Options for REDD+ action: what are their effects on forests and people?

An introduction for stakeholders in Central Sulawesi



UN-REDD
PROGRAMME

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The UN-REDD Programme is the United Nations collaborative initiative on Reducing Emissions from Deforestation and forest Degradation (REDD+) in developing countries. The Programme was launched in 2008 and builds on the convening role and technical expertise of the Food and Agriculture Organization of the United Nations (FAO), the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP). The UN-REDD Programme supports nationally-led REDD+ processes and promotes the informed and meaningful involvement of all stakeholders, including Indigenous Peoples and other forest-dependent communities, in national and international REDD+ implementation.

The United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC) is the specialist biodiversity assessment centre of the United Nations Environment Programme (UNEP), the world's foremost intergovernmental environmental organisation. The Centre has been in operation for over 30 years, combining scientific research with practical policy advice.

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Cordula Epple and Julia Thorley

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Rainforest stream. Intact forest cover on slopes can help to regulate waterflow and reduce the risk of flooding in downstream areas. © Mark Edwards, Hard Rain Picture Library

1. Introduction

REDD+ (Reducing Emissions from Deforestation and forest Degradation plus conservation of forest carbon stocks, sustainable management of forests and enhancement of forest carbon stocks) is an approach to climate change mitigation that over the past 10 years has received increasing attention from policy-makers, forest managers and other groups with an interest in climate and forestry issues. The aim of REDD+ is to combat climate change by changing the way in which forest management and other land use activities are carried out. (See Box 1 for an explanation of the link between forests and climate change.) Putting REDD+ into practice can involve a broad range of actions, such as protecting the forest from fire or illegal logging, rehabilitating degraded forest areas or introducing new logging practices that cause less damage to vegetation and soils.

It is important for those who make decisions about REDD+ to bear in mind that any such actions will influence many different aspects of the forest, and can have significant effects on the forest environment and the lives of people living in, around and from the forest. Such effects can be positive as well as negative. This document explains some of the considerations that are important for choosing between different options for REDD+ action, and aims to assist decision-makers and stakeholders, including district-level governments and local communities, to assess the consequences of these choices. The information provided in this guide can help to support discussions with local communities and indigenous people and their full and effective participation in determining the type and location of REDD+ actions, as a basis for obtaining their Free, Prior and Informed Consent (FPIC) to plans for REDD+ implementation.

2. Background

2.1 The origins of REDD+

Country representatives from around the world have agreed at the Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) that a mechanism should be created that would allow developing countries to receive some form of support from developed countries when they undertake activities to mitigate climate change by reducing emissions from deforestation and forest degradation, conserving and enhancing forest carbon stocks and managing forests sustainably. While the details of the agreement are still under negotiation, many actors are already taking steps on a voluntary basis to assist preparations for REDD+ and the implementation of pilot REDD+ projects.

UNFCCC conference delegates negotiating in Durban, 2011. © Leila Mead/IISD

Box 1 Forests and climate change.

Our climate is strongly determined by the composition of the atmosphere, i.e. the layer of air that surrounds the planet. The atmosphere includes a number of gases that have a high capacity to absorb the warmth that is created by sunlight when it reaches the earth's surface, and prevent it from being reflected back into space. The higher the concentration of such greenhouse gases within the atmosphere, the larger the amount of the sun's heat that is retained close to the earth. One of these greenhouse gases is carbon dioxide, a gas that is formed when carbon-rich substances such as fossil fuels, but also wood and other parts of vegetation, are burned or broken down in other ways. Carbon dioxide is naturally present in the atmosphere, however its concentration has been greatly increased as a result of human activities. This is considered to be a cause of climate warming.

Tropical forests contain a very high amount of living and dead plant material both above ground and in the soil, and therefore represent one of the world's largest stores of carbon on land. Maintenance of the carbon reservoirs stored in forest ecosystems therefore plays a vital role in helping to slow the increase of carbon dioxide content in the atmosphere and regulate the global climate.

2.2 Who is involved in preparations for REDD+ in Indonesia?

The spectrum of actors involved in preparations for REDD+ in Indonesia includes the national government as well as province and district governments, agencies of the United Nations, multilateral and bilateral development institutions, national and international NGOs, academic bodies and universities, indigenous people and local communities and the private sector. Together, these actors are developing and testing the methods that will be required to plan, implement, monitor and reward REDD+ actions. They are also working to compile and create the information that is necessary to manage forests and their carbon stocks. Fundamental decisions on how to implement REDD+ in Indonesia, the establishment of a supportive legal framework, and the development of the National REDD+ Strategy are the responsibility of the national government. These national level preparations provide the starting point for provincial and district governments when they develop their own strategies for putting REDD+ into practice.

The UN-REDD Programme is one of several international initiatives that support countries in preparing for REDD+. It is carried out in collaboration between the Food and Agriculture Organization of the United Nations (FAO), the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP). Since 2010, the UN-REDD Programme in Indonesia has been implementing a series of activities to develop REDD+ methodologies and build capacity on REDD+ issues in Central Sulawesi following its selection as a pilot province. Capacity building in Central Sulawesi has involved a number of workshops engaging local REDD+ actors. These have resulted in the formation of the Central Sulawesi REDD+ Working Group, representing a wide range of stakeholders. In supporting REDD+ in Central Sulawesi, the REDD+ Working Group works with the local government through the Forestry Office of Central Sulawesi Province. The UN-REDD Programme Indonesia's national-level Programme Management Unit (PMU) is involved throughout the process of planning, implementation, and evaluation of activities proposed by the Group.

2.3 REDD+ and local communities

REDD+ actions are particularly relevant for indigenous people and local communities living in and around the forest, as they can affect the quality of their

Community in Central Sulawesi discusses UN-REDD plans. © YL Franky

Sulawesi herb garden including species from the forest. Medicinal and aromatic plants can be an important non-timber forest product, whether harvested directly from the forest or transplanted for domestic cultivation. © Ulf Narloch - UNEP-WCMC

environment and their livelihood opportunities positively or negatively, depending on how they are planned and implemented. At the same time, local communities can themselves be involved in REDD+, either by proposing and implementing activities of their own or as partners for external actors for whom their experience and knowledge of the forest can be highly valuable. Local communities can contribute to the planning and implementation of REDD+ actions, as well as to the required monitoring and reporting of REDD+ outcomes, and there is ample evidence from initiatives for community-based forest management to show that they can be very effective in such tasks. However, in order to achieve successful community involvement in REDD+, activities need to be planned in a way that is compatible with local needs and perceptions, and the roles, rights and responsibilities of all actors need to be clear. Ensuring the full and effective participation of indigenous people and local communities and clarifying land tenure and land use rights are therefore essential for the success of REDD+.

