Chapter 10

Policy options to reduce deforestation

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- Four types of policies could reduce deforestation: policies to depress agricultural rent, policies to increase and capture forest rent, policies that directly regulate land use, and cross-sector policies that underpin the first three.
- While payments for environmental services (PES) have clear advantages, in the early stages of REDD+ implementation, broader policies which address underlying causes are more feasible and likely to be more successful.
- REDD+ is a new direction in forest conservation. This means that countries need to take into account research on deforestation, and lessons learned from previous forest conservation policies, when developing national REDD+ strategies.

Introduction

A key feature of REDD+ provides incentives and compensation to forest managers (carbon rights holders) to reduce deforestation through payments for environmental services (PES). However, full-scale implementation of a PES system faces a number of obstacles: unclear and contested land rights,

inadequate monitoring, reporting and validation (MRV), inadequate administrative capacity, poor governance, corruption, and so on. Since reducing emissions from deforestation (RED) was launched at COP-11 in 2005, it has become increasingly clear that to successfully implement REDD+, governments need to put in place a broad set of policies that go well beyond PES.

The first step in designing and implementing forest conservation polices is to understand the causes of deforestation. This chapter analyses deforestation in the framework of the von Thünen land rent model that assumes that people use land in a way that brings them the highest land rent (surplus). Farmers, companies and other land users deforest land because non-forest uses such as agriculture, is more profitable (has a higher rent) than using the land for forests.

Within the land rent framework four sets of policies could reduce deforestation: policies to bring down agricultural rents at the forest frontier; policies to boost and capture forest rents; policies that directly regulate land use (for example, that protect forest and regulate land use planning); and cross-cutting policies, such as good governance and decentralisation. This chapter gives a broad overview of these policies in the framework of the land rent model. Several of the policy options are discussed further in subsequent chapters.

Frameworks for understanding deforestation

Hierarchy of causes

One framework for understanding deforestation distinguishes between causes at different levels, as shown in Figure 10.1 (Angelsen and Kaimowitz 1999). At one level are the *sources* of deforestation, i.e., the agents (individuals, households or companies) responsible for clearing the forest.[1] The main agents of deforestation are subsistence farmers practising shifting cultivation, cash crop smallholders and large companies that clear land for crops and cattle. Together, these account for three-quarters of all tropical deforestation (IPCC 2007).

At another level are the prices, access to markets, agricultural technologies, agro-ecological conditions and so on that influence the choices made by these agents of deforestation. These decision parameters constitute the *immediate or direct causes* of deforestation. At a third level, these decision parameters are in turn affected by broader national and international policies,[2] the *underlying causes* of deforestation.

1 The terms used in the literature are far from uniform. 'Proximate causes' is sometimes used for the immediate or direct causes, while the term 'drivers' is used for both agents and underlying causes.

2 For the sake of simplicity, Figure 10.1 implies that causal effects flow in only one direction. But important effects also flow in the opposite direction. For example, agents will make decisions that have important feedback effects on market prices (general equilibrium effects). Agents' collective actions, political pressure and demographic behaviour also affect underlying causes.

