and Global Warming:** Forests account for 65 percent of net plant growth and carbon fixation on land (over half occurring in boreal forests), which prevents carbon from entering the atmosphere and contributing to global warming. When forests are burned, they release their carbon, accounting for approximately one-fifth of all carbon released. Ironically, global warming may also trigger increased decomposition and die-off of forest biomass, and cause boreal forests to become more vulnerable to fires, which would also lead to further release of carbon dioxide. This could result in a decline of 10 percent of all carbon held on land in plants and soils. However, reforestation would increase carbon sinks in forests.

The Problem of Forest Decline

Two-thirds of deforestation in tropical forests, where deforestation is most rampant, is due to slash-and-burn agriculture by displaced peasants. However, forestry policy tends to focus on the minor players in tropical deforestation, such as commercial loggers and cattle ranchers.
Policymakers need to focus more on the sources of the problem, and examine the motivations behind peasant action. The cultivator is driven to deforest by population growth, poverty and inequitable land-use systems, among other forces. Thus the source problems are non-forestry related.

Temperate forests are more or less in equilibrium. However, boreal forests are also starting to decline in expanse, more from long-term degradation than outright destruction. Clear-cut logging, burning, acid precipitation and industrial pollution affect boreal forests. Degradation in Siberian forests is twice as much as recent annual deforestation in Brazilian Amazonia, although in contrast to the situation in the tropics, boreal forests can usually regenerate themselves over a period of decades.

Ultimate Sources of Deforestation

The ultimate source of deforestation is the fact that councils of power, including governments and international agencies, marginalize the forest issue and treat forests as dispensable. To illustrate, the forestry budget of the UN Food & Agriculture Organization, the UN agency in charge of forestry, has dropped from 5 percent in 1975 to 3 percent today. This stems from the fact that policymakers lack a full scientific and economic understanding of the value of forests.

Two New Institutions: Their Scope and Scale

The World Commission on Forests and Sustainable Development works to propose policy reform and institutional changes, and assemble and strengthen scientific research related to the sustainability of forests. The Intergovernmental Panel on Forests aims "to pursue consensus for action toward sustainable development of forests through international cooperation" (161). Both institutions should build on the achievements of other forestry initiatives such as the Declaration of Forestry Principles at the Rio Earth Summit and the Bandung Initiative for Global Partnership in Sustainable Forest Development, among others.

The challenge for the two institutional initiatives is to formulate a vision for forests' future focusing on six questions:

• How much forest and of what type do we want in the 21st century?
• What environmental and socioeconomic purposes should forests serve?
• How can forests' development contribute to society's sustainable development?
• How far can existing institutions go to serve the long-term purposes of forestry, and how much are new institutions necessary to promote joint responses to joint problems?
• How can different actors work together to ensure that forests play their full part in the world of the future, and to bring about consensus between the scientific communities and political leaders?
• How can concrete proposals be formulated to support those governments and other institutions that seek sustainable forestry?

There is still an inadequate recognition of what sustainable forestry entails. The forestry profession tends to focus on logging technology, industrial processing, timber markets, wood engineering and plantation genetics etc., and downplay external factors, such as poverty, that play the largest role in forests' fate. Thus, the two new international bodies should seek to expand the policy horizon of traditional forestry.

Policy Reform

To reform policy to successfully achieve sustainable forestry, the following proposals should be considered:

•**Change the Definition of Sustainable Forestry:** The definitions of sustainable forestry advanced by many international organizations do not view forests in the context of their wider physiobiotic, socioeconomic or politico-legal landscapes, thus ignoring the outside factors that play such a large role in forests' fate. To withstand the myriad pressures and threats overtaking forests, we need an approach that enables forests to make their full contribution to socioeconomic advancement for all communities concerned.

• **Enhance the Institutional Status of Forests**: Basic forestry policies are effectively, though unwittingly, set by powerful bureaucracies in charge of non-forestry economic sectors such as agriculture or employment. Policy planners need to view the forests with an eye for their full set of actual and potential goods and services. Additionally, forests ultimately benefit communities

in all parts of the world, a factor which must be taken into account in policy formulation. One response would be to compensate forest countries that supply global-scope benefits, through mechanisms such as the World Bank's Global Environment Facility. Also useful are debt-for-nature swaps, in which wealthy countries pay off part of the national debts of poorer countries in exchange for their agreement to preserve their natural resources, can also be further utilized.

• **Increase Scientific Understanding of Forests**: A full scientific evaluation would include forests' character, extent, make-up, mechanisms and dynamic linkages with the rest of the biosphere. This need is to be partly met by a Scientific Advisory Council under the World Commission.

• **Increase Economic Understanding of Forests**: Economic analyses should be undertaken to evaluate the entire range of goods and services that forests provide. This is difficult as many of these products are consumed outside the marketplace. Where quantitative assessments fail, qualitative assessments can highlight actual and potential benefits. The analytic methodologies underlying these assessments should be geared to social equity as well as economic efficiency.

• **Remove Perverse Subsidies**: Subsidies that encourage over-logging make it profitable for concessionaires to over-exploit forests and cut trees that should be uneconomical to harvest. In addition, governments often receive only a fraction of the natural resource rent they could have achieved had these resources been sold at their true value. Subsidies to cattle ranchers also promote deforestation. The Brazilian government has spent $2.5 billion to subsidize ranchers, who often don't even bother to sell the trees felled to make pastureland, collectively torching $5 billion worth of timber per year. "Virtually every ranch has been a financial success for the individual entrepreneur while an economic disaster for the national economy." [164]

• **Calculate the Costs of Inaction**: The costs of not acting to preserve valuable ecosystem goods and services should be calculated, including the impact on watershed functions, fisheries, fuelwood, genetic resources, climate stabilization, and overall environmental values. For example, at an estimated value of $20/ton, the carbon storage function of tropical forests alone amounts to US $3.7 trillion.

• **Include all Goods and Services in Valuation**: Valuation methodology for all ecosystem services in forests should include direct-use values such as timber and medicinal plants, indirect use values such as soil conservation and watershed protection, as well as existence values conferred by assuring the survival of a resource and option values of potential future use.

A preliminary review of ecosystem services in several dozen tropical forest indicates that the hypothetical overall value of sustainable use of one hectare of forests is about $220 per year, comprising $69 from forest products, $12 from recreation, $10 from watershed functions, $5 from hunting and fishing, $16 from option and existence values and $110 from timber. It should also be noted that as the incomes of people rise, they are willing to better recognize and pay more for ecosystem services. Additionally, as forests continue to disappear, the value of those remaining will increase.

• **Promote Forests as a Global Commons Resources**: There is need to reconcile the fact that the forests' environmental services benefit the global community, yet fall within the sovereign jurisdiction of individual nations and are subject to the policy discretion of individual governments. The two new forestry bodies should serve to "foster a coalition of interests as a basis for an eventual international instrument or set of instruments on forests," and establish a consensus about the world's forests and their values so that the effort to sustain them is truly global.