2.4 The multiple benefits of REDD+

When forests that would have been lost or degraded are retained or restored through REDD+, protection and enhancement of carbon stocks is not the only benefit. Other benefits linked to the improved condition of forests can include cleaner water and a lower risk of flood and drought, conservation of fertile soils, larger numbers of rare and threatened plant and animal species and a larger supply of non-timber forest products, as well as increased availability of forest-based job opportunities, livelihoods and income. REDD+ can also lead to wider social benefits through land tenure clarification, enhanced participation in decision-making and better governance. Together, these possible positive effects are often referred to as ‘the multiple benefits of REDD+’.

Various factors can affect the extent to which these benefits are delivered, including the type, location and condition of the forest involved, the type of REDD+ actions that are undertaken, how they are implemented, and the extent to which the local population depends on forest resources.

REDD+ actions will result in the greatest benefits if they are designed to suit local conditions. For example, certain actions are most suitable for implementation in forest areas with high environmental value, whilst the benefits yielded by others may be greatest near settlements or on degraded lands. Later sections of this guide include an explanation of where different types of REDD+ actions can and/or should be implemented.

2.5 Safeguards that support the achievement of multiple benefits from REDD+

A number of rules exist or are being developed that will need to be respected in the selection of REDD+ actions. Some of these rules can prevent harm and support the achievement of multiple benefits from REDD+. Existing national rules of this kind include legal provisions such as the specifications of the Forest Law with regard to permissible activities in forests of different functions. At the international level, the Conference of the Parties to the UNFCCC has agreed that countries should promote and support the Cancun Safeguards, which indicate amongst other things that REDD+ activities should be carried out with respect for the knowledge and rights of indigenous peoples and members of local communities and with the full and effective participation of relevant stakeholders, and that they should incentivize the protection and conservation of natural forests and their ecosystem services, and enhance other social and environmental benefits. The UN-REDD Programme has agreed a set of Social and Environmental Principles and Criteria that are intended to assist countries in developing a national approach to these safeguards.

The Government of Indonesia is taking the Cancun Safeguards as a starting point for the development of a national framework for the implementation of fiduciary, social and environmental REDD+ safeguards. Once this framework is in place, all actors who want to implement REDD+ activities will be required to take steps to ensure that risks are mitigated as part of the implementation process, through periodic monitoring, reporting and evaluation.

The information contained in this guide can help to assess whether planned or proposed REDD+ actions can be expected to support the protection and conservation of natural forests and their ecosystem services and to enhance other social and environmental benefits, thus indicating whether they are in line with the Cancun Safeguards.

3. Description of possible REDD+ actions and their effects on the different kinds of benefits that can be obtained from the forest

3.1 Overview

There is a range of different actions that can be undertaken to protect, restore and enhance the amount of carbon stored in forests. Following the typology used by the United Nations Framework Convention on Climate Change, REDD+ actions can be grouped into five types of 'activities':

- reducing emissions from deforestation
- reducing emissions from forest degradation
- conservation of forest carbon stocks
- sustainable management of forests
- enhancement of forest carbon stocks.

In practice, one and the same action can sometimes contribute to several UNFCCC 'activities'. For example, the introduction of new logging techniques that cause less damage to the forest can be part of the sustainable management of forests, as well as of reducing emissions from forest degradation.

The following sections of this chapter describe options for REDD+ action that can be applied in order to:

- limit the area of forest that is used for logging or converted to other land uses (as part of reducing emissions from deforestation, reducing emissions from forest degradation and conservation of carbon stocks)
- reduce damage to the forest from timber extraction and fire (as part of reducing emissions from forest degradation, managing forests sustainably and enhancing forest carbon stocks)
- rehabilitate degraded forest areas (as part of enhancing forest carbon stocks)
- increase the density of trees on non-forest land (as part of enhancing forest carbon stocks).

At the end of this chapter, a graphic overview summarizes the impacts of important types of REDD+ actions on multiple benefits and indicates the suitability of each action for implementation in different types of location (see charts 1 and 2). Options for action that are included in this overview are marked **in bold** in the text.

When selecting and planning REDD+ actions, it is also important to take into account the following three general principles:

1. It must be possible to measure the impact of the actions on carbon stocks. This is easier for large and visible changes (e.g. the re-establishment of forest on a large area of degraded land) than for small ones (e.g. a small increase in the density of trees in a forest that is used for timber extraction). Ease of measuring success can therefore be an important consideration when choosing REDD+ actions. One way to promote large and visible impacts of REDD+ can be to focus conservation measures on forest areas that are currently suffering high rates of conversion or damage, and to focus restoration measures on severely degraded areas.
2. The results of REDD+ actions must be "permanent" over the duration of the REDD+ project or programme (which is usually several decades). Decision-makers who are tasked with choosing REDD+ actions therefore need to consider the risk that the forest areas that have been maintained, restored or created under REDD+ will later be damaged as a result of human actions or natural events like fire or drought. Actions whose results have a high risk of being reversed should not be selected unless something can be done to combat this risk.
3. It must be ensured that the implementation of REDD+ actions in one area does not lead to the shifting of the activities causing forest conversion or damage to another area. In REDD+ terminology, this is often referred to as 'avoiding leakage'. For example, REDD+ will not be successful if the amount of timber cutting in one forest concession is reduced, but at the same time the amount of timber cutting is increased in another concession.

Sulawesi forest and area recently cleared for agriculture. © Ulf Narloch - UNEP-WCMC

To some degree, appropriate and effective land-use planning strategies can help to address these issues.

