

# Economic valuation of the Leuser Ecosystem in Sumatra

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Despite its formally protected status, the Leuser Ecosystem is under severe threat of deforestation due to the economic crisis in Indonesia. 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 the Leuser Ecosystem. Mainly, this study aims to determine the Total Economic Value (TEV) of the Leuser Ecosystem and evaluate the consequences of deforestation for its main stakeholders.<sup>1</sup>

## What is economic valuation?

The road towards sustainable development involves better integration of environmental considerations into economic decision-making, in particular through the

<sup>1</sup> The lack of reliable data in combination with the need for quantification and monetisation of the main effects forced us to adopt rather compromising assumptions. Therefore, these results should be considered as indicative, but not as authoritative if it comes to actual investment decisions in the Leuser Ecosystem.

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 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 TEV.

In determining the TEV of a tropical rainforest, a distinction is often made between direct use values, indirect use values and non-use values. The first relates to the values derived from direct use or interaction with a rainforest's resources and services; the second stems from the indirect support and protection provided to economic activity and property by the rainforests' natural functions, 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 provided by forests to support downstream agricultural areas. Non-use values, among others, refers to an individual's willingness to pay (WTP) to secure the continued existence of, for instance, 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. 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 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 in this study proceeds in a series of methodological steps.

Figure 1 provides an example of

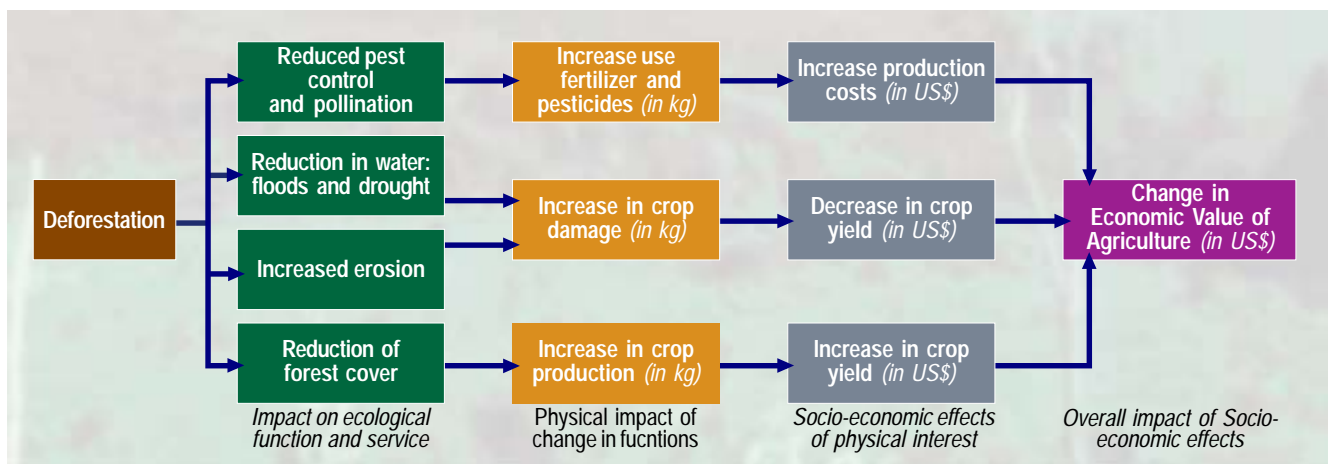


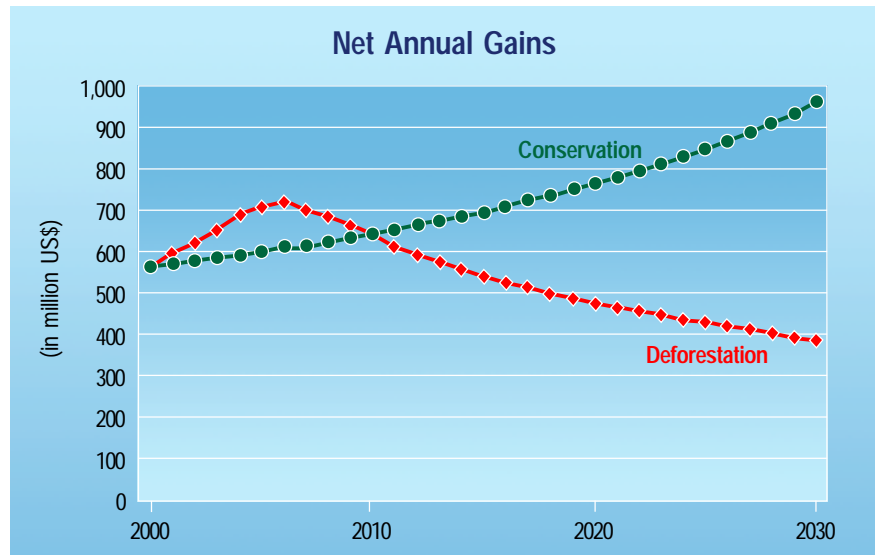
Figure 1. Overall approach applied to the agricultural sector

how the economic value derived from the Leuser Ecosystem by the agricultural sector is calculated. First, ecological consequences are estimated 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.

Economic valuation has been applied to evaluate the TEV of the Leuser Ecosystem under two 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; and (2) the 'deforestation' scenario, implying a continuation of the current trend of clear cutting. The current level and the change of a large number of benefits have been determined. 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. Net gains over time of Leuser National Park for the two scenarios.**

Figure 2, which highlights the TEV in the two 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 2.

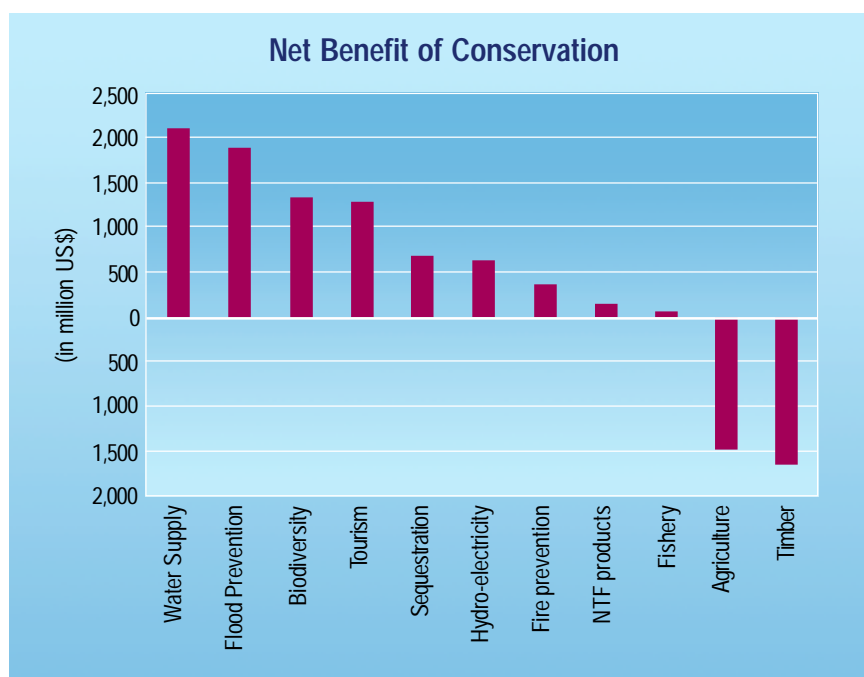
By aggregating the annual gains over the 30-year period, the overall TEV has been determined.

