

Eco-certified Natural Rubber from Sustainable Rubber Agroforestry in Sumatra, Indonesia

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BACKGROUND

This project applies an action research method to analyze and test eco-certification of jungle rubber as a mechanism for conserving biodiversity and enhancing the livelihood of rubber-growers in Jambi, Sumatra, Indonesia. Jungle rubber is a traditional agroforestry system practiced by farmers in rural areas of Jambi. This system has been practiced since 1904 and the rubber plantation commences with slash and burning land after which rain-fed paddy and perennials are planted. Farmers then allow natural vegetation to grow amongst the rubber trees. They selectively nurture some economically valuable plants to create a mix of food, medicine, timber and fibre-producing trees. This system is also commonly called “rubber agroforestry”.

The jungle rubber system develops a complex, multi-strata canopy that resembles natural secondary forest and shares about 60-80% of plant species found in neighbouring primary forests (Gouyon et al., 1993; Penot, 1995; Beukema and van Noordwijk, 2004; Michon, 2005). It forms a buffer zone for natural parks and functions as an animal corridor for these parks. Besides biodiversity conservation, the woody biomass in a typical jungle rubber system also represents a substantial carbon stock (about 20 Mg C ha⁻¹) that is larger than that achieved by the average rubber rotational systems over time (Tomich et al., 2004). The rubber agroforestry in Bungo, Jambi are located in the Batanghari watershed and have important hydrological functions for the locals living both upstream and downstream in the watershed.

Rubber agroforestry or jungle rubber supports the livelihood of rural smallholders and also has socio-cultural values. Despite their low productivity, about 80% of smallholder rubber farmers with plots less than 5 ha in size produce nearly 67% of the national production. Rubber is one of the major products in Jambi province. Smallholder farmers gain some benefits from selling rubber slabs and providing labour to collect the sap, carry out post-harvest tasks and sell rubber products. Culturally, this agroforest system has been maintained by successive generations and local communities have traditional beliefs about maintaining their rubber agroforestry. For example, they are forbidden to climb durian trees to harvest fruit, but rather have to wait until the fruit falls down to the ground.

Earlier feasibility studies to identify a potential payment mechanism in regard to the conservation issue associated with the rubber agroforestry system in Bungo indicated both potential and difficulties with timber and latex eco-certification (Gouyon, 2003). Eco-certifiers guarantee to consumers that producers have followed a set of standards that offer ecosystem protection. Identification by a community of its conservation practices and its commitment to them form an important first step toward certification. Based on a comprehensive investigation of the issue, Bennett (2008) recommended eco-certification to allow jungle rubber farmers to generate revenue streams by marketing the environmental benefits of their practices.

Recently ICRAF, in partnership with local NGOs WARSI and Gita Buana, implemented an action-research project in Bungo district in Jambi to investigate a reward mechanism for conservation of traditional rubber agroforestry. Agreements to conserve 2,000 ha of jungle rubber were made with four villages. Intermediate rewards were provided in the form of support to establish micro-hydro power generators, local tree nurseries and model village forests. The conservation agreements also set the stage for potentially pursuing eco-certification as a longer-term feasible approach that can reward jungle rubber farmers for the biodiversity services they provide.

A partnership between ICRAF and the W-BRIDGE (Waseda-Bridgestone) Initiative (Bridging Human Activities and Development of the Global Environment, Research and Action Support

Program) is an ideal and timely opportunity for supporting action-research on testing the eco-certification approach, as well as to advance understanding of the role of natural rubber production and environmental issues. As the trends to integrate environmental thinking into business strategies emerge, we foresee the potential use of this eco-certified “dark green” rubber (from jungle rubber) in the “green products” among the rubber-based industry.

The project is a proactive effort to protect the threatened biodiversity in jungle rubber systems by providing an economic incentive (a premium price for rubber) through eco-certification. This will help introduce the natural rubber industry to producers of environmentally friendly rubber in the developing world and to the environment-conscious consumers in the more developed world.

The following outcomes are envisaged:

- Outcome 1: Stakeholder recognition of the trade-off between private profitability of land use systems and the conservation value of traditional rubber agroforestry in Jambi, Sumatra – complex rubber agroforestry corridors connecting protected forest areas.
- Outcome 2: Appropriate eco-certification approach, as an innovative incentive, for maintaining the environmental qualities of natural rubber production.
- Outcome 3: Enhanced conservation support from the natural rubber industry and local governments.

