Sumatra's Rubber Agroforests; Advent, Rise and Fall of a Sustainable Cropping System

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Abstract

Until the end of the 19th century primary forests covered nearly all the island of Sumatra. The first valorisation of this natural resource was hunting and gathering activities, followed by and later associated with swidden cultivation of upland rice. The industrial revolution in Europe and North America in the 1950s created increasing demand for rubber. Answering this new market opportunity, farmers introduced rubber seedlings in their swiddens amidst the upland rice. By doing so, they invented a new cropping system, i.e. rubber agroforests. Thanks to the continuously increasing demand for rubber by the developing industry, rubber agroforests spread over Sumatra's eastern peneplains until the 1990s. Forest conversion to rubber agroforests conserves a high level of forest biodiversity and the agroforests act as a buffer zone around national parks. But with growing demographic pressure, market integration and household monetary needs, agroforests are increasingly endangered. New cropping systems have appeared and challenge agroforests' dominance in the landscape. Since the mid-20th century, rubber monospecific plantations have been competing for land, with an undoubtedly higher profitability than agroforests. More recently, oil palm plantations have spread over the island, quickly becoming the new challenger to rubber agroforestry. Nevertheless, the international community shows more and more interest in forest and biodiversity conservation. Forest cover in Jambi province has nearly disappeared over the past 30 years. The only way to save the remnants of forests and agroforests seems to be the creation of market incentives through conservation programs such as reducing emissions from deforestation and degradation.

Keywords: natural rubber, oil palm, landscape dynamics, market incentives, deforestation.

Introduction

While global policies and markets are often held responsible for accelerated deforestation in the tropics (Colfer and Resosudarmo 2002; Cunningham *et al*. 2005), local knowledge is generally assumed to lead to overall positive outcomes in matters of conservation (Berkes *et al*. 2000; Gadgil *et al*. 2003). Even in matters of primary forest conversion, local communities are usually presented as the best managers to reconcile conservation and development (Colfer and Resosudarmo 2002).

In South-East Asia, and especially in Indonesia where massive deforestation has taken place during the last three decades, examples of conversion of primary forest to small-scale rural agroforests abound. Agroforests are smallholders' plantations combining perennial cash crops such as rubber with useful plants including timber and fruit trees, food crops, building and handicraft material (palms, rattan and bamboo) and medicinal plants (Gouyon *et al*. 1993; Michon and De Foresta 1997; Huxley 1999). To some extent, agroforests mimic the natural forest. Pioneer, post-pioneer and late-phase species in a natural forest are replaced by similar crops in succession, with a range of needs in light. The first step after slash-and-burn consists

of replacing the pioneer stage with a cultivated stage with similar characteristics: heliophilous crops with quick development (rice, vegetables, bananas and papaya) take the place of natural pioneers and inhibit weed growth. This cultivated stage creates a shady environment and a humid microclimate at ground level, favourable to the development of young forest species (rubber, fruit trees, palms and timber trees). The post-pioneer phase, dominated by fast growing crops productive after 4 to 8 years (e.g. coffee, pepper, clove and cinnamon), maintains a biophysical environment favourable to the growth of young trees and benefits from maintenance operations (slashing, weeding, fertilisation) intended for the major crops. After 15 to 20 years, the agroforest presents a complex forest structure, with a high and closed canopy in which many forest species thrive spontaneously. Later, the reproduction of the productive structure will rest on the death or fall of trees, which will create space for a new generation of plants to grow (Michon and Bompard 1987). Because of the continuous and spontaneous regeneration of many species, rubber agroforests show a forest structure in which trees of every age are represented.