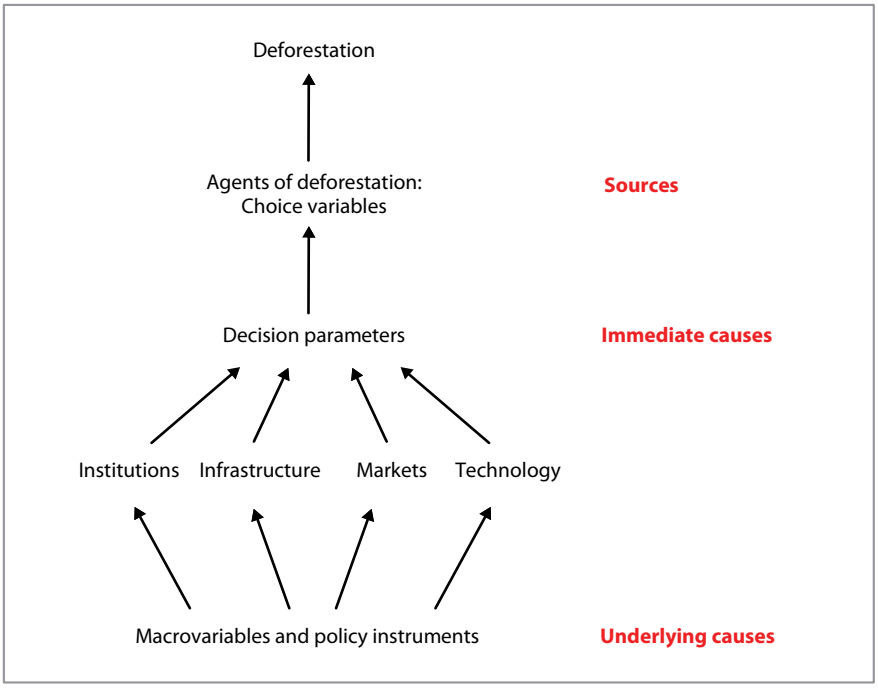

Figure 10.1. Sources, immediate causes and underlying causes of deforestation
Source: Angelsen and Kaimowitz (1999)

In this framework, policies to reduce deforestation would address the decision parameters by restructuring markets, disseminating new technologies and information, and developing infrastructure and institutions. These policies would change the way agents use land. The next section analyses these policies in the framework of the von Thünen land rent model.

Land rent (von Thünen model)

The economics of land use assume that *land is allocated to the use with the highest land rent* (surplus or profit). A number of factors, many directly or indirectly dependent on location, such as crop prices, labour costs and accessibility, determine the rent for different land uses. A key aspect of location is remoteness, as measured by the distance to markets or cities. The von Thünen model shows how land rent – as determined by distance from a commercial centre (markets) – shapes land use.

The von Thünen model is a key to understanding deforestation (Box 10.1). When applied to two land uses, agriculture and forest, the model shows that anything that makes agriculture more profitable stimulates deforestation. Anything that makes forests more profitable (brings higher forest rent) has the opposite effect. Calculating the forest rent is, however, more complicated than calculating the agricultural rent because property rights are often unclear

Box 10.1. The land rent model from von Thünen

Farmers, companies and other land users deforest because nonforest uses are more profitable (i.e., have a higher rent) than forest uses. A key determinant of land rents is location, most typically measured by the distance to markets or cities. This is the approach proposed by Johann von Thünen in 1826 (von Thünen 1966), when he asked: 'Under these conditions what kind of agriculture will develop and how will the distance to the city affect the use of land if this is chosen with the utmost rationality?'

As an analytical simplification, consider a model where land has only two uses, agriculture and forest (Angelsen 2007). First, we can define the land rent as:

$$r_a = p_a y_a - w l_a - q k_a - v_a d$$

Agricultural production per ha (yield) is given (y_a). Output is sold in a central market at a given price (p_a). The labour (l_a) and capital (k_a) required per ha are fixed, with input prices being the wage (w) and annual costs of capital (q). Transportation costs are the product of costs per km (v_a) and distance from the centre (d). The rent declines with distance, and the agricultural frontier is where agricultural expansion is no longer profitable, i.e., where $r_a = 0$.

Thus, the frontier is defined at:

$$d = \frac{p_a y_a - w l_a - q k_a}{v_a}$$

This model is illustrated in Figure 10.2 and yields several key insights into *the immediate causes* of deforestation. If we ignore forest rent, deforestation will take place up to the distance A. Higher output prices, and technologies that increase yields or reduce input costs, make expansion more attractive, i.e., they move the agricultural rent curve to the right. Lower costs of capital in the form of better access to credit and lower interest rates pull in the same direction. Higher wages work in the opposite direction. Reduced access costs (v_a), for example, new or better roads, also provide a stimulus for deforestation. A survey of more than 140 economic models of deforestation finds a broad consensus on three immediate causes of deforestation; higher agricultural prices, more and better roads and low wages coupled with a shortage of off-farm employment opportunities (Angelsen and Kaimowitz 1999; Kaimowitz and Angelsen 1998).