METHODS OF THE STUDY

Study under this project encompassed quantitative and qualitative analysis to achieve different outcomes.

Outcome 1: Trade-off analysis of different land use systems.

Firstly, to assess the profitability of rubber agroforestry and other land use systems within the Bungo district, we conducted a series of household interviews and collected secondary socioeconomic data at the provincial and district level (Appendix 1). We focused on three socioeconomic variables in smallholder rubber farming: (1) farming system profitability; (2) labour requirements; and (3) establishment cost of the farming systems. We compared the profitability of three smallholder rubber system: (1) complex rubber agroforestry with a rotational/cyclical system; (2) complex rubber with a *sisipan* system; (3) monoculture rubber with improved rubber clone. Farmers practicing the complex rubber agroforestry with a rotational system usually clear their 35-44 year old rubber gardens to start new rubber plantation. Under the *sisipan* system, farmers actively interplant rubber seedlings or maintain rubber saplings within productive rubber plot to ensure the productivity of their complex rubber agroforestry. We assumed that farmers begin to interplant their gardens at year 20 and these rubber plots would continuously be productive up to year 68. The monoculture rubber with improved rubber clone represented a high-input and high-output system. It required intensive plantation management to ensure optimal latex production. Available data indicated that this system remained productive up to year 30.

The policy analysis matrix (PAM) technique that estimates profitability indicators and analyses labour requirements and the farm budget was applied to provide insights into patterns of incentives in conserving rubber agroforestry at the microeconomic level (Table 1 Appendix 1). It also estimates quantitatively the impacts of policies on such incentives by valuing agricultural production at private and social prices.

Secondly, to analyse land use dynamics and their trajectories, including potential threats to rubber agroforestry and opportunities for eco-certification areas, we conducted spatial analysis using a series of land-use/cover maps interpreted from satellite images dated from 2000 to 2005 and 2007 to 2008 (Table 7 Appendix 2). The research team also performed direct on-site checks on dominant land cover types and collected Global Positioning System (GPS) points. These data are useful as samples for the image interpretation process and as references for accuracy assessment of the spatial analysis. An interview with local government officers was organized to gain their perspectives on future land allocation for different land uses in Bungo. For the biodiversity context, we analyzed the connectivity index of the remaining forest patches using FRAGSTATS – a computer software program designed to compute a wide variety of landscape metrics for categorical map patterns¹.

Outcome 2: Potential of eco-certification of rubber agroforestry

The research team, including an MSc student from the University of Amsterdam, observed the possibilities and constraints of eco-certification of rubber agroforestry in Bungo district, Jambi (Appendix 3). This process captured the perceptions of different stakeholders that were relevant to the development of a rubber eco-certification scheme. The stakeholders were suppliers, (smallholder rubber farmers), buyers (companies using natural rubber in their production), intermediaries (local NGOs) and regulators (district and provincial government). A series of interviews and focus group discussions were organized with these various groups.

Outcome 3: Support from industry and government

In partnership with Komunitas Konservasi Indonesia-WARSI (KKI-WARSI) and cofounded by the Landscape Mosaic Project of the Swiss Agency for Development and Cooperation, the WARSI and ICRAF team facilitated regular meetings among stakeholders in the Bungo district or the Forest Governance Learning Group (FGLG). The team visited the Bridgestone Company in North Sumatra and exchanged to discuss any potential to increase natural rubber quality within the Bungo rubber agroforestry system. As the follow up action, the Bridgestone staff visited Bungo and conducted a training to improve quality of rubber produced from jungle rubber (Appendix 4 and 5).

RESULTS AND DISCUSSION

Trade-off analysis of different land use system

The profitability assessment of smallholder rubber systems indicated that all the systems (complex rubber agroforestry with a rotational system, complex rubber agroforestry with a *sisipan* system and monoculture rubber) were profitable at the current rubber price (IDR 13,000 or about USD 1.44 per kg). Under well-managed conditions and without any credit to pay back, monoculture rubber was more profitable compared to complex rubber agroforestry, with both private and social prices. Within the complex system, the rotational system was more profitable with private prices, but lower with social prices compared to the *sisipan* system (Table 3 and 4). However, to interpret this result, we have to consider some important assumption and on-ground realities:

- Assumption: monoculture rubber is optimally managed, with selective planting material, intensive pest control and recommended practices for rubber tapping and post-harvesting.