Sumatran rubber agroforests, which still cover more than 3 M ha of the eastern peneplains of the island, have often been presented as the archetype of small-scale rural forests or domestic forests (Michon 2005), a model of traditional and sustainable forest resource management. While deforestation caused by timber extraction and cash crop expansion translates into landscape degradation, biodiversity loss, extinction of animal and plant species and release of greenhouse gases, conversion to agroforests preserves many plant and bird species (Rasnovi, 2006; Beukema *et al*., 2007; De Foresta, 2008) and most ecological functions of the natural forest (Michon *et al*. 1986). In the province of Jambi, rubber agroforests have a strong foothold in low-lying areas from the eastern coast up to the foothills of the Barisan range. They are often mixed with remnants of natural forests and secondary forest regrowth (Ekadinata and Vincent 2004). But nowadays even agroforests are endangered, because their owners often opt for their conversion to monospecific plantations of rubber or oil palm.

This paper first examines how local people invented rubber agroforests in response to market incentives, then shows how the outstanding sustainability of the rubber agroforest system translated into major conversion of the province's natural forest. Nowadays the global economic change, new opportunities, new needs and new wants incite local people to convert their agroforests to monospecific rubber and oil palm plantations.

The present study is based on literature review of Indonesian agroforests completed by data collection in the province of Jambi. Data were collected in 2007 and 2008 in Bungo district, using landscape analysis, historical survey of various stakeholders in the agricultural sector and socio-economic surveys of 100 households. More than 20 villages in the district were visited.

Advent of Rubber Agroforests: Innovative Response to a New Market Incentive

Until the end of the 19th century the eastern peneplains of Sumatra were covered mainly by primary forest. Self-sufficiency in the production of staple foods was achieved by the swidden cultivation of upland rice, while hunting and gathering contributed substantially to the people's diet. Population density was low (fewer than 5 inhabitants/km^2) and only a minor part of the landscape was under swidden cultivation. The *ladang,* or swidden, was cultivated for one or two consecutive years and then left fallow for 15 to 20 years (Levang *et al*. 1997; Ruf and Lançon 2004). Monetary needs were fulfilled by the gathering and sale of forest products including resins, latex and rattan to Malay and Chinese traders. This system of

swidden cultivation and gathering of forest products proved sustainable, in an ecological as well as economic sense (Levang and Gouyon 1993).

With the industrial revolution in Europe and North America in the second half of the 19th century, the demand for natural resources such as resins and latex boomed. In Sumatra, the soaring prices of natural rubber – especially *Palaquium spp*. and *Dyera costulata* rubber, and to a lesser extent *Ficus elastica* rubber – caused local collectors to overexploit the resource until depletion. Faced with excessive collecting costs, the swidden farmers found a solution to their problem by switching to the exotic Para rubber (*Hevea brasiliensis*), introduced by large colonial plantations in Sumatra at the beginning of the 20th century. With minimal labour input, rubber seedlings were introduced to the *ladang* amidst the upland rice. After the second harvest of rice, the plot was left fallow and the rubber seedlings managed to survive among the secondary forest regrowth. About 10 years later, when rubber trees were ready to be tapped, the farmer merely opened some harvesting paths and cleared the space around the trees to be tapped (Levang *et al*. 1997). A new 'traditional' cropping system was born, i.e. rubber agroforests.

The first studies of Indonesian agroforests by ecologists underlined their outstanding positive impact on conservation issues. More than 50% of the birds and flora species present in nearby natural forests were preserved in the agroforests (Thiollay 1995). Most ecological functions of the forests were also preserved, especially water flow regulation, soil protection and ecological habitat provision (Michon *et al*. 1986; Michon and Bompard 1987). Agroforests have a remarkable potential as buffer zones between villages and protected forest areas. They establish an ecological transition between closed forest ecosystems and open fields, avoiding the fragmentation of forest cover, and as a non-inhabited space constitute a geographic barrier between forest and human-made environment. Major economic products and services of the forest including hunting, gathering and fishing are preserved in agroforests. This may be viewed as a kind of re-appropriation of forest resources by agriculture (Michon 2005). Agroforests also contribute to the preservation of fruit tree cultivars, especially of some last wild representatives of non-marketable species (Michon *et al*. 1986). By conserving the high levels of biodiversity in their agroforests, farmers preserve a potential for the development of future resources (Michon 2005). Pressure on the remaining forests has considerably decreased, because of the increased distance to forests and also because of the abundant presence of most forest products inside agroforests. Agroforests have replaced the forest for most activities that previously took place inside the latter.

