Economic valuation of the Leuser Ecosystem in Sumatra, Indonesia

Executive summary

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The prolonged economic crisis that has afflicted Indonesia since 1997, together with lack of law enforcement in the forestry sector has led to natural forest areas becoming a 'free-access' resource. This in turn has resulted in severe deforestation of 'protected' forests. Not only is this believed to have severe ecological consequences, but the local economy is also expected to be structurally damaged. The decline of several crucial ecological functions of the rainforest may have serious consequences for numerous economic activities in and around forest ecosystems.

The Leuser Ecosystem, situated in the provinces of Aceh and North Sumatra, Indonesia, is an area of 2.6 million hectares of mainly natural forests designated by Presidential Decree No. 33/1998, which contains the most complete representation of the biodiversity of the West Indo-Malayan Realm. It is recognised internationally as the core of one the 25 most critical ecosystems in the world. Due to its mainly mountainous core, it is critical for the protection of the water-catchments that support the livelihoods of surrounding communities. Nevertheless, it is subjected to high levels of illegal logging and plans that will disturb its ecological functions. Such plans arise primarily due to a gross under-valuation of its economic benefits. This in turn is due to the lack of quantitative economic analysis of the value of its ecological functions, together with all its other economic values.

The main objective of this study is to determine the Total Economic Value (TEV) of the Leuser Ecosystem and evaluate the consequences of deforestation for its main stakeholders. [1] Of particular importance to government policy under current economic conditions, is the evaluation of the short and long-term economics benefits of a current-trends policy of deforestation compared to a policy of conservation.

What is economic valuation?

The road towards sustainable development involves better integration of environmental considerations into economic decision-making, in particular through the use of economic techniques for the appraisal of projects and policies. A method central to this effort is 'economic valuation'. In this study, economic valuation is used as the main analytical tool to compare the advantages and disadvantages of certain management or policy scenarios in the Leuser Ecosystem. Nowadays, most economists agree that the value of natural resources depends not only on the market prices of its direct uses, but also on all other functions of the natural resources that generate value in its broadest sense. This is reflected in the concept of the so-called Total Economic Value (TEV).

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[1] The lack of precise data in combination with the need for quantification and monetisation of the main effects forced us to adopt certain assumptions. Therefore, these results should be considered as indicative, but not as authoritative if it comes to actual investment decisions in the Leuser Ecosystem.

In determining the TEV of tropical rainforest, a distinction is often made between direct use values, indirect use values and non-use values. The former relates to the values derived from direct use or interaction with a rainforest's resources and services, whereas the second stems from the indirect support and protection provided to economic activity and property by a rainforest's natural function, or regulatory 'environmental' services. A typical example of a direct use value of rainforest ecosystems is the provision of wood for housing or cooking. The classic example of an indirect use value as it relates to rainforest ecosystems is the water retention function that the forests support to downstream agricultural areas. Non-use values, amongst others, refers to an individual's willingness to pay (WTP) to secure the continued existence of, for example an endangered wildlife species, without ever actually seeing it in the wild (a 'use'). The classic example here is the contributions people make to actions that aim to preserve charismatic mega-fauna such as the tiger or the panda bear. If an individual is willing to pay $400 for preserving biodiversity in some rainforest area without any present or future use in mind (source of food, leisure hunting, wildlife viewing etc.) then this is his or her non-use value.

A common way to determine the use and non-use values is to pursue the sequence of underlying processes, starting with the cause of an impact, on to the physical impact and ending with the social and economic effects. The approach followed in this study proceeds in a series of methodological steps. Figure 1 provides an example of how the economic value derived from the Leuser Ecosystem by the agricultural sector is calculated. First, it is estimated what the ecological consequences are in terms of, for example, changes in water retention, erosion, and pest control. Next, these changes in the ecological services are translated into the physical impact for the agricultural sector. For example, the reduction of humus availability due to erosion may cause a decline in the overall agricultural output. Also, the reduced natural pest-control by birds and animals may cause an increased need for fertiliser and pesticides. Subsequently, these changes in the physical performance of the agricultural sector may cause a decline in the crop yield as well as an increase in the costs of production. This in turn can be translated into a change in the economic value of the Leuser Ecosystem for the agricultural sector.