¹ <http://www.umass.edu/landeco/research/fragstats/fragstats.html>

Fact: farmers lack access to good planting material and lack knowledge on good plant management and rubber post-harvesting processes.

- Assumption: under the complex rubber systems (rotational or *sisipan*), farmers maximise their latex production and require labour inputs for the establishment and operation of their plantations.

Fact: farmers rely on a number of alternative jobs – on farm and off farm – to maintain their household income. In addition, the variety of trees within the complex rubber agroforestry enables farmers to have an additional source of income from their rubber plantation, such as from selling fruit from their agroforestry gardens. The complex systems usually utilize family labour, which tends to not be included in any economic assessment. In this case, the cost of labour is actually returned to the household. However, these labour inputs presumably represent the opportunity cost of foregone earnings from other economically beneficial activities.

The analysis of the labour requirement concluded that monoculture rubber required more labour for all activities compared to the complex options (Table 5). From the farmers' perspective, higher labour requirements impose a more serious constraint when the average wage rate increases beyond the returns from the labour. For policy makers, perhaps the monoculture systems could be attractive for employment generation in rural areas. However, this requires careful checking with population data and also to see whether the economically active population in agriculture can actually meet the labour requirements of a monoculture system. Current population density data shows that agricultural labour availability in Jambi is bordering on scarce.

The cost of establishment of monoculture rubber is double compared to complex rubber systems (Table 6). Therefore, cost rarely becomes a constraint for farmers to establish complex rubber agroforestry compared to the cost of establishing a monoculture rubber system. The literature mentioned that the cost of establishment of oil palm was lower compared to that for monoculture rubber. However, currently, farmers still lack the necessary technological knowledge to invest in oil palm plantations.

The sensitivity analysis of profitability to the discount rate and wage rate indicated that rubber cultivation was not a capital-intensive investment and was perhaps affordable for smallholders (Figure 3). The analysis revealed also that maintaining lower capital investment (as in a complex rubber system), will increase indirectly the profitability of the system. Although a monoculture rubber system provides better returns for labour and the opportunity for employment in rural areas, the system is more susceptible to any changes in wage rates compared to the complex systems. This implies that complex rubber agroforestry has an important role in buffering stable production, as rubber prices fluctuate over time.

Spatial dynamics and trajectories of rubber agroforestry

Based on field observations, there are four dominant types of land cover in Bungo: (1) forest; (2) rubber agroforestry; (3) monoculture rubber; and (4) oil palm (Figure 8 and Table 8 – Appendix 2). Rubber agroforestry is further classified into two classes: (1) complex rubber agroforestry; and (2) simple rubber agroforestry. The overall accuracy of spatial analysis using the 2007/2008 land cover map is 81.3% (Table 9). Most misclassifications occurred among the classes of complex rubber agroforestry, simple rubber agroforestry and monoculture rubber, because of their similar canopy cover structure.

The spatial analysis showed that the landscape of Bungo has been dominated by monoculture plantations since 2002. Between 2005 and 2008, oil palm plantation establishment expanded rapidly while rubber monoculture seemed to slow down. Oil palm was established as large-scale homogenous patches in the landscape, since this plantation type is managed by large-scale companies. Complex rubber agroforestry or jungle rubber formed a continuous corridor along the river in the central part of Bungo district. Simple rubber agroforestry was located closer to settlements forming small fragmented patches. New patches of simple rubber agroforestry appeared in 2005 and 2007/2008, indicating that this system was being increasingly adopted. Forest cover also declined, especially in the penneplain area and was replaced by tracts of shrubs and grass. This indicated the occurrence of logging activity or an initial stage of conversion to tree-crop land use. Table 10 and Figure 10 show the amount of each land cover at three points in time (2002, 2005 and 2007/2008).

The land cover transition matrix showed that most complex rubber agroforestry was converted to monoculture rubber and oil palm during 2002-2008 (Table 11). In general, rubber agroforestry, under both simple and complex systems, was converted to oil palm, cropland and monoculture rubber, while forest areas degraded to shrubs, monoculture rubber and oil palm plantation (Figure 12).

With the assumption that forest and rubber agroforestry had an index of similarity of 0.8, based on the number of species found in both land cover types (Dewi and Ekadinata 2010), our analysis of the connectivity index identified priority locations for the eco-certification process (Figure 13). There were at least three crucial locations where rubber agroforestry provided connectivity with the forest.