Forest rent can be defined as:

$$r_f = (p_t y_t - w l_t - q k_t - v_t d) + p_l y_l + p_g y_g$$

We distinguish between three types of rent. First, there is *extractive* forest rent for forest products, such as timber and non-timber forest products. This is similar to agricultural rent and expressed within the brackets. Second, there is *local protective* forest rent ($p_l y_l$), which is the local public goods that standing forests provide, such as water catchment and pollination services. Third, there is *global protective* forest rent ($p_g y_g$), which is the provision of global public goods, such as carbon sequestration and storage, and maintaining biodiversity.

Forest rent is not necessarily taken into account by agents of deforestation. In open access situations, without any *de facto* property rights to forests, no forest rent will be taken into account. (Point A in Figure 10.2). In a system with private property, the extractive forest rent is incorporated (Point B). Community forest management (CFM) should, in principle, include the local protective forest rent (Point C). If local land users also receive payments for environmental services (PES), and capture global protective forest rent, this combination could reduce deforestation even further (Point D).

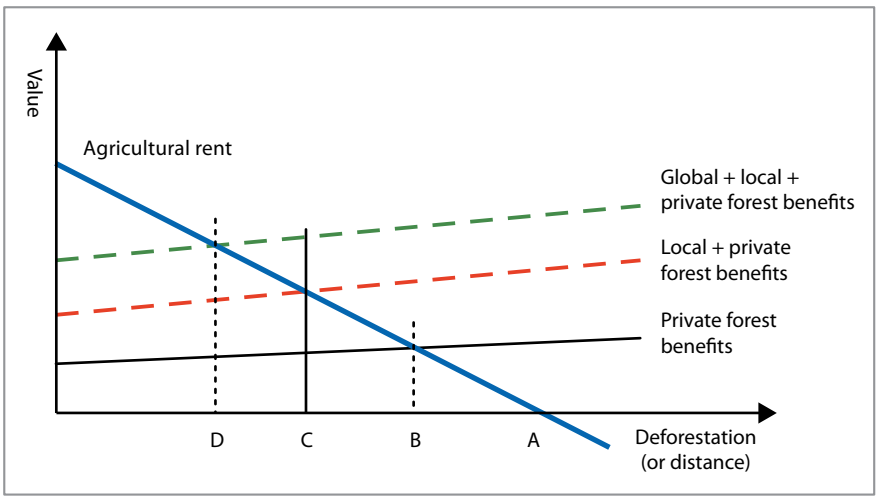

Figure 10.2. Agricultural and forest rents

and because key elements of the forest rent, such as environmental services (including carbon sequestration and storage) provided by forests, are considered public goods. Thus when making decisions about forest conversion, it is more important to explore how the forest rent should be captured by land users than it is to determine the actual forest rent.

Agricultural policies to reduce deforestation

Reduce agricultural rent

Understanding agricultural rent is critical to understanding deforestation rates. Keeping agricultural rents low can be very effective in saving forests. This has been called 'the "improved Gabonese recipe" for forest conservation' (Wunder 2003). The main ingredients of this recipe are heavy taxes on export crops and neglect of rural roads and support to smallholders. Such policies run counter to mainstream policy recommendations for agricultural and rural development (World Bank 2007), and conflict with the objectives of reducing poverty and increasing agricultural production. They are blunt policy instruments with perverse side effects (Kaimowitz *et al.* 1998). They also are likely to be politically controversial, although for decades policies have had a strong bias against rural development and agriculture in many poor countries in an attempt to keep urban food prices low (Krueger *et al.* 1988).

