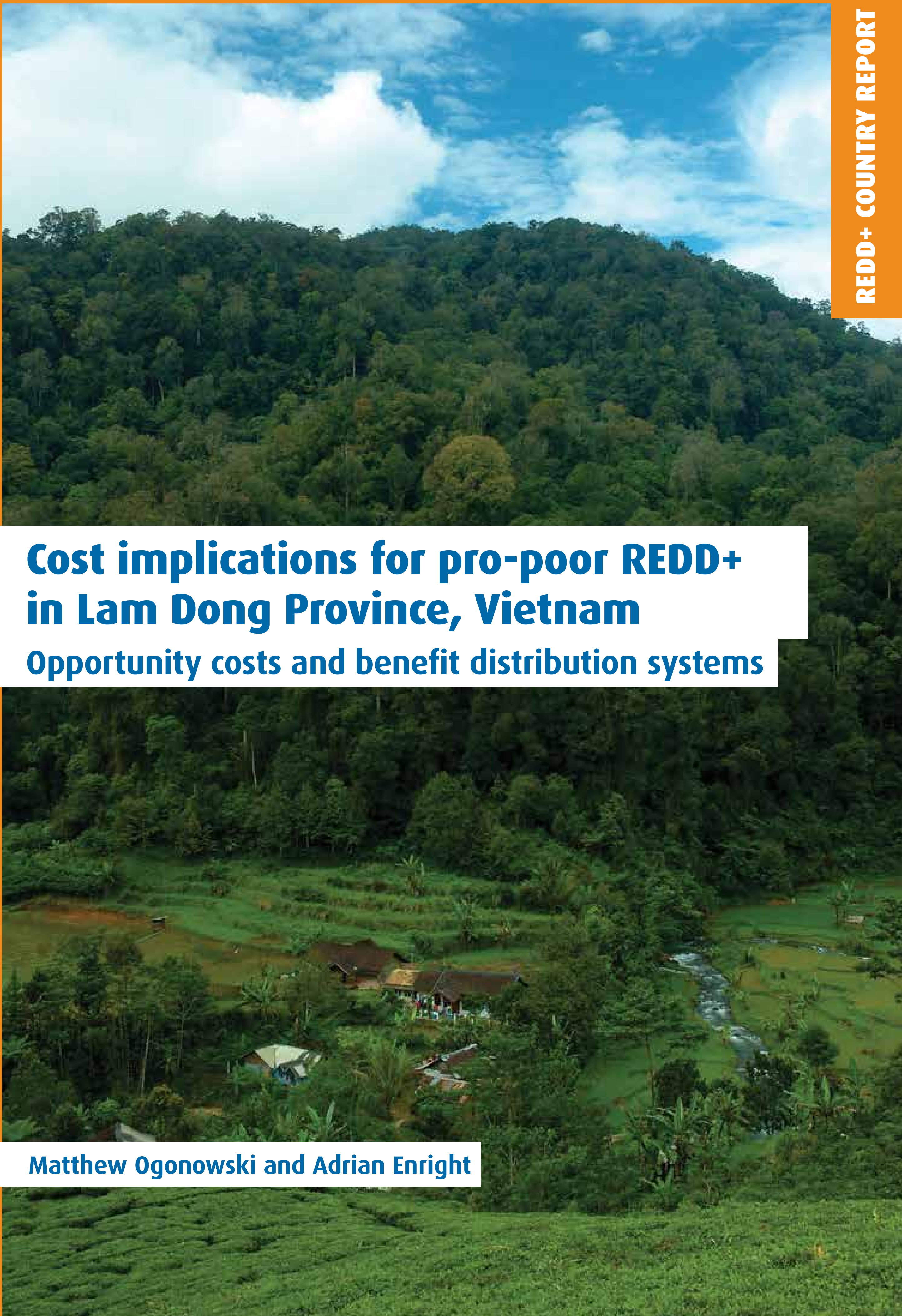
REDD+ COUNTRY REPORT



Cost implications for pro-poor REDD+ in Lam Dong Province, Vietnam

Opportunity costs and benefit distribution systems

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Poverty and sustainable development impacts of REDD architecture; options for equity growth and the environment

About this project...