When REDD+ actions are implemented, appropriate monitoring is thus needed to show that the measures are successful, that the results are permanent and that shifting of land use does not cancel out the achieved carbon benefits. Changes in biodiversity and ecosystem services should also be monitored, as the knowledge gained can help to assess compliance with social and environmental safeguards, as well as to adjust management and improve future choices of REDD+ actions to achieve multiple benefits.

3.2 Options for limiting the forest area that is subject to land use change and timber extraction in order to reduce deforestation and forest degradation

One approach to reducing the rate of deforestation and forest degradation is to **maintain intact natural forest or forest with a low degree of disturbance** by limiting the area of forest that is used for timber extraction or converted to other land uses. This can be done both by limiting legal forest use and conversion (e.g. issuing fewer permits, stopping the issuance of permits in certain areas or providing incentives for permit holders to refrain from using or converting the forest), and by controlling illegal forest use and conversion.

Intact natural forest has the highest carbon content of all land use types and also provides the best protection for biodiversity, soil and water resources (see for example Box 2). The multiple benefits of maintaining forest are highest in areas that are important for biodiversity (e.g. areas where rare and endemic plant and animal species occur, such as the anoa, maleo or babirusa), and in areas where soil and water resources can easily be damaged by logging and forest conversion (e.g. on steep slopes and along river banks). The establishment of conservation areas and protection forest in areas that are important for biodiversity can help to preserve natural forest. Smaller-scale reserves interspersed with production forest can also form part of a sustainable approach to forest management (see section 3.3).

Maintaining natural forest can be a very cost-efficient approach for REDD+ because it often requires little investment other than identifying suitable areas, raising awareness and enforcing regulations. However, limiting the use of the forest area can restrict the income and livelihood opportunities of local communities and cause conflicts with other stakeholders (e.g. logging concessionaires). It can also lead to the displacement of forest use to other places. In order to balance this, plans for REDD+ that are based on maintaining forest should as a complement include the promotion of other income and livelihood opportunities. These additional actions will themselves have environmental or socio-economic impacts that need to be considered.

Box 2 Comparing the biodiversity benefits of natural forests and cacao agroforestry in Central Sulawesi.

A large number of scientific investigations have compared the biodiversity of natural forest and cacao agroforestry systems in Central Sulawesi. The groups of animals and plants that have been studied include birds, amphibians, reptiles, butterflies, bees, wasps, beetles, ants, trees, forest herbs and mosses. The studies reveal that total species numbers are high in both natural forest and cacao agroforestry. However, a large share of the typical forest species, including many endemic and threatened species, occur only in the forest and are unable to use the agroforestry areas as a habitat. As a result, transformation from near-primary forest to agroforestry has little effect on overall species richness, but reduces the richness of forest-using species by 60%. One can conclude that undisturbed rainforest areas are most important for the conservation of forest specialists and endemics but that cacao plantations, if managed to maintain a high and diverse cover of forest trees, can still provide a valuable habitat to native biodiversity. They are also likely to maintain important ecological functions, such as pollination and natural pest control. (Sources: Abrahamczyk *et al.* 2008, Bos *et al.* 2007, Cicuzza *et al.* 2011, Maas *et al.* 2009, Schulze *et al.* 2004, Steffan-Dewenter *et al.* 2007, Wanger *et al.* 2009; most of these studies have been carried out as part of the STORMA project).

Encouraging the **use of non-timber forest products** such as rattan, honey or agathis resin, or facilitating the generation of income from such products, can often help to improve local livelihoods if it is possible to use or create access to a suitable market. It can also increase local interest in maintaining the forest. If a range of non-timber forest products are sustainably extracted and marketed, forests can often provide greater economic benefit than if they are used exclusively for timber. The subsistence value of forest products can also be high for local communities. It is important to avoid the risk of overharvesting target species in order to prevent decline of the potential income, and to minimize negative impacts from harvesting on biodiversity, soil or water resources (see Box 3). As long as the rates of harvesting and the harvesting methods are sustainable, use of non-timber forest products normally has little impact on biodiversity and ecosystem services. One important way to ensure sustainable harvesting levels is to carry out monitoring of the resource, which is best undertaken by the users themselves.

The livelihood impacts of limiting forest use can also be balanced by promoting other alternative sources of income, such as tourism or the production of handicrafts.

Where agricultural expansion is the main driver of forest conversion, changing cultivation methods can be a way to balance the limitation of potential income when restrictions on conversion are imposed or enforced more strictly. There are two main options for doing this. One is to increase crop yields per hectare, the other is to switch to producing crops that provide higher profits.

The impacts of changing methods in agriculture depend very much on the baseline situation and the new methods that are introduced. To illustrate this, **intensification with high-input conventional methods** and **switching to organic agriculture** will be described as two scenarios. In practice, many intermediate forms exist between these two extremes. A third potential option for increasing

Box 3 Overharvesting – a serious threat to the supply of non-timber forest products.

A review of 70 case-studies that quantify the ecological effects of harvesting non-timber forest products from plant species (Ticktin 2004) warns that many non-timber forest products are currently harvested at high levels that are unlikely to be sustainable in the long term.

An example of the negative economic effects that can result from overharvesting has been provided by the use of wild rattan in Central Sulawesi. An analysis carried out between 1996 and 2000 showed that both the number and the length of harvestable canes was significantly lower in 2000 than in 1996. In fact, in 2000 there was less than half the amount of harvestable cane as recorded on the same plants in 1996, despite the fact that cane cutting stimulates new growth. The reduction in mean cane length reduced the returns of labour and required collectors to travel further into the forest. These trends are seen as a consequence of intensive harvesting activity (FAO 2002).

Reduced availability of non-timber forest products often has particularly negative impacts on poor communities. An analysis of the use of forest products in and around Lore Lindu National Park showed that such products are an important resource for the poorest third of the households, and contribute to 21% of their total household income. (Schwarze 2007) Achieving sustainability in the use of non-timber forest resources can therefore contribute to poverty reduction.

Rice fields near Lore Lindu National Park, Central Sulawesi. © Marion Mehring

agricultural income per hectare, agroforestry, is described later (see section 3.5).