Sumatran people switched from harvesting and hunting activities to swidden cultivation and then to agroforests. They integrated and even invented technical innovations so as to benefit from new opportunities or to overcome new constraints. They converted primary forests to secondary forests and then to agroforests, always maintaining a high level of biodiversity and the ecological functions of the forests (Michon and Bompard 1987). As such, agroforests have often been presented as the result of local people's ecological wisdom. It would be a mistake, however, to consider biodiversity conservation as being intentional. People do not value biodiversity for itself. It is more the scarcity of labour that allows for natural regrowth of spontaneous species in rubber plantations. Farmers do not expect this vegetation; they just let it grow. Part of the preserved biodiversity is far from being welcomed by farmers, especially mammals including wild pigs, tigers, elephants and monkeys. These major pests are considered unavoidable because of local people's dietary restrictions as muslim praticants, the status of the animals as protected species or simply the lack of means to control them (Levang and Sitorus 2006).

The Rise of Rubber Agroforests, a continuous expansion to the Detriment of Natural Forests (1910-1990)

First introduced in Jambi in 1904, rubber became the most important commodity for the whole eastern coast of Sumatra in the 1920s. Accompanying a continuously increasing demand for rubber for tyres in the motor vehicle industry, the price of natural rubber peaked in the mid-1920s. Colonial authorities encouraged the development of indigenous rubber plantations (Dove 1994). Also, Chinese and Malay traders organised an efficient trading chain benefiting from the proximity of the active seaport of Singapore. Jambi experienced unprecedented wealth during this period (Le Fèvre 1927). Farmers soon decided to plant rubber trees in all their *ladang*. By doing so, they switched from temporary swidden cultivation to permanent agroforestry (Gouyon *et al*. 1993). The labour needed to open a new swidden was made more profitable by planting rubber trees in the plot and creating a productive plantation. The establishment of rubber agroforests instead of *ladang* had profound impacts on the local tenure systems because it implied recognition of individual land and tree ownership (Gouyon *et al*. 1993). With the introduction of perennial crops, land acquired a value where previously labour was the only productive resource. Thus, agroforests introduced a new concept unknown in swidden cultivation, the concept of productive capital. This new and unique opportunity to accumulate wealth and to transmit it to offspring translated into a harsh economic and social differentiation (Levang and Gouyon 1993). For local farmers the choice was to join the movement towards rubber agroforests, or lose access to land. Soon all the plots near villages were converted to agroforests. This rapid and huge expansion of agroforests translated into increased labour needs. Large numbers of Chinese and Javanese immigrants were hired as rubber tappers.

The boom lasted until the 1928 global financial crisis, when the price of rubber plummeted. The regional economy was in shock. Migrants who were employed as tappers and did not possess any land left for the cities. But even during the crisis farmers continued to plant rubber in their *ladang*. As the immature period of a rubber agroforest can last 10 to 15 years, farmers hoped that the price of rubber would increase again. Furthermore, by planting a permanent crop they secured tenure over the new plot. Thus the rubber agroforests survived the crisis, as did the rubber industry in Jambi. The absence of any profitable land use alternative in Jambi at that time also explains this trend to expand agroforests (Penot 2001).