To understand further the potential location of rubber eco-certification sites, we overlaid the land cover map 2007/2008 and the “Forest Designation Map” published by the Indonesian Ministry of Forestry. We found that about 91% of the rubber agroforestry area in 2007 was located in the “land for other use” category. The “land for other use” was owned mostly by local people or managed by local government (Figure 14). Thus, decision making for any eco-certification scheme will depend mostly on local communities and/or local government. Our interviews with local government revealed that they had entered into some agreements with private companies to convert areas under the “land for other use” category to oil palm plantation. Most of the land under this category was complex rubber agroforestry.

Potential of eco-certification of rubber agroforestry

Quality remains the most important aspect of natural rubber for most companies. Most companies also indicated that there is already a demand from both the consumer and the producer for green certified rubber, or that this demand can be created because of the growing consumer awareness of the loss of biodiversity through monoculture farming. The valuation of biodiversity in monetary terms though, is still rather low; most companies would pay a premium price of 1-5% for green certified rubber, with the highest offer being from one company that indicated it would pay a 10-25% price increase. Companies would expect green certified rubber to come from plantations that were either simple or complex mixed rubber agroforestry systems. An interesting note is that the Indonesian division of a large producer of pneumatic bicycle tyres seemed interested in the idea of green rubber and placed a premium price on this of 5-10%.

From the supply side, the most important actors on the production side of the natural rubber value chain in Jambi were the smallholder farmers, local government and the assisting agencies, such as NGOs and ICRAF. The focus of this survey is on Bungo, Jambi and specifically Lubuk Beringin village. The choice of Lubuk Beringin as the data source is based on the fact that the village has prior knowledge on eco-certification and is participating in the eco-certification project. Lubuk Beringin

can act as an example for the rest of the region after the eco-certification of agroforestry rubber has been proven successful.

The farmers in Lubuk Beringin have a very positive attitude towards eco-certification, as we have already noticed from previous research. However, their expectations might be too high; when asked what extra money they would need from eco-certification in order to sustain agroforestry, almost all farmers indicated that they would need a 100% price increase for the rubber. This might be due to the nature of the question itself, because perhaps it was not fully understood. With questions regarding the valuation of positive outcomes of eco-certification, most farmers ranked the financial benefits in first (and often also second) place. They were willing to work hard for these possible financial benefits and to form a cooperative (*Koperasi*) with smallholders who could trust each other. However, the farmers having participated in projects where certification was mentioned before, were wondering when the “talk” of eco-certification will actually become “action”.

Interviews with local government officials provided further clarification on land use and concessions in the Bungo district. Their message was very simple; if eco-certification in Lubuk Beringin works (thus, if it is profitable to the farmers), then their attitude towards it will be very positive. As long as there is proof that eco-certification can be financially beneficial to the area, it is worth investing in. There might even be a possibility that local government helps fund the transaction costs needed for eco-certification (however, this was only mentioned by one individual). It must be noted that big companies operating in the region, and the relationship that local government has with these companies, might be an obstacle, when farmers are not as willing to sell their land anymore. However, this is a concern for later and might not even occur due to the division of Bungo into production and forest areas.

Furthermore, the local government wants and needs to have more knowledge on the concept of eco-certification and what it might mean for the region. Not many government officials have a clear understanding of what it entails.

The experience of the local NGO, in this case WARSI, with the certification of organic products explains a lot about the possibilities and challenges that eco-certification of rubber faces. Organic certification, supposedly creating the highest premium prices for all kinds of certification, was good for a 10-20% price increase. This was not all given directly to the farmers, but was used to develop facilities in the village as well. Such a system might not increase the financial assets of the rubber farmers very much, but would increase their livelihoods by improving their village surroundings/facilities. Although WARSI believes generally that eco-certifying rubber is a very difficult task because of the nature of rubber (it is not edible and so does not directly concern people’s health, neither is it a very visible product on its own), getting certification for the production system might not be as difficult. As WARSI staffs have assisted Lubuk Beringin for many years, their role as an NGO will be prominent in the eco-certification process, perhaps as a potential facilitating NGO. As a facilitating NGO they will then commit to provide training, and assist in management planning, marketing and quality control.