Agricultural rent can be lowered by raising the opportunity cost of labour (better employment opportunities off-farm). Forest cover in a country might, over time, go through forest transition (see Box 1.2). Better off-farm wages, and employment opportunities that pull labour out of agriculture, can be major drivers of a transition to stable forest cover and are often referred to as 'the economic development path' (Rudel *et al.* 2005). Economic development is, however, not a policy instrument, but the aggregate outcome of, amongst other things, a basket of policies. Targeted policies can stimulate nonfarm employment in rural areas, but they do not guarantee forest conservation. Although higher nonagricultural incomes will tend to pull labour out of extensive agriculture, the higher wages earned might be invested in ventures that deplete forests, such as cattle ranching (Vosti *et al.* 2001). Win-win outcomes seem more likely in labour-intensive than in capital-intensive agricultural systems (Angelsen and Kaimowitz 2001). In the latter, any stimulus to the local economy will help relax capital constraints that currently slow otherwise profitable agricultural expansion.

Support intensive agriculture and technological change

An important extension of the von Thünen model distinguishes between intensive (lowland) and extensive (upland or frontier) agriculture, where 'intensive' is understood to mean intensive in productive inputs other than

land. Spatially targeted policies to stimulate intensive agriculture can be an effective forest conservation policy. The logic is similar to that for off-farm employment. By making the alternatives to extensive agriculture more attractive, labour is pulled out of deforesting activities. For example, better small-scale irrigation systems in the Philippines pushed up demand for labour, boosted wages and pulled labour out of extensive agriculture. More and better paid jobs in lowland agriculture nearly halved the rate of upland forest clearance (Shively 2001; Shively and Pagiola 2004). Adding to this, higher productivity in the intensive sector can push domestic agricultural prices down, further reducing the agricultural rent of extensive agriculture and thereby deforestation rates (Jayasuriya 2001).

Policies to intensify agriculture in specific areas are discussed in depth by Rudel in Chapter 15 under a new term: reduced emissions agricultural policy (REAP). They include credit programmes, subsidised fertilisers and seeds, assistance in marketing and agricultural extension programmes.

Although these policies might reduce deforestation, there is no guarantee. If the main crop is traded internationally, an increase in supply may only have a small effect on the price that farmers get for their produce. If policies save labour or encourage technological change, the pull effect on labour may be weak or even negative (Angelsen and Kaimowitz 2001). In addition, higher profits in intensive agriculture could be invested in clearing more forest for extensive crops and cattle production. This happened in Sulawesi, Indonesia, in the 1990s. Mechanisation of lowland rice freed up labour and produced more rice, and the profits were used to expand cocoa cultivation in forested uplands (Ruf 2001).

Ignore extensive agriculture?

Policies stimulating intensive agriculture in certain areas might ignore agriculture in remote forest areas where poverty rates are typically higher (Sunderlin *et al*. 2008b). Is it possible to raise productivity, boost output prices by improving access to markets, and support extensive agriculture without increasing deforestation? A summary of more than a dozen studies on the effect of technological changes on tropical deforestation (Angelsen and Kaimowitz 2001) concluded that 'tradeoffs and win-lose between forest conservation and technological progress in agriculture in areas near forests appear to be the rule rather than the exception'.

Certain technologies and market conditions may produce win-win outcomes. New labour-intensive or capital-intensive technologies could slow rates of deforestation and increase profits. Most farmers have labour or capital constraints and could be expected to adopt technologies that save labour or

Table 10.1. Policies to reduce deforestation

Policy	Effectiveness of forest conservation	Direct costs of policy (efficiency)	Effect on inequality or poverty	Political viability
1. Reduce (extensive) agriculture rent				
Depress agricultural prices	High	Negative	Negative	Low
Create off-farm opportunities	High	Medium – high	Neutral – positive	High
Support intensive agricultural sector	Moderate – high	High	Uncertain	High
Selectively support extensive agriculture	Uncertain – moderate	High	Positive	Moderate
Ignore extensive road building	High	Negative	Negative	Low – moderate
Secure property rights	Uncertain	Medium	Uncertain	Moderate – high
2. Increase forest rent and its capture				
Higher prices for forest products	Moderate	Low	Positive – uncertain	Moderate
CFM – capture local public goods	Moderate	Low – medium	Positive	Moderate
PES – capture global public goods	Potentially high	Medium – high	Uncertain – positive	Moderate – high
3. Protected areas	Moderate – high	Medium	Uncertain	Moderate
4. Cross cutting policies				
Good governance	Low – moderate direct effects	Low or even negative	Positive	High
Decentralisation	Low – moderate direct effects	Low – medium	Positive	High