Families had to secure food self-sufficiency again. During periods of high rubber prices, farmers purchased low-priced rice imported from Java. Inundated rice cropping, developed by migrant labour behind river levees during the period of high prices, was neglected during the crisis by local people because of the smaller return to labour. Access to forests was still easy, and rubber was a valuable source of wealth and an indicator of individual land ownership. Hence, farmers largely opted for opening new plots, to the detriment of primary forests, rather than recycling old agroforests, which were already an inalienable part of family properties. Another hindrance to the rehabilitation of rubber agroforests by smallholders has always been the high specialisation of income sources. Households' income has been and is still generated by several rubber agroforests, with 70% of total household income coming from rubber in Bungo district (Joshi *et al*. 2002). Over the whole duration of a rubber agroforest's lifespan, rubber trees provide approximately 85% of the total return to land (Gouyon *et al*. 1993). The clear-cutting of a plot implies more than 10 years without any major cash income generation. Thus a household needs to possess sufficient plantation area to withstand this shortage of income. The expansion of rubber agroforests in Jambi only came to a halt at the beginning of

the 1990s. By then, productive plantations were distant from the villages, which were surrounded by old, mostly unproductive agroforests. Rubber agroforests covered 0.5 M ha in the province of Jambi at the beginning of the 1990s (Joshi et al. 2002) and about 3-4 M ha on the eastern coast of Sumatra at the same period (Levang and Gouyon 1993).

Many ardent supporters of agroforest farming (and of traditional knowledge) have not paid attention to the major condition for its sustainability, namely its continuous expansion to the detriment of natural forest. Young men can easily make a living by tapping agroforests belonging to older farmers on a sharecropping basis. The harvest (or its revenue, depending on the landowner) is usually shared equally between tapper and owner, but where labour is scarce, such as in Bungo district, the tapper receives two thirds of the harvest and the owner one third. No maintenance work is involved. Old agroforests serve as a pension scheme for aging heads of households. New heads of households wanting to build a source of wealth have no choice but to open new agroforests by slashing and burning natural forests. By introducing a perennial crop (rubber) in their *ladang*, farmers take that plot of land out of the swidden cultivation cycle and out of the community land dedicated to rice cultivation, forcing new household heads to go to the primary forest for land. Thus, long before the development of industrial plantations, Sumatra's primary forests fell victim to the unabated development of agroforests.

Farmers were the only consumers of land and forest in Sumatra until the beginning of the 20th century. But soon new stakeholders came, also competing for the conservation, exploitation or conversion of the remaining primary forests of Sumatra. Probably worried by the rapid pace of deforestation, as early as the mid-1930s the Dutch colonial government set aside vast areas of forests as natural reserves (Gouyon 1995). Rigorously preserved until Independence in 1949, many of these reserves subsequently fell victim to the axe of local farmers. With the reorganisation of the forestry service and the concession system established in the 1970s, primary forest became state-owned forest and local people lost access to their traditional land reserves. Other large tracts of forest were devoted to agrarian reform, i.e. the *transmigration program,* which aimed to move people from the densely populated islands of Java and Bali to the less populated islands of Sumatra and Kalimantan (Levang 1997), then to industrial oil palm and rubber estates (private or involving transmigration), and later to large-scale forestry plantations for pulp and paper.

With the denial of their rights to primary forests in the early 1970s local farmers could no longer expand their agroforests. Some scholars (including Levang and Gouyon 1993 and Michon *et al*. 1995) thought that progressive land saturation would oblige farmers to convert old, low-production agroforests into more intensive monospecific plantations. This prediction was confirmed in only some villages, however, whereas in others land saturation triggered the rejuvenation of rubber agroforests. The slow process of intensification of rubber production partially explains this unexpected preservation of agroforestry practices. Intensive techniques, especially the use of improved saplings (GT 1 and PB 260), have not been fully adopted by farmers. Some unsuccessful experiments – including the planting of rubber saplings sold under the label 'improved' but which were found to produce less than local cultivars – resulted in a loss of confidence in the quality of the new material. Disappointed farmers stood by agroforestry practices, with no cost of fertilisation or saplings (which are produced by the farmers). Besides, population increase at village level remained low thanks to the active outmigration of younger people to cities, to transmigration sites where they could find free land and employment or even to Malaysia. As a direct consequence of this low population density, pressure on land remained low and intensification of land productivity remained a

minor objective. The use of non-intensive practices is generally more a consequence of constraints rather than of choice. Smallholders generally lack the initial capital to buy selected clones, fertilisers and chemicals. In all development projects in which a third party assumed the establishment costs and related risks, smallholders adopted clones and more intensive techniques (Levang and Sitorus 2006).