Poverty and sustainable development impacts of REDD architecture is a multi-country project led by the International Institute for Environment and Development (IIED, UK) and the Norwegian University of Life Sciences (Aas, Norway). It started in July 2009 and will continue to December 2013. The project is funded by the Norwegian Agency for Development Cooperation (Norad) as part of the Norwegian Government's Climate and Forest Initiative. The partners in the project are Fundação Amazonas Sustentável (Brazil); Hamilton Resources and Consulting (Ghana); Netherlands Development Organisation (SNV) (Vietnam); Sokoine University of Agriculture, Faculty of Forestry and Nature Conservation (Tanzania); and Makerere University, Faculty of Forestry and Nature Conservation (Uganda).

The project aims to increase understanding of how different options for REDD design and policy at international, national and sub-national level will affect achievement of greenhouse gas emission reduction and co-benefits of sustainable development and poverty reduction. As well as examining the internal distribution and allocation of REDD payments under different design option scenarios at both international and national level, the project will work with selected REDD pilot projects in each of the five countries to generate evidence and improve understanding on the poverty impacts of REDD pilot activities, the relative merits of different types of payment mechanisms and the transaction costs.

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For further information on SNV's REDD+ project in Lam Dong, publications and other REDD+ projects managed globally by SNV, please visit: snvworld.org/redd

International Institute for Environment and Development

Contents

List of figures, boxes and tables

Executive summary

SNV has developed a programme with an emphasis on designing approaches to promote pro-poor REDD+ and integrate these approaches into national and sub-national REDD+ decision making. This paper contributes to the existing SNV efforts by achieving two objectives.

The first relates to the evaluation of the economic viability of REDD+ in two forested districts of Vietnam in Lam Dong province (Bao Lam and Cat Tien, see Figure 1), with an emphasis on investigating how opportunity costs can help to identify the land-use options most relevant to poor actors there. This section of the report will also explore the potential benefits and challenges associated with the use of opportunity cost estimation. This will be achieved through a quantitative evaluation of 30-year net present values of future profits from alternative land uses conducted using the World Agroforestry Center's REDD Abacus model,[1] along with field-based cost data and land-use change estimates with associated changes in carbon stocks from 2000–2010. This is followed by a qualitative discussion of the implications for pro-poor REDD+.

Although opportunity costs may help to identify low-cost options for REDD+ in poorer areas, other supporting mechanisms must be put in place to facilitate the delivery of a pro-poor model of REDD+ and avoid situations where the poor may be made worse off in the pursuit of low-cost REDD+ activities. Part II of the report provides a preliminary investigation of the costs associated with one fundamental component of the pro-poor approach: the local benefit distribution system (BDS). This analysis is a first attempt at quantifying such costs. This section is therefore aimed at provoking further discussion and investigations into the implementation costs of REDD+ in Vietnam rather than providing definitive estimates of the costs of pro-poor BDS models.

Key findings

Part I of the analysis found that from 2000–2010 both districts experienced significant deforestation, with losses of natural forest cover equal to 13 per cent in Bao Lam and 19 per cent in Cat Tien. CO_2 emissions from clearance and degradation of the six main forest types totalled 5.3 million tonnes and 2.1 million tonnes, respectively. The study identified a number of pro-poor REDD+ options which could potentially be employed in the two districts. In particular, afforestation/reforestation (A/R) and forest regeneration represent 'win-win' options that can improve rural livelihoods and increase carbon stocks at the same time, with a net benefit of US$1–3 per tonne CO_2-equivalent sequestered for most options. These activities can thus be profitable for small farmers if implementation and other project costs can be kept low enough.

The results also show that REDD+ is competitive with many of the key agricultural land-use options already used by farmers in the districts. The opportunity costs for converting most forest types to rice, other annual crops, cashews and tea are all around US$4 per tonne or less, making them appropriate potential areas for REDD+ projects. At current carbon prices on the voluntary market (around US$5 a tonne), REDD+ could therefore enable poor farmers in Bao Lam and Cat Tien to potentially increase their incomes by choosing to preserve natural forests. For coffee, while the opportunity cost is more than double the assumed carbon price, the US$11–12 per tonne value is well within the range of prices that would be anticipated on a future international compliance market for REDD+. Only the opportunity cost of rubber (US$95 per tonne and up) remains far outside the expected price range of carbon markets. The assumptions used were

1. See code.google.com/p/redd-abacus

for a large-scale, modern plantation however, so opportunity costs for small-scale individual rubber projects in the districts will likely be significantly lower. The analysis also demonstrated the importance of harvesting and sales of non-timber forest products (NTFPs) for REDD+. Furthermore, the analysis highlights the importance of carbon accounting methods to the viability of REDD+. In particular, when the values of carbon for different crops are included in calculations, the opportunity costs of all alternative land uses increase substantially, although most still remain well below US$10 per tonne.