Support from industry and government, local consultation and awareness building

ICRAF and WARSI continue to work and consult with local people at the project site in Bungo. Four villages (Lubuk Beringin, Sangi, Letung and Mengkuang) have been further identified for testing the eco-certification of jungle rubber. Awareness building at the local community and district government levels is continuing. In the process of monitoring extant conservation agreements in the four villages

in Bungo District, WARSI and ICRAF field-based colleagues are in regular contact with the local people to explore and pursue eco-certification for jungle rubber.

A team from ICRAF and WARSI visited the Bridgestone Company in North Sumatra in March 4-5, 2010. Some points of discussion were (1) productivity of rubber agroforestry and its potential to increase its production; (2) updates of ICRAF-WARSI facilitation to encourage sustainable rubber agroforestry, such as RUPES activities and *Hutan Desa* (village forest) initiatives; (3) rubber trade between rubber agroforestry farmers and Bridgestone as part of their corporate social responsibility program.

Staffs from Bridgestone North Sumatra visited Bungo district and conducted training on rubber sapping and post-harvesting techniques in March 12-13, 2010. The total participants were about 30 rubber farmers and local traders. The Bridgestone staffs observed that the rubber sapping technique currently practiced by the farmers caused about 30% lower rubber productivity compared to the techniques applied by the Bridgestone. Farmers also utilized different type of chemical liquid to treat their rubber slabs. Overall, the rubber quality at the village level was still low because of many contaminants, such as leaves and stones. Farmers usually dipped their rubber slab into water to increase its weight. This process was not recommended because it can destroy the rubber elasticity.

Our field observation also revealed that farmers usually had weak bargaining position compared to the local traders (or called *toke*). A social connection between them was formed. A *toke* not only acts as a rubber trader but also as a money lender when farmers need urgent financial problem. This left no choice for farmers – they had to sell their rubber harvest to certain *toke* to whom they borrowed some money.

A Memorandum of Understanding between ICRAF and Bridgestone Japan represented by Mr Hideki Yokoyama was signed on April 29, 2010 in ICRAF Office, Bogor, Indonesia. The company will fund a cost-benefit analysis on improved quality of rubber, train more local farmers in how to get better rubber from their tress, and share the results of the research globally.

CONCLUSION

There is now a consensus among research and development professionals on the need to provide incentives (as rewards, compensation and recognition) to the poor tropical producers of non-timber forest products for providing environmental services. Eco-certification at its most fundamental level protects environmental services by attaining agreement from producers to follow a defined set of practices in exchange for certification that they have done so. When consumers elect to pay price premiums for environmental services, the premiums can increase the pool of funds available for conserving environmental services by providing returns to the landholders for their environmental outputs. These returns would make land-uses that provide biodiversity services more competitive with land uses that emphasise only crop production. One mechanism investigated in the Jambi Province of Indonesia involved eco-certification of jungle rubber, a traditional Indonesian management practice that retains a forest-like environment, harbouring far more species than a monoculture.

Despite its economical and ecological functions, the study found that traditional complex rubber agroforestry system was under threat but somehow opportunities to preserve it still exist. The economic calculation showed that the monoculture rubber and oil palm are much more economically attractive for farmers in Bungo. On-ground realities revealed that not all assumptions have been well-justified. Some constraints exist for both monoculture rubber and oil palm plantations, such as

unavailable good seedlings and lack of technological knowledge for establishing, managing, harvesting and handling post-harvesting process of the plantations. The spatial analysis revealed that the monoculture rubber has been relatively stable since 2002 and oil palm plantations were still dominated by large companies. However, in the future, when constraints become minimal for smallholders to adopt monoculture rubber and oil palm plantations, it will be no doubt that jungle rubber can slowly diminish.

The case in Jambi showed that supportive policy toward eco-certification was still very low. Most of government's programmes and policies were only focused on agricultural productions without providing incentives to sustainable agricultural management, including eco-certification. Technically, this concept was still nascent to relevant actors in Bungo (and elsewhere in Indonesia). We observed that the local governments at district and provincial level are the most prominent decision makers for championing the implementation of eco-certification scheme. They were the ones who had stronger position to decide whether the existing jungle rubber would be preserved or converted to other land uses, such as oil palms. Farmers, in this case, would rationally select the most beneficial farming system that is affordable and familiar for them. The roles of intermediary, such as local NGOs become important to sensitize the importance of sustainable resource management and the long-term advantage of linking livelihood and conservation.