The Fall: Challenging the System's Sustainability (1970-present)

The socio-economic context of rubber agroforestry has evolved over time, and so have the people's needs and wants. Before the introduction of Para rubber, local communities were already in contact with national and international markets through the collection and sale of forest products. With the adoption of rubber agroforestry, they became increasingly integrated into the market economy. Forms of consumption and needs and priorities of villagers changed over time. Nowadays, most children engage in secondary education, sometimes far from the village, which imposes additional expenses for the farming households. When they return to the village, they have new hobbies, new habits and new wants. Electrification of the villages and asphalting of access roads brought along new wants, including television, video sets, mobile phones, refrigerators, motorbikes and cars. Better accessibility and better information opened the villages to new opportunities, new techniques, new commodities and new markets.

Agroforests are still praised for their low establishment and management cost. Their ecological sustainability is unquestioned. Establishment and maintenance costs of rubber agroforests with ordinary seedlings are low, but compared with improved rubber seedling cultivated with fertilizing and improved tapping techniques, they generate low returns to labour and land. However, secondary products (fruit, timber, building and handicraft material, fuelwood) as well as their social and landmark functions are typical advantages of agroforests. Rubber agroforest is wonderfully suited to a subsistence farming strategy, because the trees can be tapped according to immediate monetary needs rather than according to market demand (farmers often describe rubber agroforests as their 'rubber bank'). But in terms of economic returns, they do not stand comparison with oil palm or clonal rubber monospecific plantations. Therefore, improving the economic performance of agroforests is a *sine qua non* condition to their preservation. But how can a relatively extensive system be improved other than by way of intensification? Research centres including World Agroforestry Centre and non-governmental organisations (NGOs) have been seeking alternatives to the disappearance of agroforests through productivity improvement while still maintaining species complexity. For example, the introduction of improved rubber clones in agroforests has been popularised, but the higher plantation establishment cost discourages smallholders from the adoption of this practice. Whatever the success of clonal rubber plantations will be, the plantations will probably not be completely monospecific. Some aspects of agroforests will survive. Examples abound of farmers diverting the innovations of rubber development proposed by government projects in a way more in line with their agroforest practices. Some have planted other tree species inside project plantations, some have introduced improved clonal rubber seedlings (GT 1 or PB 260) collected in the plantations into agroforests, and some have tried direct grafting of clonal material in the field (Chambon 2001). In a survey conducted in West Kalimantan, about 40% of the farmers in rubber estate projects had introduced other trees inside their rubber plots (Chambon 2001).

Increasing the present productivity of agroforests implies greater labour input in order to clean the plots of weeds, to favour more profitable species over less profitable ones and to replace old and no longer productive trees with new high-yielding seedlings. In short,

intensification would progressively convert complex agroforests into more simple systems and perhaps eventually to monospecific plantations (Levang 1991). If conversion to monoculture is the ultimate goal, it would be much more efficient to plant directly clonal rubber plantations to replace the oldest unproductive agroforests. Most often only the cost of improved seedlings and other inputs during the first stages of the plantation hold back the farmers from doing so. Local governments already promote clonal rubber plantations through various schemes, providing free or subsidised planting material and fertiliser or easier access to credit and technical information.