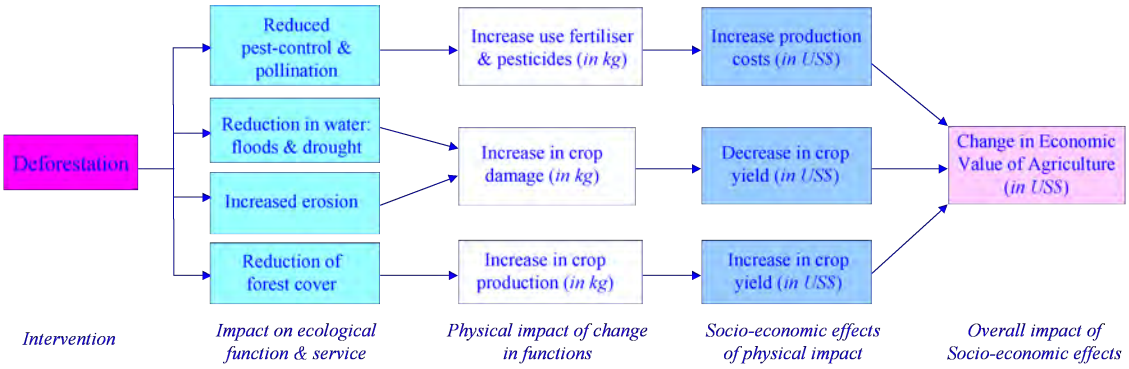

Figure 1 Overall approach applied to the agricultural sector

Economic valuation has been applied to evaluate the TEV of the Leuser Ecosystem over a thirty-year period under three possible future scenarios: (1) the 'conservation' scenario, implying that protection of the rainforest is strictly enforced and thus logging will be

excluded as an economic activity; (2) the 'deforestation' scenario, implying a continuation of the current trend of clear-cutting; and (3) the 'selective use' scenario, in which logging of primary forest is substantially reduced and replanting of logged forest is assumed to be compulsory. Results are presented in terms of the type of benefits, the allocation among stakeholders, and the regional distribution. These benefits include: water supply; fisheries; flood and drought prevention; agriculture and plantations; hydro-electricity; tourism; biodiversity; carbon sequestration; fire prevention; non-timber forest products; and timber.

What is the TEV of the Leuser Ecosystem?

Deforestation may be considered an easy way to generate fast cash. In the long term, however, the negative consequences will dominate. This is shown in Figure 2, which highlights the TEV in the three scenarios over time. In the deforestation scenario, ample revenues are generated in the first seven years. After the year 2006, revenues decline. The conservation scenario shows a steady increase in annual benefits throughout the 30-year period. By the year 2030, the annual benefits in the conservation scenario outweigh those of the deforestation scenario by a factor of 4.

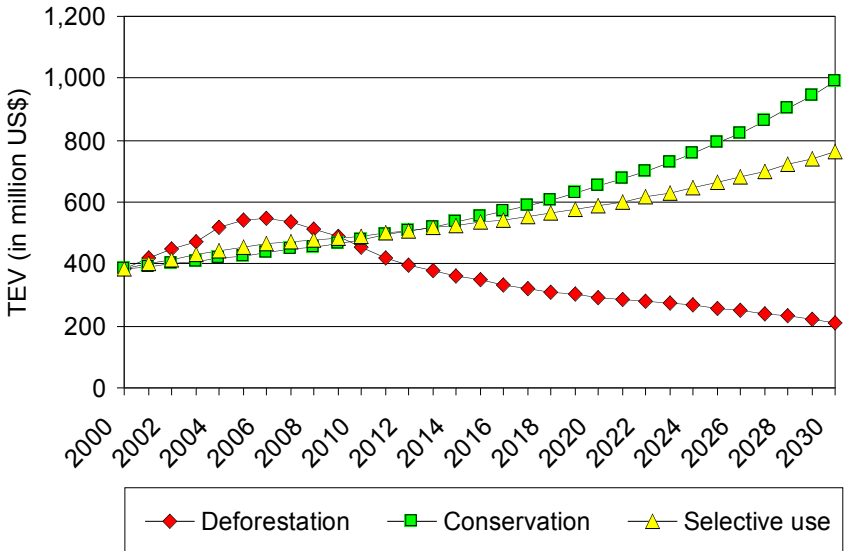

Figure 2 Net gains over time for three scenarios in the Leuser Ecosystem.

By aggregating the annual gains over the 30-year period the overall TEV has been determined. The accumulated TEV at a zero discount rate of a deforested Leuser (US$ 11.3 billion) and of a conserved Leuser (US$ 18.5 billion) differ by US$ 6.2 billion. This amount can be considered as the benefit of conservation (or the costs of deforestation).

What is the value of the Leuser Ecosystem composed of?

The TEV is composed of numerous categories. These categories are shown in Table 1 for the three scenarios, discounted at a rate of 4%. The main contributors to the TEV are water supply, flood prevention, tourism and agriculture. Not surprisingly, timber revenues play an important role in the deforestation scenario.