capital. But, with some important exceptions, we are *not* likely to get the kind of technological change that would save the forests (Angelsen and Kaimowitz 2001). For example, it is technically possible to make more intensive use of pastures throughout Latin America, but farmers typically do not do this until there is no more forest to be cleared (Kaimowitz and Angelsen 2008). This confirms Boserup's (1965) hypothesis that farmers will exploit the extensive margin before they exploit the intensive one.

A more likely win-win way to help farmers in remote areas would be in situations where they are involved in both intensive and extensive production systems side by side, and the extensive system being the principal source of deforestation. In Zambia, high-yielding maize varieties introduced in the 1970s lessened the need for extensive shifting cultivation and slowed down deforestation (Holden 2001). Similarly, more recent and widely adopted programmes on 'conservation agriculture' in the country have the potential to reduce the pressure on natural forests (Ibrekk and Studsrød 2009).

Roads

Constructing new roads or improving existing ones opens up new areas, brings down transport costs, makes markets more accessible and makes deforesting activities more profitable. In general, improving roads and infrastructure is a main cause of deforestation. This led Eneas Salati, a respected Brazilian scientist, to conclude, 'The best thing you could do for the Amazon is to bomb all the roads' (cited in Laurance 2009).

Roads are particularly important in the early stages of forest transition as they open up new areas (Weinhold and Reis 2008). In later stages, in a best-case scenario, roads encourage agricultural intensification and economic development that lessen pressure on forests, and provide incentives (such as opportunities for tourism) to manage forests better and the means to do so, namely better access. Further, the role of the state in building roads, and in other large-scale undertakings such as colonisation programmes, has weakened since the 1980s (Rudel 2007). Still, no forest conservation policy can be considered comprehensive unless it provides clear guidelines on transport infrastructure.

Reform tenure

An analysis of the effects of property rights (to agricultural land) on deforestation must distinguish between exogenous and endogenous tenure (Angelsen 2007). If exogenous, the question is, What is the impact of insecure tenure on deforestation? If endogenous, the question is, How do the actions of land users to secure tenure affect deforestation?

The effect of *exogenous* tenure insecurity on deforestation in an extended von Thünen model is straightforward: a land user will invest by clearing more forest and converting it to agriculture (Angelsen 1999; Araujoa *et al*. 2009). This is the opposite of what is commonly assumed. Insecure tenure should slow deforestation whereas more secure tenure should increase the value of the investment and encourage forest clearing. Forest protection is, from a societal perspective, an investment for the future. In contrast, from the individual's point of view, deforestation is an investment in future income.

As usual, the reality is more complex. For example, in a shifting cultivation system, security of tenure varies depending on the stage in the cultivation cycle. Farmers may have fairly secure tenure over plots they are currently cultivating, but weak tenure for fallow plots. The longer the plot has been fallow the less secure the tenure, which may lead to inefficient, short fallows (Goldstein and Udry 2008). Moreover, insecure tenure means farmers invest less in the land and exhaust the soil more quickly which, increasing in turn the need or the incentives to cut down more forest to replace degraded land. This is the 'land degradation-deforestation hypothesis' (Angelsen and Kaimowitz 2001), but is only valid under certain assumptions about behaviour and markets (Angelsen 1999).

The effect of *endogenous* tenure is that land users act to make tenure more secure. Forest conversion, according to both customary and statutory law, often establishes or strengthens existing land rights. Deforestation therefore becomes a way to establish title. This could lead to a 'land race' or 'race to the frontier', where forest is cleared in order to establish property rights. This is particularly the case in the Amazon, where clearing strengthens claims by landowners and squatters in conflict (Araujo *et al*. 2009).