Oil Palm as a New Challenger (1980-present)

New market opportunities and the instability of rubber prices lead farmers towards diversification of their income sources. The Asian financial crisis of 1997, which led to reduced prices of natural rubber on the international market and volatility of the Indonesian rupiah, was a strong incentive to diversification. Agroforests were considered a valuable alternative, but also new crops were developed (including oil palm) as well as off-farm activities. The disengagement of the state after the crisis meant the end of all large agricultural development projects organised by the national Indonesian government and the official end of the transmigration program (De Koninck 2005). With regional autonomy being implemented in 2000, provincial and district governments inherited control of land and natural resources. They immediately favoured the expansion of large private oil palm companies by granting them huge concessions, often encroaching on state forest land or agroforest smallholdings. For instance, the governor of Jambi announced plans to develop 1 M ha of oil palm in the province by 2005 (Nurrochmat 2005).

Well-established traditions do not resist the introduction of a new interesting crop, but try to adapt its cultivation to local norms and needs. Oil palm was introduced in Sumatra in 1911, not long after rubber. In 2008 Indonesia surpassed Malaysia and became the world's largest producer of palm oil, with 15.6 M tons on 4.58 M ha (FAO 2008). Large companies increasingly see their monopoly challenged by the development of smallholder plantations. Farmers try integrating oil palm into their own cropping practices, especially agroforestry, applying less fertiliser and chemicals. They favour a less intensive cropping system and associate oil palm with several other perennial crops. This tendency to revive ancient agroforestry practices should not be viewed as a desperate way to hold on to outdated traditions, but rather as a reflection of the innovative spirit and abilities of Jambi farmers. By integrating oil palm into their existing farming systems and adapting techniques to their constraints, objectives and knowledge, farmers make it their own and reinvent the odl tradition of agroforestry.

Oil palm companies recently found new ways to reduce their land acquisition costs and to avoid recurrent conflicts with farmers over land ownership. Nowadays oil palm companies offer turnkey solutions to farmers who officially own their land (and have certificates to prove it) on condition of the company's monopoly on the harvest. People entrust their land to the companies, which plant, manage and harvest the plantation. Landowners are paid a percentage of the harvest revenue after deduction of plantation establishment and management costs (Casson 2000). Local government participates in the process by making cadastral registration of the land, but this is not a free service and adds to farmers' debts. A bank is also a partner in the process, offering credit to farmers with the companies vouching for the farmers' loans. Another option for local people is to buy an already developed plantation from a company. This new investment opportunity has a tremendous impact on

local perceptions. Farmers were used to switching from one commodity to another, or from agricultural to off-farm activities, exploiting their natural resources, their land or their labour. Now they are offered the totally new opportunity of exploiting their funds by investing into share cropping schemes with oil palm companies, in which they as landowners will only have to wait for the monthly result of their plantations, which are fully managed by the companies. Many smallholders' oil palm plantations are located not in the village of origin of the investor but at a distance (often in another district). Preferred locations are far away from the village but close to a trustworthy relative. The latter enables the plantation owner to keep an eye on his investment; the former allows him discretion in order to escape his social responsibilities. Indeed, social pressure is high for wealth sharing among close relatives and for social spending to the benefit of the poor, the disabled, the young and the elderly in the neighbourhood. Increasing individualism causes erosion of reciprocity. Owning plantations far from the village allows one to escape traditional wealth sharing.

Conclusion: Only Market Incentives Can Save Agroforests

While global markets clearly favour the more 'modern' model of monospecific plantations, the champions of agroforests object to this model. Those calling for the maintenance of agroforests point to the local knowledge on which they are based. The defenders of local knowledge are seldom locals, but more frequently foreign scientists and NGO activists. Where farmers tend to place priority on income generation, activists pinpoint the trade-offs associated with conversion out of agroforests. Indeed agroforests present many advantages relative to monospecific plantations: low costs of establishment and maintenance are tantamount to limited financial risks; low labour requirements allow more free time; monospecificity increases risks of pests; economic specialisation increases risks in relation to price declines (Levang 1991; Ashley *et al*. 2006). For all these reasons, only the richest farmers develop monospecific plantations, what in turn reinforces social differentiation. Oil palm development is unlikely to come to an end, because it is far too financially attractive for all the stakeholders, from small landowner to large companies as well as the international community, which is demanding palm oil (Sandker *et al*. 2007).