Table 1 Distribution of TEV among goods and services provided by the Leuser Ecosystem over the period 2000-2030 (in million US$).

	Deforestation		Conservation		Selective use	
	Value	*Proportion*	*Value*	*Proportion*	*Value*	*Proportion*
Water supply	699	10%	2,419	25%	2,005	22%
Fisheries	557	8%	659	7%	674	7%
Flood prevention	1,223	18%	1,591	17%	1,396	15%
Agriculture	2,499	36%	1,642	17%	1,016	11%
Hydro-power	252	4%	898	9%	696	8%
Tourism	171	2%	828	9%	407	4%
Biodiversity	56	1%	492	5%	92	1%
Carbon sequestration	53	1%	200	2%	125	1%
Fire prevention	30	0%	715	7%	643	7%
NTFP	235	3%	94	1%	1,222	13%
Timber	1,184	17%	0	0%	825	9%
Total	6,958	100%	9,538	100%	9,100	100%

Note: for the period 2000 to 2030, at a discount rate of 4 %.

Figure 3 looks at the net benefits in more detail. Except for timber, NTFP and agriculture, the value of all benefits is higher in a scenario of conservation. Therefore, these categories are presented as benefits of conservation while timber, NTFP and agriculture are presented as the (opportunity) costs of conservation. The total aggregated benefits and costs of conservation amount to US$ 4.8 billion and US$ 2.2 billion, respectively, at a discount rate of 4%. The main categories that gain from conservation are water supply, flood prevention, tourism and biodiversity. At the cost side of conservation, timber and agriculture are approximately of the same size. On balance, at a discount rate of 4%, the economy gains US$ 2.6 billion from conservation over a 30-year period.

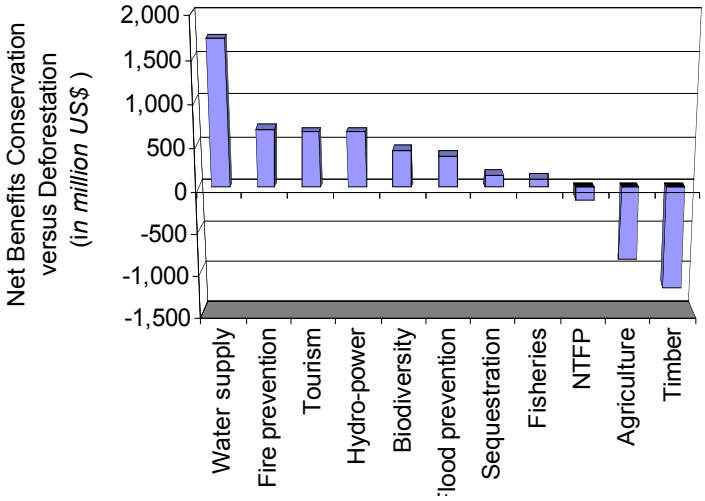

Figure 3 Net Benefits of Conservation versus Deforestation of the Leuser Ecosystem distributed over the various categories (in 2000-2030, discount rate 4 %).

Who wins and who loses?

Besides the overall economic value of the Leuser Ecosystem, it is important to be aware of the distribution of the TEV of deforestation, selective logging and conservation among the different stakeholders. Five groups of stakeholders have been identified in this study: (i) local communities; (ii) local government; (iii) elite logging and plantation industry; (iv) national government; and (v) international community. The distribution of the economic value among the stakeholders is presented in Table 2. Several typical features can be observed.

Contrary to popular belief, the local community is at present by far the main beneficiary of the Leuser Ecosystem. Their share will grow in the conservation scenario. As expected, deforestation benefits the logging industry, mainly in the short run. In the long run, however, deforestation also harms the elite to a certain extent. As owners of large plantations and industries, they suffer negative consequences of reduced ecological services from the Leuser Ecosystem. The local and the national government may also gain in the short term by collecting part of the rents of the harvested timber. In the long run, however, infra-structural damages increase while tax income decline. The international community only benefits from conservation of the Leuser Ecosystem. Both the biodiversity value and the option of sequestration are important gains for developed countries.