Field interviews revealed that while jungle rubber had the potential to meet eco-certification standards, many obstacles inherent in current eco-certification approaches needed to be overcome to make it a viable option for Jambi's rubber producers. From the demand perspective, although the awareness about green products was increasing, companies were still hesitant to adopt the eco-certification concept. They were still uncertain about the effect of buying green product with premium prices, even with small scale of trading, since this was assumed to distort the global price market. Therefore, the current practice to adopt environmentally friendly production system was through their corporate social responsibility programmes. At the supplier level, farmers had been enthusiastic with the concept; however, many further steps have to be prepared, such as improving the rubber quality, strengthening local institutions and capacity to actively involve in the scheme.

RECOMMENDATION AND FUTURE RESEARCH QUESTION

To date, eco-certification has not resulted in high rates of conservation of tropical forests. As of mid 2005, less than 1.5% of tropical forests had become eco-certified, compared to slightly over 31% of temperate forests. Reasons for the low rate of eco-certification in the tropics include the fact that producers have not received higher prices for eco-certified products. Nonetheless, eco-certification shows promise. Studies in temperate forests indicate that eco-certified forests are better managed than others. In addition, eco-certification is based on using areas for economic purposes, while at the same time protecting them and this necessitates working to integrate small producers into markets. Evaluation of integrated conservation and development projects indicates these factors are associated with ecological and economic success. Therefore, as the results of this study, we recommend that:

- *Sustainable eco-certification needs to promote development*

Eco-certification comes with much fine print to observe if it is to deliver on its promise. First, in the tropics, eco-certification cannot deliver sustainable conservation if it does not also deliver sustainable development. If biodiversity-conserving land-uses do not produce benefits for small holders that out compete biodiversity-destroying uses, producers will opt for the use

that offers the best returns for their labour and resources, especially in settings like Indonesia, where a high percentage of rural people earn USD 2 or less per day.

- *Certification choices should match local circumstances*

Producers wanting to pursue certification should match the market and conservation strengths of the various types of certification (organic, fair trade, eco-based) to the circumstances of their specific locale. Organic certification has provided the most evidence of price premiums for crops consumed or worn. Evidence also shows that fair trade produces price premiums. However, eco-certification schemes establish conservation protection most rigorously and explicitly, making them highly suited for situations with threatened biodiversity. Among the eco-certification approaches, each has its own strengths as well as weaknesses in different situations. Research to target improvements to weak areas for each situation could result in the best set of options for producers and their crops. Crops already traded internationally make the best choice for internationally-based eco-certification.

- *Research should target price premiums, transaction costs and conservation outcomes.*

Research for improving the reach and efficacy of eco-certification should focus on the following:

1. Can eco-certification deliver sufficient price premiums?

Powerful retailers and retail manufacturers near the consumer end of the eco-certification value chain have agreed to stock eco-certified products whenever possible. However, these retailers have not offered consumers choices between eco-certified and non-certified products, thereby giving them no way to communicate demand by “voting with their dollars.” Furthermore, there is evidence these retailers use their power to pass the costs of eco-certification up the value chain without passing along any price premium that might materialise. Yet, if these retailers marketed eco-certified products, they could potentially gain market share and consumer loyalty, while being able to pass the costs onto consumers.

2. Could contracts directly between producers and retailers get price premiums to producers while otherwise meeting the needs of producers and sellers?

Such contracts are used in fair-trade certification, which has effectively transmitted price premiums to producers. The contracts would, in effect, separate the value chain of the biodiversity conservation services product created through eco-certification from the value chain for raw materials.

3. Could shortening the eco-certification value chain enable an “accounting chain-of-custody?”

Selling products under an eco-certification label requires proof that the items were actually produced according to eco-certification standards. Currently, to offer such proof, each intermediary in the value chain must keep certified and non-certified material physically separate and maintain documentation of doing so. This requirement adds to the transaction costs.

4. Would contracts produce more conservation value if they paid producers based on indicators of the desired biodiversity conservation, rather than amount of raw material produced? If so, these contracts could limit the potential for perverse incentives to producers to grow more raw materials, when more conservation is the desired goal.

Eco-certification is a relatively new and still evolving market. Whether it ultimately succeeds or fails in conserving environmental services depends on whether consumers can be motivated to pay for these services, so that producers near and far can earn decent returns for providing services with global value. Creating this willingness and the value chains to meet the demand will require significant resources, just like for any more traditional business products.