Policies to increase and capture forest rent

Increasing forest rent over time is the second way to protect them: 'the forest scarcity path' of the forest transition (Rudel *et al*. 2005). High demand and a limited supply of forest products stimulate stabilisation of forest cover and regrowth. Policies can influence forest rent in similar ways to agricultural rent, e.g., through taxes and marketing arrangements that affect the prices of timber and other forest products, or by promoting new technologies. While historically this path has been driven by forest extractive rent (rent from forest products), the fundamental idea of REDD+ is to stimulate forest cover stabilisation through an increase in the protective rent (rent from environmental services). An increase in forest rent, however, will not affect deforestation unless land users can capture a share (and include it in deciding how to use land). There are two main ways of 'internalising the externalities' for optimal forest use: by moving decisions to a greater scale

at which the effects are occurring and therefore can be incorporated, and by creating a market for the public good (i.e., environmental services provided by standing forests).

Large tracts of tropical forests are characterised by weak, unclear and contested property rights, making them *de facto* open access (Sunderlin *et al*. 2008a, see also Chapter 11). In these areas land users have no economic incentive to factor forest rent into their decisions about forest conversion. A higher extractive forest rent will not, in itself, affect agricultural expansion. But, better infrastructure and roads lead to more logging, and often logging and expansion of agricultural land go together (Geist and Lambin 2002). If we also consider forest degradation, higher timber prices might lead both to more intensive logging in production forests and to an expansion of the area being logged (Amsberg 1998).

In a context of private property rights to the forest land, a higher forest extractive rent implies more forest will remain (Figure 10.2). But if we take degradation and changes in overall forest carbon stocks into account, the effects are more complicated. In general, higher timber prices will shorten the rotation period and therefore reduce the average carbon stock.

Assigning individual property rights to forest is often put forward as a solution to excessive deforestation. Individual property rights alone will not solve the problem of local and global externalities, but clear and secure property rights, either at the individual or the community level, are a necessary to establish PES systems. They will also encourage more sustainable management of forests compared with an open access regime, with positive effects on degradation and carbon emissions.

Community forest management (CFM) moves decisions from the individual to the community to compensate for negative externalities from deforestation (C in Figure 10.2). The success of CFM depends on the ability of the community 1) to make decisions that take account of externalities, and 2) to enforce the rules effectively among members and to exclude outsiders. Chapter 16 reviews experiences with CFM, and the lessons that need to be carried forward into the REDD+ debate.

The key proposal in the REDD+ debate is to create a multilevel (global–national–local) PES system for carbon sequestration and carbon storage in forests (Angelsen 2008b). The PES experiences and challenges are reviewed in Chapter 17. PES systems assume that tenure, MRV, administrative capacity, governance, corruption and so on have been addressed. But in most deforestation hotspots, land rights are unclear, overlapping and contested. This means that it will be more difficult to use PES as the main instrument

to achieve REDD+ than policy makers commonly assume. In the short to medium term, national REDD+ strategies will have to rely heavily on policies other than PES.

Protected areas (PAs)

Forest protected areas (PAs) in IUCN categories 1 to 6 make up 13.5% of the world's forests (Schmitt *et al.* 2009), the share being significantly higher (20.8%) in rainforests. Chapter 18 reviews experiences with PAs and integrated conservation and development programmes (ICDPs) and their effectiveness. A key question is whether PAs do in fact protect forest. There is broad consensus in the literature that the degree of protection is not 100%, but that rates of deforestation within PAs are lower than outside. This is still true after controlling for 'passive protection', that is, allowing for the fact that PAs are often located in remote areas with less pressure on forest (Bruner *et al.* 2001; DeFries *et al.* 2005). Recent studies also attempt to estimate spillovers or 'neighbourhood leakage', i.e., where deforestation activities shift from inside to outside the PAs. Studies from Costa Rica (Andam *et al.* 2008) and Sumatra (Gaveau *et al.* 2009) find these effects to be small, and not easy to detect (See Box 22.2).