Conventional methods for increasing agricultural productivity through intensification usually involve the cultivation of monocultures of high-yield varieties with high inputs of energy, fertilizer and agrochemicals such as pesticides and herbicides. While such cultivation systems can be successful at raising yields and producing more income, they require high initial investment and are rather susceptible to crop failure after extreme climate events or pest outbreaks. They also generally have negative impacts on biodiversity and soil and water quality, as well as on the climate. Greenhouse gas emissions are caused by the depletion of soil carbon stocks and the large energy demand for heavy machinery and the production of agrochemicals; this may reduce any climate change mitigation benefits achieved through forest conservation. More sustainable intensification can be achieved when the suitability of the site and the requirements of the crop are carefully considered, excess inputs are avoided and advanced methods for the control of pests and weeds are applied.

*Harvesting of honeycomb from Indonesian honey bees (*Apis dorsata binghami*), Sulawesi.* © Specialist Stock

In organic agriculture, efforts to increase yield usually focus on enhancing soil fertility through organic inputs and avoiding of intensive tillage, as well as on using site-adapted varieties of crops and minimizing use of agrochemicals. Organic agriculture therefore tends to have positive effects on soil carbon stocks and soil and water quality. Due to the lower application of agrochemicals, there is normally also a small benefit for biodiversity, including the biodiversity of adjacent streams and water bodies. Although organic farming requires specific skills and know-how, it is often more affordable for smallholder farmers and more robust against extreme events than high-input cultivation systems (see Box 4). Where access to premium markets is available, organic farming can provide higher profits than conventional agriculture.

Any kind of increase in agricultural productivity can potentially lead to increased conversion pressure. It is therefore extremely important to consider agriculture and forest use as linked systems and take account of potential impacts on both in planning actions.

3.3 Options for managing forest more sustainably in order to reduce forest degradation and enhance forest carbon stocks

Sustainable management of production forests that are used for timber extraction aims to ensure that management is carried out in such a way that the productivity of the forest and its environmental and socio-economic value will be maintained over the long term. Sustainable forest management can be a useful strategy for REDD+ because it minimises degradation of the forest in areas that would otherwise be treated less carefully. However, measuring the carbon gains or avoided losses of carbon through changes in forest management is normally more difficult than for REDD+ approaches based on forest conservation or forest restoration.

Minimum standards for ensuring the sustainability of forest use are required by the Indonesian legal framework on forestry, for example in regulations concerning the TPTI (selective cutting and planting) system. Stricter control and enforcement of these regulations can be a necessary first step to stop forest degradation. More demanding voluntary standards are used in forest certification, e.g. under the LEI or FSC certification standards. These involve a number of conditions on how the forest is managed, and in return for compliance allow the use of a

Box 4 Can low-input agriculture benefit poor farmers as well as the global climate?

Efficient low-input cultivation systems can be a way to reduce greenhouse gas emissions from agriculture. They may also have several advantages for poor farmers. In a review of case studies of organic farming and resource-conserving agriculture from around the world, Bennett and Franzel (2009) found that positive livelihood impacts of conversion to organic farming can potentially arise from three sources: increased yields, higher product prices and decreased costs. Whether these effects occur depends both on the initial farming system and access to markets. Yield increases are most likely where productivity is initially low due to lack of investment capital, know-how or purchased inputs. Higher prices tend to be achieved where farmers have access to export markets. Decreased costs and increased returns to labour could be found in both cases. On average, conventional farmers see their total variable costs decline when they change to low-input systems, because lower costs for material inputs more than offset the higher labour costs. Higher labour requirements can also have positive effects on the local economy through increased rural employment. Further, low-input systems often include avoiding of monocultures and diversification of crops. This can reduce vulnerability to price fluctuations and crop failure and increase income. Finally, increases in the quality of the environment, such as better water quality and healthier food, can lead to additional improvements in the well-being of communities (See also IFOAM 2009, Murniati *et al.* 2001, Tscharntke *et al.* 2012, Giovanucci 2007, Gardjito 2011).

However, the comparative advantages of organic or other sustainable forms of agriculture over conventional farming depend on the cropping system and local circumstances. For example, researchers investigating the potential of the System of Rice Intensification, a low-input method aimed at increasing rice harvests through higher labour input and use of organic fertilizer, found that in Indonesia the system was capable of raising the productivity of land, water, seeds, capital, and labor (Gardjito 2011). A study on traditional and intensified coconut farming systems in North Sulawesi (Waney and Tujuwale 2002) found that traditional technologies were far more successful than intensified systems with higher fertilizer and chemical inputs. By contrast, a study comparing more traditional, shade-grown cocoa production with intensified full-sun agroforestry in Central Sulawesi (Juhrbandt 2010) found that intensification was financially favourable, and that the main risks were related to long-term agronomical and ecological sustainability. In this case, the near-term financial interests of farmers may be at odds with efforts to make agriculture both more climate-friendly and more sustainable.

certification label that confirms that the wood and timber products have been produced in a responsible manner. This can make it possible to sell them at a higher price. Obtaining the necessary documentation for the certification process can be a challenge for small forest enterprises and managers of community forest, although some certification standards have introduced simplified procedures to make it easier for these groups to participate in the market.

A number of approaches can contribute to sustainable forest management. These include **reduced-impact logging techniques** that aim to limit damage to vegetation and soil during timber extraction, observing harvesting limits (e.g. only cutting trees of a certain diameter or only cutting a fixed amount of timber per hectare), designating 'buffer areas' so that trees are not cut in sensitive locations (e.g. on steep slopes and in riparian zones, to avoid soil erosion), supporting the regeneration of forest after cutting by assisting natural regeneration or through **enrichment planting**, and the establishment of small-scale conservation areas in areas that are important for biodiversity and rare or endemic species (see also section 3.2).

Reduced-impact logging techniques involve planning and controlling tree felling and extraction to minimize the impact of timber harvesting on the surrounding forest. Conventional logging techniques damage or kill much of the remaining vegetation during harvesting and cause heavy disturbance to the soil, both of which can result in large losses of carbon. Reduced-impact logging can therefore reduce the amount of carbon released, and also reduces soil erosion and surface runoff, which means that soil quality will be maintained, the risk of flooding and pollution of streams is reduced and water storage in soils is enhanced. In comparison to conventional logging, reduced-impact logging techniques generally have positive impacts on biodiversity.