Table 2 Distribution of TEV among stakeholders (in %)

Scenario	TEV (*million US$)*	Local Community	Local government	Elite industry	National government	International community
Deforestation	6,958	45%	11%	23%	7%	13%
Conservation	9,538	56%	9%	11%	5%	19%
Selective use	9,100	53%	10%	14%	5%	18%

Note: for the period 2000-2030 at a discount rate of 4%

A striking element is that the elite (logging) industry collects a much larger share of the total value in the deforestation scenario (23%). If the Leuser Ecosystem would be strictly conserved, their share is only 11%. This reduction in value for the elite industry in the conservation scenario benefits predominantly the local and the international community. The power structure by the elite (logging and plantation) industry and the societal and spatial spread of the local and the international community, however, prevents the conservation scenario to emerge. For similar reasons, compensation of local communities by the elite industry is constrained.

How is the value of the Leuser Ecosystem geographically distributed?

Each regency that is part of the Leuser Ecosystem has very different characteristics. Geographically, regencies vary in the structure of the land (e.g. mountainous, lowland), the type of land-use (i.e. primary forest, secondary forest), precipitation (i.e. amount and intensity of rain fall), and altitude (i.e. upstream, downstream). Economically and socially, regencies are different in terms of population characteristics (i.e. size, density, income), economic structure (i.e. industry, agriculture, public sector), and infrastructure (i.e. roads, bridges, houses). Therefore, the TEV derived from the Leuser Ecosystem is also likely to vary among the regencies. Figure 4 presents the distribution of the overall TEV of the Leuser Ecosystem across the 11 regencies for the 3 scenarios.

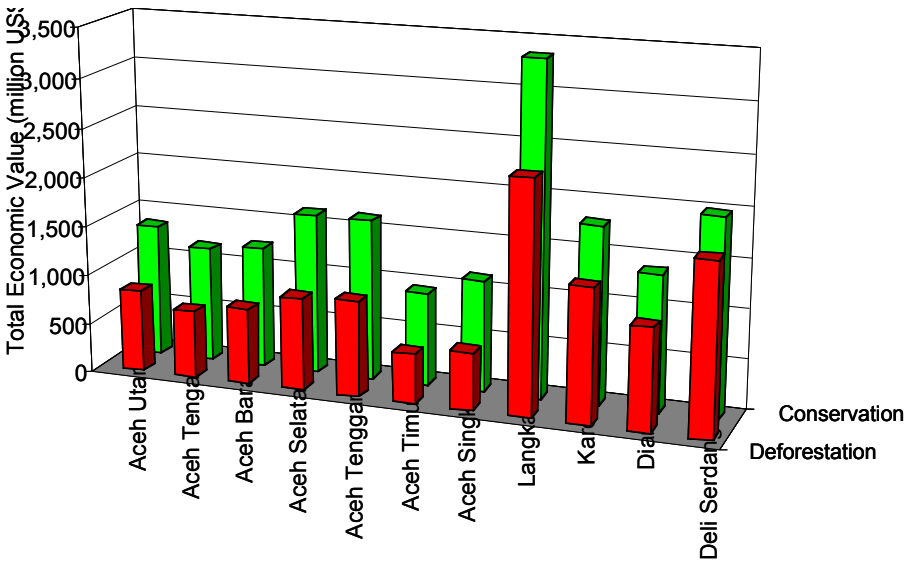

Figure 4 Distribution of the TEV of Leuser Ecosystem among the regencies over the period 2000-2030.

Among others, the shares depend on the size of the economy and the dependency on the Leuser Ecosystem. All the regencies are shown to benefit from conservation of the Leuser Ecosystem. Aceh Singkil and Aceh Timur take the smallest part of the total, mainly due to the small size of their economies. In contrast, Langkat and Deli Sardang generate high TEV from the Leuser Ecosystem. The regencies in North Sumatra are least affected by the negative impacts of deforestation. (Note: since the study was conducted, four new administrative regencies were created. For future reference, Nagan Raya is included in Aceh Barat; Aceh Barat Daya in Aceh Selatan; Gayo Lues in Aceh Tenggara; and Aceh Tamiang in Aceh Timur).

What are main lessons of economic valuation of the Leuser Ecosystem?

Economic valuation has proved to be a strong and useful tool in analysing welfare changes for the different management scenarios in the Leuser Ecosystem. Considering the TEV discounted at 4%, several lessons can be learned from the analysis:

- Conservation prevents damage and loss of income of US$ 4.8 billion while deforestation generates US$ 2.2 billion of revenues in the coming 30 years.
- Conservation spreads the benefits of the Leuser Ecosystem equally among Kabupaten and thus prevents further conflict, while deforestation widens the income gap between Kabupaten and thus may be an additional source of further conflict. This dependency may form a strong incentive for the regencies to develop and enforce a common plan.
- Conservation promotes social and economic equity because it mainly supports the poor majority of society while deforestation widens the gap between rich and poor by mainly benefiting the rich industry elite.

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