Nowadays the international community is growing more and more concerned with environment and biodiversity conservation. International institutions have launched programs to promote sustainable land use and environment protection. Local people would probably welcome programs of environment conservation, provided they generate as much return to land and labour as their alternative (e.g. oil palm plantations). Numerous projects are tested to conserve forests all around the world, but in Jambi intensification is happening rapidly and the remaining forests are protected only by their difficult access. It is a challenge and race against time to safeguard them.

Programs of environmental conservation have to deal with oil palm development in the district, and should favour participation of all the stakeholders in the search for a consensus that combines environment preservation and economic development. There is, it is hoped, still time to propose schemes of eco-certification (of natural rubber as well as of palm oil) and restrictions on land use to avoid the degradation of all agroforests and remaining forests. The Alternative to Slash and Burn partnership for the humid forest margins has shown that human-dominated landscapes in the humid tropics are associated with a wide range of environmental services, with multi-strata agroforestry systems generating much higher levels of environmental services than secondary forests or forest plantations, although clearly lower than primary forests (Tomich *et al*. 2004). These characteristics of agroforests could be

valorised by the implementation of projects that reduce carbon emissions from deforestation and forest degradation to reach the goal of an ideal landscape that provides environmental and financial benefits to all stakeholders (Angelsen 2008).

The history of rubber agroforest development in Jambi is an account of local people's ability to quickly respond to economic incentives and new opportunities. Local communities constantly try to adapt local realities to global changes (Ruiz-Perez *et al*. 2004). When prices of forest products collected from the wild peaked, these forests resources were overexploited and soon faced depletion. Collectors found a way to domesticate the wild resource by introducing it into the agricultural sphere, through the invention of agroforests. In some cases agroforests preserved the resource from vanishing (e.g. *Shorea javanica*, used for resin production), while in others the introduction of an exotic species (*Hevea brasiliensis*) replaced the resources collected from the wild (e.g. from *Dyera, Palaquium* and *Ficus* species) (Michon 2005). In neither case did local people preserve the primary forest. Rather, they participated actively in converting natural forests into agroforests. One might argue that agroforests preserve more biodiversity than monospecific plantations. That outcome has been far from intentional, however. Smallholders at best adapted to the scarcity of labour (and financial capital) compared with the abundance of forests. Nowadays conditions have changed in that forests are no longer abundant and farmers have more labour and capital at their disposal. Perceptions change, traditions evolve. Farmers, however, are still attached to their rubber agroforests, especially aged traditional ones. Rubber cropping is an intricate part of the local way of life. Rubber is tapped every morning and a tree can produce for more than 30 years. Rubber cultivation is more than the production of a commodity, it is a cultural token. Rather than abandoning rubber for another commodity, farmers will try to combine the new activity with rubber production. This is often the case for oil palm, mainly planted by traditional rubber producers. Will agroforests adapt to evolving global conditions or disappear? The dominant model of the future will probably be neither monoculture plantations nor agroforests, but a mixture of the two. The landscape will evolve into a mosaic of diversified plantations, with some plots of agroforests integrating the diversity in a unique space.

During the last 10 years, the demand for palm oil and natural rubber has constantly increased. Recently, speculation about increasing demand induced peak prices and put pressure on governments and farmers to convert the last patches of forests and agroforests into high-yielding rubber plantations. The present global economic crisis may somehow slow down this tendency. Natural rubber and crude palm oil prices plummeted during the second half of 2008. However, the lack of alternatives and smallholders' unfailing confidence in well-known commodities will probably drive local communities to carry on planting. One outcome of the crisis may also be a partial revival of agroforestry practices as a risk-reducing strategy in a period of economic uncertainty. In the long run, unless carbon trading becomes reality, rubber agroforests will continue to give way to more profitable monoculture plantations.

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