Implementation costs can be an important consideration for logging operators. Reduced-impact logging takes more preparation time than conventional logging, but the cost of the logging activity itself need not be higher if it is well planned. Although it may limit the amount of wood that can be harvested in the first rotation, reduced-impact logging is likely to contribute to higher income from the forest in the long term by reducing degradation and the time needed for the forest to recover (see Box 5). Because of lower reliance on heavy machinery, reduced-impact logging can also provide better job opportunities.

Box 5 Costs and benefits of improved logging techniques.

The benefits of reduced-impact logging as compared to conventional logging have been the subject of scientific research for a considerable time. A study in Sabah, Malaysia, concluded that reduced-impact logging converted a much smaller proportion of the area to bare soil than did conventional logging (8% vs. 17%). As a consequence, it was estimated that reduced-impact logging caused significantly lower amounts of sediment to be deposited in downstream settlement ponds. Also, it was found that it caused a much smaller decline in rattan abundance from unlogged forest levels than conventional techniques. (Healey *et al.* 2000)

Putz *et al.* (2008) found that in forests subjected to conventional logging, average carbon emissions after harvest were over 100 tons per hectare, and that a large part of these emissions could be avoided through improved harvesting practices, mainly due to reduced collateral damage.

Both Healey and Putz confirm that the carbon stocks on sustainably logged plots can still be significantly higher (by around 20 %) than those on conventional logging sites at the beginning of the next harvesting period, which potentially also means higher revenues from the next logging cycle.

With regard to the costs of improving logging techniques, research results indicate that although reduced-impact logging can result in direct costs to timber producers, there are also possible savings, for example by reducing bulldozer time used for skid trail construction. In the long term, avoiding the damage resulting from poor logging practices is likely to provide net benefits in terms of timber yields, non-timber forest products and environmental services. (Applegate 2001, Applegate *et al.* 2004, Putz *et al.* 2012)

Enrichment planting supplements the number of trees in an area by planting and thus speeds up the process of forest regrowth. This technique can be applied in areas such as moderately degraded or logged-over forest. Enrichment planting has noticeable potential to speed up carbon sequestration and increase carbon storage within an area. If it is designed and implemented well (e.g. using native species and taking care not to cause unnecessary damage during the planting operation), enrichment planting can be beneficial for biodiversity, soil and water resources. Depending on the choice of species to be planted, it can also be designed to increase the availability of non-timber forest products (positively impacting livelihoods of local people), to benefit valued wildlife, and/or to increase numbers of desirable timber species within an area.

In addition to unsustainable timber harvesting, forest degradation can also be caused by human-induced fires, e.g. when fire spreads from agricultural areas into the forest. Raising awareness of the need for **fire control** and increased enforcement of rules for preventing fire in both protected and managed forest areas at risk can play a critical role in ensuring the conservation of carbon stocks. Burning of vegetation results in a significant release of carbon from both the plant matter itself and the soil. In areas like Central Sulawesi, where frequent fires do not occur naturally, control of fire can be expected to have positive impacts on carbon storage, biodiversity, soil quality and erosion control, water resources, the availability of non-timber forest products and the livelihoods of local people.

3.4 Options for rehabilitating degraded forest land in order to enhance forest carbon stocks

When the vegetation and soil of a forest have been highly disturbed by human activities such as logging or burning, the growth of new trees can sometimes become very slow or even impossible, either because the fertile soil layers have been lost or because the new vegetation, e.g. *alang alang* grass, inhibits tree growth. Assisting the recovery of forest on such degraded areas (for example areas identified as "critical land" or *lahan kritis*) can be a useful approach for REDD+ that provides both environmental and socio-economic benefits. The rehabilitation of degraded forest land involves re-establishing the productivity and some of the plant and animal species that were originally present at the site.

There are a number of different methods for forest rehabilitation, and choosing the right method for a given location is important for success (see also Box 6). More intensive methods may be required on severely degraded lands than on lands that are only slightly degraded. All successful rehabilitation efforts

Top: *Conventional skidtrail.* **Bottom:** *Workers extracting logs in a reduced-impact logging operation. Reduced-impact logging practices can lower carbon emissions and protect the surrounding forest.* © FAO, Simmone Rose, 5221 / USAID

Box 6 Choosing appropriate methods for forest rehabilitation.

Southeast Asia holds large areas of degraded land that have been abandoned and could potentially regenerate to forest, but are prevented from natural recovery because of soil degradation, recurring disturbance, and isolation from intact forests. Often, grasses or ferns become dominant in the altered environment and prevent the re-establishment of trees.

Decisions on which restoration strategies to adopt should consider the cost and benefits associated with different objectives of restoration, and the extent to which the processes of natural regeneration have been interrupted.

Assisted natural regeneration is most suitable for restoring areas where some level of natural succession is in progress. That is, sufficient tree regeneration must be present so that their growth can be accelerated. Seedlings of pioneer tree species are often found among and below the weedy vegetation even on seemingly weed-dominated land. To ensure further successional development, remnant forest should be in proximity so that there would be sufficient input of seeds. Most importantly, it must be possible to prevent further disturbances such as fire, grazing, and illegal logging (Shono *et al.* 2007).

Compared to conventional planting of tree seedlings, assisted natural regeneration offers significant cost advantages because it reduces or eliminates the costs associated with propagating, raising, and planting seedlings. It aims to accelerate, rather than replace, natural successional processes by removing or reducing barriers to natural forest regeneration (Shono *et al.* 2007).

Enrichment planting aims to increase regeneration and productivity by planting seedlings of desirable species. In the past, nitrogen-fixing exotic pioneer species have often been favoured for this purpose. However, given the significant problems with invasive species, awareness of the advantages of using native species has increased. Matching sites and species is a pre-condition for success (Kettle *et al.* 2010).

In contrast to enrichment planting, full replanting involves higher cost and is typically carried out in order to establish timber plantations for commercial use, rather than to restore the original forest cover and its ecological qualities. Setting up plantations can involve intensive techniques such as creation of a nurse canopy followed by under-planting with the target species, as well as intensive weeding and thinning to favour target species growth.

