Science News

Reconciling Conservation and Needs of People

A new model of land-use preserves natural forests, generates "new" natural resources, and gives rise to farmers' income. As soon as ten years after the start deforestation could be stopped.

Our work aims at investigating the deforestation and reforestation/rehabilitation processes for a tropical landscape. Both a financial perspective and aspects of sustainability were incorporated into the analysis: Using computer simulations we developed a concept of Ecological-Economic Farm Diversification (EFFD) that is capable of convincing farmers of the benefits of sustainable practices and of halting deforestation.

The EFFD showed that stopping deforestation after ten years is possible without violating subsistence demands. The key activity in halting deforestation at the farm level is the accumulation of "new" natural resources, through reforestation with the native tree species Andean alder (*Alnus acuminata*); a species that can be used for a wide variety of purposes, which are scientifically well documented. By reforestation, formerly unproductive "wastelands" like abandoned pastures can be returned to productive land use.

Classical Strategies Lead to Deforestation

For a small farm (30 ha), including 10 ha of previously degraded wastelands, a traditional land-development strategy would lead to deforestation of 18,3 ha over the course of one generation of farmers (40 years; Figure 2a). This type of land management provides relatively constant net revenues (Figure 2a) when a specific probability of pasture abandonment is given.

The new model results in the conservation of natural forest and yields continous profits for farmers, since they are able to re-use pastures after reforestation with Andean alders. Photo: Baltazar Calvas.

The risk of future yield losses due to pasture degradation promotes further deforestation. Moreover, after the establishment of new pastures, the conversion of tropical forests continues (after 10, 20, and 30 years), to compensate for yield losses as a result of pasture abandonment.

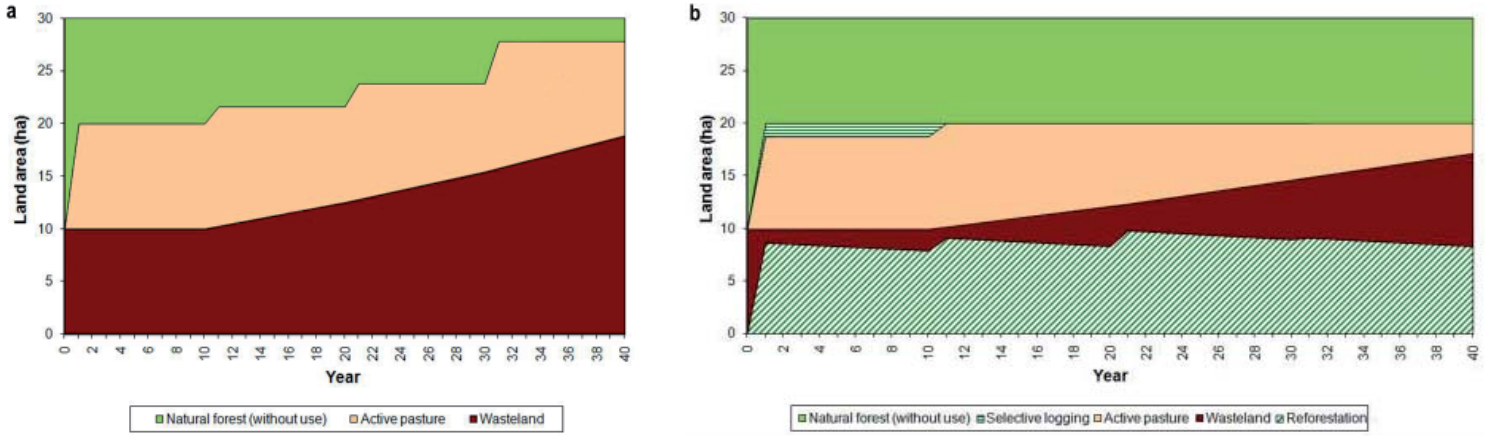

Figure 1
Allocation of land-use activities to the available farm area **a)** under a classical single-use pasture system and **b)** under the EFFD system.