The accumulated TEV at a zero discount rate of a deforested Leuser (US\$ 16.9 billion) and of a conserved Leuser (US\$ 22.3 billion) differs in US\$ 5.4 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 the first two columns of Table 1 for the two scenarios. The main contributors to the TEV

	Economic Value of deforestation	Economic Value of conservation	Net Benefits of conservation	
	(in million US\$)	(in million US\$)	(in million US\$)	(proportion)
Water supply	1,601	3,730	2,129	25%
Fishery	1,351	1,404	53	1%
Flood prevention	3,269	5,174	1,905	22%
Hydro-electricity	1,000	1,643	644	8%
Tourism	350	1,645	1,294	15%
Biodiversity	150	1,484	1,334	16%
Sequestration	0	682	682	8%
Fire prevention	400	762	362	4%
Non-timber forest products	100	241	141	2%
<i>Net-benefits of conservation</i>			<i>8,544</i>	<i>100%</i>
Agriculture	7,003	5,535	-1,468	47%
Timber	1,651	0	-1,651	53%
<i>Net-costs of conservation</i>			<i>-3,119</i>	<i>100%</i>
<b>Total Economic Value</b>	<b>16,875</b>	<b>22,299</b>	<b>5,424</b>	



**Figure 3.** Net Benefits over time of Leuser National Park for the two scenarios distributed over the various categories.

are water supply, flood prevention, tourism and agriculture. Not surprisingly, timber revenues play an important role in the deforestation scenario.

**Figure 3** looks at the net benefits in more detail. Except for timber 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 and agriculture are presented as the (opportunity) costs of conservation. The third column of **Table 1** also shows this difference between the TEV of conservation and deforestation. The total aggregated benefits amount to US\$ 8.5 billion and the costs of conservation, US\$ 3.1 billion. 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, the local economy gains US\$5.4 billion from conservation over a 30-year period.

### 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 and conservation among the different stakeholders. Five groups of stakeholders have been identified in this study: (1) local communities; (2) local government; (3) elite logging and plantation industry; (4) national government; and (5) international community. The

distribution of the economic value among the stakeholders is presented in **Table 2**. Contrary to popular belief, the local community is at present by far the main beneficiary of the Leuser Ecosystem. In the conservation scenario, they receive 57% of the benefits. These benefits mainly result from the support of water supply, prevention of floods, tourism, fisheries and agriculture. Similarly, the local government is a major beneficiary of the Leuser Ecosystem. Compared to the distribution in the deforestation scenario, only the plantation and logging industry sees its economic value derived from the Leuser Ecosystem declining as a result of conservation. This is shown in the last column of **Table 2**.

The net benefits shown in the last column of **Table 2** are the sum of benefits and costs (see **Table 3**). For example, by conserving the Leuser Ecosystem, the local population will gain benefits in the form of prevented flood damage and sufficient water supply but at the same time they will experience the (opportunity) costs of not being able to collect the timber or clear

**Table 2.** Distribution of the TEV among stakeholders over the period 2000-2030 (in million US\$)

	TEV Conservation		TEV Deforestation		Net Benefits
Local community	12,750	57%	8,923	53%	3,827
Local government	4,168	19%	3,065	18%	1,104
Elite industry	2,086	9%	3,093	18%	-1,007
National government	1,192	5%	910	5%	282
International community	2,102	9%	884	5%	1,218
<b>Total</b>	<b>22,298</b>		<b>16,875</b>		<b>5,425</b>

**Table 3.** Distribution of the costs and benefits among stakeholders over the period 2000-2030 (in million US\$)

	Benefits of Conservation		Costs of Conservation		Net Benefits
Local community	4,882	57%	143	5%	3,827
Local government	1,571	18%	174	6%	1,104
Elite industry	0	0%	2,602	83%	-1,007
National government	592	7%	200	6%	282
International community	1,498	18%	0	0%	1,218
<b>Total</b>	<b>8,544</b>		<b>3,119</b>		<b>5,425</b>

the land for additional agriculture. For the local communities, however, conservation results in a positive net benefit of US\$3.8 billion. Therefore, local communities gain 57% of the benefits of conservation. If logging takes place in the forest, the plantation and logging industry receives 83% of the gains. In conclusion, deforestation harms the majority of the population (i.e. local communities) at the cost of the welfare of the rich minority (i.e. plantation and logging industry). The opposite is true for conservation.