Man observing burning forest, Indonesia. Forest fires can release large quantities of carbon and significantly reduce the provision of ecosystem services. © Mark Edwards, Hard Rain Picture Library

will re-establish tree cover. However, the benefits for biodiversity and ecosystem services, including the availability of non-timber forest products, depend upon the tree species established and the methods that are used. Rehabilitation methods include encouraging **natural regeneration** through activities such as protection of the site from disturbance and threat management, **assisting natural regeneration** through additional interventions to speed up the process of natural regeneration, and **enrichment planting** with native species to speed up the re-establishment of a tree layer.

Natural regeneration uses minimal interventions to allow a natural process of forest colonization and succession. The management of threats such as grazing, fire, extractive use or invasive species are the only practices that may be required as part of this technique. Natural regeneration is a very cost-effective approach to forest rehabilitation. However, severely degraded sites are unlikely to be suitable locations, and the availability of seeds from nearby sites in order for vegetation to re-establish is essential for its success.

Assisted natural regeneration involves additional human intervention to speed up the process of natural regeneration, and aims to enhance the ability of species to regenerate, particularly where some of the conditions for natural regeneration are lacking. Practices can include planting perch trees to attract birds that disperse seeds, planting nurse trees to provide shade and protection for seedlings of species that are adapted to growing in the forest interior and to stablise soils, soil restoration through the use of green manure, clearing competing vegetation, or the addition or removal of drainage. As a result of this additional management, this technique is more expensive than natural regeneration alone.

Where land is significantly degraded, enrichment planting with mixed native species can be used to create a forest that resembles natural forest in its structure and species composition. In addition to tree planting, practices can include clearing competing vegetation, managing pests and encouraging rapid tree growth, e.g. by supplying seedlings with water and nutrients. This technique is more expensive than natural or assisted natural regeneration. The multiple benefits that can be achieved using enrichment planting are described in section 3.3 above.

In some cases, where rehabilitation with native species is not possible or extremely expensive because of severely damaged soils and harsh environmental conditions, establishing more intensively managed plantations of timber species or tree crops (native or non-native) may be an alternative. The impacts of timber and tree crop plantations are described in the following chapter. On state forest land, appropriate permits need to be obtained in order to establish plantations unless the land is already so degraded that there is no natural forest vegetation left. Planting on natural forest land would also be contrary to Cancun and other safeguards, which state that REDD+ activities should not be used for the conversion of natural forest.

Community members participating in reforestation activities as part of Alam Sehat Lestari project. © Kinari Webb - Health In Harmony

Carbon stocks in both vegetation and soils can be significantly enhanced through forest rehabilitation. Re-establishing natural or near-natural forest through (assisted) natural regeneration or enrichment planting generally leads to higher carbon stocks than the establishment of intensively managed plantations. In terms of benefits for biodiversity conservation, water regulation and soil conservation, (assisted) natural regeneration is usually the best option, followed by enrichment planting. In the case of assisted natural regeneration and enrichment planting, the species planted can be selected so as to increase the availability of non-timber forest products.

3.5 Options to increase the density of trees on non-forest land

On non-forest land, REDD+ actions can be undertaken to increase the amount of trees by re-establishing native forest (see previous chapter).
It is also possible to enhance carbon stocks by establishing **plantations of timber species or tree crops**, or by introducing **agroforestry** methods on agricultural land. However, it is not yet clear whether

for carbon accounting purposes plantations and agroforestry systems will be counted as 'forest' in Indonesia, and thus whether their carbon stocks will be included in the calculation of REDD+ carbon outcomes. In any case, it is likely that their carbon stocks will only be allowed to count towards REDD+ targets if they are established on land that has already been without forest cover for a long period of time. This is because it is to be expected that REDD+ accounting rules will be developed in accordance the safeguards agreed under the UNFCCC, which specify that incentives for the conversion of natural forest to plantations should be avoided.

Harvesting of pods from a cocoa plantation. © Mark Edwards, Hard Rain Picture Library

Even if some or all types of plantations and agroforestry systems are excluded from carbon accounting, they can still have a role in REDD+ as part of a strategy to reduce pressure on natural forests by providing alternative sources of income and livelihoods, as well as food, timber and non-timber forest products (see also section 3.2). A number of donors and some of the voluntary market standards for forest carbon projects include plantations and agroforestry in their portfolio of eligible activities.

Plantations are artificially established areas of tree stands, using either native or non-native species. They can be composed of a single species (monoculture) or mixed species. Plantations usually store less carbon than natural forest (although this may vary depending on the age and type of the plantation), so they will only result in carbon gains if they are established on non-forest land or in areas of heavily degraded forest. Another issue to keep in mind is that plantations can be more vulnerable to extreme weather events or pest outbreaks than natural forest, thus their carbon stocks may be less permanent.

Although plantations provide lower biodiversity benefits than natural forest, they can still enhance biodiversity if properly planned and implemented (see Box 7). Biodiversity outcomes will depend on the design of the plantation. Mixed cultures and native species

Box 7 Enhancing the ecological benefits of plantations.

Among all tree-dominated ecosystems, plantations often have the smallest environmental benefits. In a study on different land use types and their value for forest birds in Central Sulawesi, plantations recorded only 32% of the forest bird species. (Sodhi 2005). Intensively managed plantations often lack dense understorey vegetation, which not only decreases habitat functions for native biodiversity, but also makes them vulnerable to soil erosion and degradation. Various studies have confirmed the reductions in carbon stocks that occur when forests are converted to plantations. According to Lasco (2002), conversion to tree plantations can reduce carbon density to less than 50% of the original forest stock.

A number of approaches can be used to design plantations in a way that enhances their environmental functions without losing economic profitability. Such approaches include using indigenous species rather than exotic species, creating species mosaics by matching species to particular sites, embedding the plantations in a matrix of intact or restored vegetation, using species mixtures rather than monocultures, avoiding clearance of remnant natural forest or encouraging a diverse plant understorey. The degree of ecological restoration possible using these alternatives ranges from modest to significant, although none is likely to achieve complete restoration (Lamb 1998, Miles *et al.* 2010, Kanowski *et al.* 2005).

that are managed to increase structural diversity tend to provide the greatest benefits. Plantations can also have positive impacts on ecosystem services such as maintaining the quality of soil and water resources, and they can be designed to provide non-timber forest products. Again, benefits tend to be greater in plantations of mixed native species than in non-native monocultures. Plantations can also be certified by schemes which attest that they are responsibly managed, which can enhance the value of timber or tree crops produced in these areas. However, investment costs for plantations can be high, and this can pose a barrier to their establishment, particularly for poor communities.