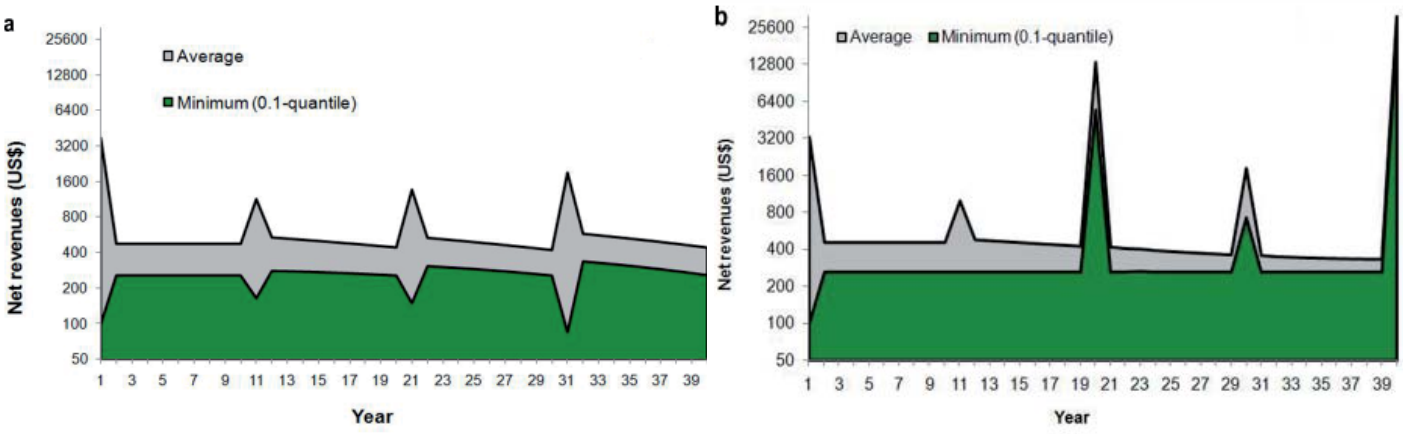

Figure 2
Average expected and minimum net revenues under **a)** a classical single-use pasture system and **b)** under the EFFD system.

Our EFFD model suggests an immediate land-use diversification that provides multiple activities and products (Figure 1b), as the diversification stabilizes the uncertain net revenues and reduces the demand for land which is necessary to provide subsistence net revenues.

The combination of pasture and selective logging (Figure 2b) produces higher minimum net revenues per year than the single pasture system (Figure 2a), although the conversion of tropical forests is only 8.7 ha instead of 10 ha under the single pasture system (Figure 1a).

The model considered market price fluctuations, correlations and pasture degradation, changes in diary productivity, as well as uncertainties associated with the sustainable harvest under selective logging and fire damage.

Results show a feasible win–win scenario: it is possible to reconcile conservation objectives and the subsistence needs of local people. Ecological–economic farm modelling, focused on subsistence revenues and long-term effects, shows the economic benefits of diversification and reforestation of abandoned wastelands. We assume that the absence of quantitative experience of the available land-use options and of land-use combinations is an important factor in the currently accelerating deforestation.

After 40 years, 8,3 ha of tropical forest per farm will have been conserved under the EEFD concept, as compared with the classical system. As a result of the Andean alder plantations valuable natural resources will be also available. During the 40-year time frame, land devoted to the plantations can be used to reestablish agriculture, while the areas degraded by pasturing can be reforested.

65% Increase in Profits

Following the optimized management path under EEFD, farmers can achieve a 65% increase in profit from their land (US$20,680 ± 2,260, discounted at a risk-free 5%, versus US$12,560 ± 2,560 with the classical system), with deforestation being limited to a maximum of 10 ha per farm. The farm profit at risk (profit that is achieved with a probability of 0.9), which we maximized, is 109% greater for the EEFD approach (US$16,970 versus US$8,100 for single-use pasture). Our model shows considerable peaks in revenue in years 20, 30, and 40 (Figure 2b), when final crops of Andean alder plantations can be harvested. These financial results should be attractive to farmers who are not necessarily interested in conservation, because – from their point of view – fulfilling subsistence needs and increasing profits are of primary importance.

We consider it important to estimate biophysical and financial coefficients for different regions. Also, the land-use forms discussed here do not represent all possible options like bee keeping, nurseries of native tree seedlings and saplings, non-timber forest products, home gardens, etc. This example therefore represents a first step in analyzing and modelling options to reconcile subsistence and conservation demands.

The challenge is now to link the results to local farmers in Ecuador. *Baltazar Calvas*

More Information

Thomas Knoke, Baltazar Calvas, Nikolay Aguirre, Rosa María Román-Cuesta, Sven Günter, Bernd Stimm, Michael Weber, and Reinhard Mosandl (2009):

Can tropical farmers reconcile subsistence demands with forest conservation? Frontiers in Ecology and the Environment 2009 Doi: 10.1890/080131