**How is the value of the Leuser Ecosystem geographically distributed?**

Each regency that forms part of the Leuser Ecosystem has very different characteristics. Geographically, they vary in the structure of the land (e.g. mountainous, lowland), the type of land use (primary forest, secondary forest), and precipitation (amount and intensity of rain fall). Economically and socially, differences may be in terms of population characteristics (size, density, income), economic structure (industry, agriculture, public sector), and infrastructure (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. 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 the conservation of the Leuser Ecosystem. Aceh Singkil and Aceh Timur take the smallest part of the pie, 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.

**What are the 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 scenarios in the Leuser Ecosystem. Several lessons can be learned from the analysis:

- Conservation prevents damage and loss of income of

US\$ 8.5 billion while deforestation generates US\$ 3.1 billion of revenues in the coming 30 years;

- Conservation spreads the benefits of Leuser equally among the Kabupaten and thus prevents further conflict, while deforestation widens the income gap between the Kabupaten and may be an additional source of discord. 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 the rich and the poor.

The above results should be considered as tentative outcomes of the economic valuation in the context of the management of the Leuser Ecosystem. The work in the field of economic valuation of the Leuser Ecosystem goes on. Methods will be improved and converted to more user-friendly software to encourage application of economic valuation by local experts. As data collection continues, the uncertainties surrounding the analysis decline. Also the spatial application of economic valuation by linking with methods of Geographic Information Systems (GIS) will be investigated. Finally, additional scenarios will be simulated. For example, by focusing on the cost-benefit conditions of 'projects' rather than the cost-benefit situation of the Leuser Ecosystem 'as a whole', the concept of economic valuation can be used more effectively as a communicative tool. ■

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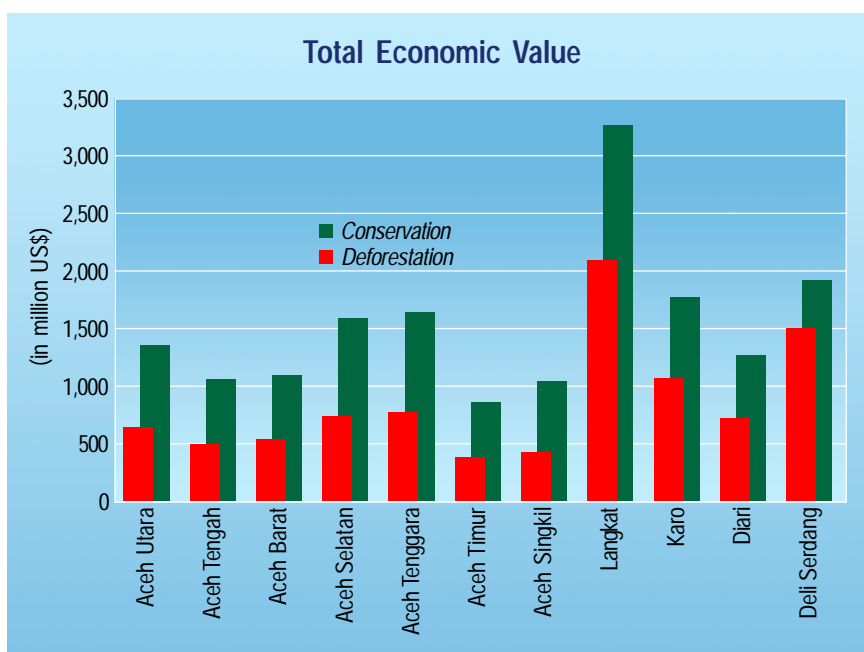


Figure 4. Distribution of the TEV of Leuser Ecosystem among the regencies over the period 2000-2030.