Agroforestry combines crop production with tree planting on agricultural land. These systems store and sequester more carbon than conventional agriculture. Trees and shrubs planted on agricultural land can provide crops, timber or non-timber forest products such as cocoa, coffee, rubber or agathis resin (damar). In complex agroforestry systems with high canopy cover, species richness can be comparable to natural forest, although the species composition will be different and many endemic forest species may be absent. Soil fertility and erosion control is generally higher in agroforestry systems than in conventional agriculture, and this methodology also has the potential to supply some of the same resources that are usually harvested as non-timber forest products. The specific benefits gained from agroforestry will depend upon the species planted and the methods that are used. Agroforestry can often be more accessible to local communities than intensive monoculture production systems, because lower initial investment is needed.

4. Planning REDD+ actions to suit local conditions

Choosing the right location is crucial for the success of any REDD+ action, as the benefits that can be obtained in terms of carbon, income generation, biodiversity and ecosystem services depend on the natural and socio-economic conditions of the area. Land use rights (such as customary rights to forest use and existing concessions), legal provisions related to forest management and compatibility of planned actions with REDD+ safeguards also need to be observed.

The potential for carbon benefits depends both on current carbon stocks (with high carbon forest areas preferable for actions to maintain forest, and areas with strongly depleted stocks preferable for rehabilitation) and on expected land use developments. Intact forest areas that are at high risk of conversion or degradation, and degraded areas with low chances of spontaneous recovery should be a priority for REDD+ actions as long as there is a realistic chance of success.

The benefits that can be achieved for local livelihoods depend on population density, current levels of income, current occupation patterns and the degree to which local people depend on the forest for their income. For example, the same type of REDD+ action will have different livelihood impacts for communities which gain part of their income from tourism, communities that depend heavily on agriculture or communities engaged in fishery or aquaculture.

Biodiversity benefits can be maximized by prioritizing forest conservation efforts and concentrating them on high biodiversity areas, as well as on forest patches that link larger forest areas, allowing species to move between them. Forest rehabilitation can be used to create buffer zones around high biodiversity areas and to relieve land use pressure on intact forest areas.

The potential for REDD+ to enhance ecosystem services depends both on the characteristics of landscape and vegetation, and on the location of the area in relation to the potential beneficiaries of the service. For example, REDD+ actions can provide the largest benefits in the form of watershed protection if they improve forest condition in sensitive locations (such as on steep slopes and in areas with vulnerable soil types) and if a large number of settlements or sensitive infrastructure are located downstream of the site. Increasing the availability of non-timber forest products is most beneficial in areas that are close to settlements where such products are traditionally used.

To identify promising approaches to REDD+ for a given area, it can be helpful to combine maps of carbon stocks with maps showing factors related to pressures on the forest and/or the potential for multiple benefits. Relevant map themes could include recent deforestation, population growth, biodiversity or risk of erosion. The planning of specific actions should take place in consultation with all relevant stakeholders and be further informed by local knowledge and expertise.

The charts on the following pages provide a visual overview of the main considerations outlined in this report. Chart 1 shows the impacts on multiple benefits of the main REDD+ actions considered, while Chart 2 illustrates some of the basic principles that should be observed when matching REDD+ actions to a site.

Chart 1. Overview of options for REDD+ action and their impacts on multiple benefits.

This chart shows examples of possible REDD+ actions, and acts as a guide to the expected impacts of these actions on carbon, biodiversity, ecosystem services and livelihoods. It is based on a review of international scientific literature, with a particular focus on studies that were carried out in Sulawesi (see list of references). As shown in the Key, the chart distinguishes positive and negative impacts of different size, and uses darker shading where the evidence is strong. Where the scientific evidence appeared uncertain (e.g. in cases where there were some studies who came to different conclusions, where the studies showed that impacts are highly context-specific, where only few papers could be found that address a certain type of impact, or where most of the evidence found came from countries other than Indonesia), lighter shading is used.

The chart does not provide an exhaustive list of possible actions, but rather includes some of the most important options identified in Indonesian project documents and REDD+ strategies. Impacts depend both on the type of action and on the baseline situation (i.e. what kind of land use would take place without the REDD+ action), which is why for some rows of the table a particular baseline situation is specified. As the outcomes of any type of action can vary depending on local circumstances and on how well the action is designed and implemented, this chart can only serve to provide initial orientation. More specific studies on how and where actions are best carried out should take place in later planning stages. It is also important that any REDD+ actions should be accompanied by appropriate monitoring, in order to assess whether targets related to multiple benefits (including carbon benefits) are being met.

KEY:	Impacts: Positive	Impacts: Negative	Costs	Ease of measuring carbon benefits
High	● (large, green)	■ (large, red)	$$$	★ (large)
Medium	● (medium, green)	■ (medium, red)	$$	★ (medium)
Low	● (small, green)	■ (small, red)	$	★ (small)
Neutral	■ (grey)			

Shading indicates degree of certainty:

● ■ $ (dark shading)	● ■ $ (light shading)
High certainty	**Low certainty**

APPROACH	Impacts on: Carbon	Biodiversity	Soil	Water	NTFPs	Livelihoods	Cost	Ease of measuring carbon benefits
REDUCING DEFORESTATION:								
Maintaining natural forest and preventing conversion	● (large, dark green)	● (large, dark green)	● (large, dark green)	● (large, dark green)	● (large, dark green)	■ (large, light red)	$ (dark)	★ (large)
Promoting the use of **non-timber forest products (NTFPs) at sustainable harvesting levels** to provide alternative livelihoods	■ (grey)	■ (small, light red)	■ (grey)	■ (grey)	■ (grey)	● (medium, light green)	$ (light)	★ (small)
Intensification of agriculture (annual or tree crops) with conventional methods using high energy and chemicals input, to decrease conversion pressure	■ (large, dark red)	■ (large, dark red)	■ (large, dark red)	■ (large, dark red)	■ (large, light red)	● (medium, light green)	$$ (light)	★ (small)