Studies have also shown significantly less deforestation in various types of protected areas in the Amazon (parks, indigenous lands, extractive reserves and national forests). Indigenous lands account for one-fifth of the Brazilian Amazon. Nepstad *et al.* (2006) find the inhibitory effect (the deforestation ratio between 10 km wide strips of land outside and inside the PA border) for the period between 1997 and 2000 to be 8.2. These and other results reviewed by the World Bank suggest that 'protected areas may be more effective than is commonly thought' (Chomitz *et al.* 2007).

Cross-sector policies

Poor governance, including corruption, affects forest conservation in several ways, as discussed in Chapter 13. Corruption at high political level, often called 'grand corruption', directly affects the design of policies. Timber politics in South Asia involve not only rent seeking, but also rent creating, i.e., actively manipulating the rules to generate benefits for powerful groups (Ross 2001). The land use planning process is potentially a strong tool for forest conservation, but is also susceptible to manipulation by dominant individuals and groups (Chapter 13).

Corruption will, in general, weaken policies seeking to conserve forests. Petty corruption abounds in the forestry sector in the form of bribing local officials to ignore violations of forest regulations, harvesting timber without legal

permits (Smith *et al*. 2003a) and harvesting outside concession boundaries (Friends of the Earth 2009). But corruption may in some cases also slow deforestation and degradation, for example, bribes to allow illegal harvesting could be a deterrent 'tax' which makes harvesting less profitable and so reduce harvesting rates.

Similarly, decentralisation of forest governance, discussed at length in Chapter 14, is not a straightforward recipe for reducing deforestation and forest degradation. Some decentralisation reforms have had positive results on deforestation while others have had the opposite effect. Decentralisation, like CFM, could help deal with the negative local externalities of deforestation and degradation, and encourage more forest conservation. But, it is often the extractive activities (logging) that boost local incomes, thus outcomes can be mixed.

Decentralisation may be a way to implement other REDD+ policies more effectively, efficiently and equitably. By 'bringing the state closer to the people', decentralisation can increase local participation and build social capital (World Bank 1997). However, as concluded in Chapter 14, forestry decentralisation has in the past often been weakly or partially implemented, and under inequitable rules of participation and power sharing, although REDD+ has the potential to change this.

Selecting policies

Research on the underlying causes of deforestation (UCD) in the past 25 years has found that broad societal forces and nonforestry policies play a critical role (Kanninen *et al.* 2007). Thus, much of the focus has been on the causes shown in the lower half of Figure 10.1. The REDD+ debate so far has taken a different approach, namely to provide direct incentives and compensation to the actors (i.e., a PES or PES-like approach). The focus has shifted to the upper part of Figure 10.1.

There are several advantages in a PES-like approach. In general, targeting a problem directly is the most effective and efficient option. This also makes sure that those who lose out from forest conservation will be compensated for the opportunity costs. PES-like systems are also less likely to conflict with other policy goals.

But, as noted in this chapter and elsewhere in this book (particularly Chapter 17), there are a number of challenges in establishing PES systems. This means that direct payments to farmers and other forest users are unlikely to become the main REDD+ policy in the short to medium term in most countries. REDD+ policy makers should, therefore, think broadly and look

beyond the forestry sector. Some of the policies reviewed in this book can be very effective. They can also be relatively low cost, or in some cases even have negative costs such as when subsidies that encourage deforestation and degradation are removed.

Countries developing their REDD+ strategies should, therefore, consider a wide range of policies and take national circumstances into account. These include the particular agents and causes of deforestation, the stage in the forest transition, administrative capacity and previous experience with forest conservation policies. REDD+, with its strong emphasis on payment for performance, is in many ways a new game in town, at least at the national level. Yet, there is a significant risk that valuable lessons from previous policy interventions and from research on the causes of deforestation will be overlooked when designing REDD+ strategies and policies.