Change from conventional agriculture to **organic farming** to decrease conversion pressure by increasing profitability							$	
REDUCING FOREST DEGRADATION / SUSTAINABLE MANAGEMENT OF FOREST:								
Change from conventional logging to **Reduced-Impact Logging (RIL)** in production forest							$	
Enrichment planting in moderately degraded / logged over forest							$$	
Fire control to prevent fire through raised awareness and increased enforcement in forest areas at risk							$	
ENHANCING FOREST CARBON STOCKS:								
Rehabilitation of significantly degraded land through **(assisted) natural regeneration**							$	
Rehabilitation of significantly degraded land through **enrichment planting**							$$	
TIMBER OR CROP TREE PLANTATIONS (ON NON-FOREST LAND):								
Monoculture plantation (timber or tree crops) of non-native species **on non-forest land**							$$$	
Plantation of **mixed native species** (timber or tree crops) **on non-forest land**							$$$	
AGROFORESTRY:								
Conversion of open agricultural land to **agroforestry**							$$	

Chart 2. Conclusions as to where and how activities should be implemented.

This chart illustrates where different types of REDD+ actions can and/or should be implemented, taking into account both legal regulations and environmental factors such as the terrain and current condition of the vegetation.

APPROACH	Legal status					Terrain and other environmental factors			
	State forest land (Kawasan Hutan)				Non-state forest land (APL)	Degraded land	Steep slopes	Riparian zones	High conservation value areas
	Production Forest	Limited Production Forest	Protection Forest	Conservation Areas					
REDUCING DEFORESTATION:									
Maintaining natural forest and preventing conversion	●	●	●	●	●	○	●	●	●
Promoting the use of **non-timber forest products (NTFPs) at sustainable harvesting levels** to provide alternative livelihoods	●	●	◐	◐	●	○	◐	◐	◐
Intensification of agriculture (annual or tree crops) with conventional methods using high energy and chemicals input, to decrease conversion pressure	○	○	○	○	◐	◐	○	○	○
Change from conventional agriculture to **organic farming** to decrease conversion pressure by increasing profitability	○	○	○	○	◐	◐	◐	◐	◐
REDUCING FOREST DEGRADATION / SUSTAINABLE MANAGEMENT OF FOREST:									
Change from conventional logging to **Reduced-Impact Logging (RIL)** in production forest	●	●	○	○	●	○	x ○	x ○	x ○
Enrichment planting in moderately degraded / logged over forest	●	●	○	○	●	●	◐	◐	◐
Fire control to prevent fire through raised awareness and increased enforcement in forest areas at risk	●	●	●	●	●	●	●	●	●

ENHANCING FOREST CARBON STOCKS:									
Rehabilitation of significantly degraded land through **(assisted) natural regeneration**	High	High	High	High	High	High	High	High	High
Rehabilitation of significantly degraded land through **enrichment planting**	High	High	Medium	Medium	High	High	High	High	Medium
TIMBER OR CROP TREE PLANTATIONS (ON NON-FOREST LAND):									
Monoculture plantation (timber or tree crops) of non-native species **on non-forest land**	* Medium	Low	Low	Low	Medium	Medium	Low	Low	Low
Plantation of **mixed native species** (timber or tree crops) **on non-forest land**	* Medium	Low	Low	Low	Medium	High	Low	Low	Low
AGROFORESTRY:									
Conversion of open agricultural land to **agroforestry**	Low	Low	Low	Low	High	High	Low	Low	Medium

x: These areas would normally be excluded from logging activities under RIL guidelines;
*: In production forest areas without present forest cover, it is legally possible to establish plantations.

KEY:	High	Medium	Low
Suitability	High (dark green)	Medium (light green)	Low (white)

5. Concluding recommendations

Any plans for the implementation of REDD+ should strive to consider all possible effects on people and the environment. It is important to remember that the effects of REDD+ actions will not only depend on the activity itself, but also on how well it is designed and implemented in accordance with local circumstances (e.g. forest rehabilitation methods should be adjusted depending on the status of the degraded site, whilst reduced-impact logging methods need to take account of the characteristics of the forest and soil). This document is intended to give actors involved in REDD+ a first orientation to inform the selection of appropriate actions and suitable locations for their implementation, as well as for the assessment of proposals for action made by others.

The selection of REDD+ activities should be made through a consultative process involving the key stakeholders (e.g. indigenous people and local communities, forest experts, relevant authorities), and a consideration of legal regulations and factors such as the terrain and current condition of the vegetation in the proposed location. The information contained in this guide can be used to inform local stakeholders about the likely effects of different choices on their living environment and socio-economic wellbeing, as a basis for obtaining their Free, Prior and Informed Consent to proposed measures. Expert advice should be sought in order to refine the approach to apply the selected actions, and to specify the steps needed for their implementation.

Finally, it is crucial to monitor the outcomes of REDD+ measures, in order to check whether the intervention is having the intended effects on carbon stores, biodiversity, ecosystem services and livelihoods. Monitoring can serve both as an early warning system to highlight any potential problems, and to give an early indication of success. Monitoring the impacts of REDD+ actions on multiple benefits will also help to further broaden the evidence base on the suitability and likely outcomes of different approaches. It may provide useful inputs to a national Safeguards Information System as this is developed.

Agricultural landscape with natural forest in the background, Central Sulawesi. © Ulf Narloch, UNEP-WCMC

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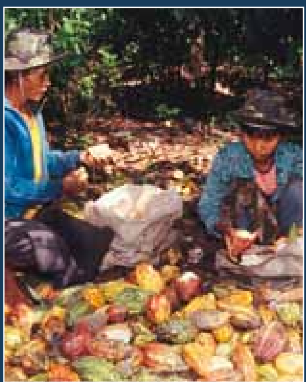

Putting REDD+ into practice can involve a broad range of actions that change the management of forest and other lands. Depending on what is done and how, these actions can have different effects on the forest environment and the lives of local people. This report identifies some of the advantages and drawbacks of different options. It aims to assist REDD+ decision-makers and stakeholders in Indonesia, including district-level governments and local communities, to assess the possible outcomes of their choices and to plan for actions that provide multiple social and environmental benefits.

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UN-REDD PROGRAMME

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