However, the estimation and use of opportunity costs also face a number of potential challenges. These include:
- difficulties in obtaining high-quality and up-to-date data;
- limited capacity and shortages of trained personnel, particularly at the sub-national level; and
- developing assumptions and procedures related to prices and costs, and accounting for forest degradation and the value of NTFPs and ecosystem services.

The report concludes that when properly developed and utilised, opportunity cost analysis can help low-income farmers to benefit from REDD+, and even to attain higher incomes in some cases. More broadly, low-emissions development plans (LEDPs) can benefit greatly from incorporating robust opportunity cost analysis. National climate policymakers and international REDD+ donors alike should make education and training on opportunity costs a priority.

Part II of the analysis suggests that the set-up and operational costs of a pro-poor BDS model will roughly equate to an additional US$25 per household over the initial five years. Up to 98 per cent of this additional cost can be attributed to the costs of conducting community-level participatory approaches to select benefit types, timing and governance structures.

A qualitative discussion of these results reveals that there are several ways these costs could be lowered by achieving economies of scale. There also exist opportunities for non-governmental organisations (NGOs) and other sources of funding to cover the up-front costs of such approaches. Compared to alternative approaches, this would significantly lower the additional cost of a pro-poor approach to BDS design. Future applications of pro-poor approaches to BDS design should also explore opportunities to combine activities with complementary, locally based interventions, including free, prior informed consent (FPIC) processes.

This section of the report concludes by recommending further investigations into the costs of pro-poor REDD+ BDS. In particular, better identifying the number of households eligible for benefits under REDD+ will improve the accuracy of the costs of BDS per household. Also, looking at additional components of a pro-poor approach will provide a more complete picture of the total additional costs for implementing organisations. Finally, future estimates of the costs of pro-poor models for BDS will greatly benefit from using post-implementation data rather than relying on speculative estimates of certain costs.

Background

Reducing Emissions from Deforestation and Forest Degradation (REDD+) has emerged as a key mechanism for addressing the link between climate change and changes in the composition of forests globally. Initially focusing on deforestation (RED), the concept soon expanded to include forest degradation (REDD) and later added the '+' component to include three additional types of activities: conservation; sustainable management of forests; and enhancement of forest carbon stocks.

In many rural areas of developing countries, many factors encourage poor communities to clear forest areas, and to use the remaining forests unsustainably. These include low agricultural yields, unpredictable harvests, lack of other non-agricultural sources of income and the inevitable reliance on wood for fuel.

REDD+ now provides a pathway to help poor farmers and communities improve their livelihoods while lowering emissions. In recent years, international REDD+ support programmes, national plans and sub-national projects have been implemented or are under development. A voluntary REDD+ market is available for new projects, international donors are providing direct assistance to REDD+ readiness programmes[2] and there are payments for performance.[3] By providing a predictable and sustainable source of income to poor communities, REDD+ has the potential to both reduce poverty and lower emissions associated from deforestation and degradation.

A key tool in the development of REDD+ will be the estimation and evaluation of opportunity costs. Opportunity costs provide a measure of the competitiveness of REDD+ by measuring the potential future profits that could be obtained through alternative land uses. This in turn can be used to represent the minimum cash payment landholders would require for them to protect a forest landscape instead of converting it into an alternative type of land-use (e.g. crops, livestock) or otherwise degrading the forest.

The first part of this paper aims to contribute to the existing SNV effort by achieving two objectives:

- evaluating the economic viability of REDD+ in two forested districts of Vietnam in Lam Dong Province (Bao Lam and Cat Tien), with an emphasis on investigating how opportunity costs can help to identify the land-use options most relevant to poor actors there; and
- exploring the potential benefits and challenges associated with estimating opportunity costs in the design and implementation of REDD+ in Vietnam and elsewhere.

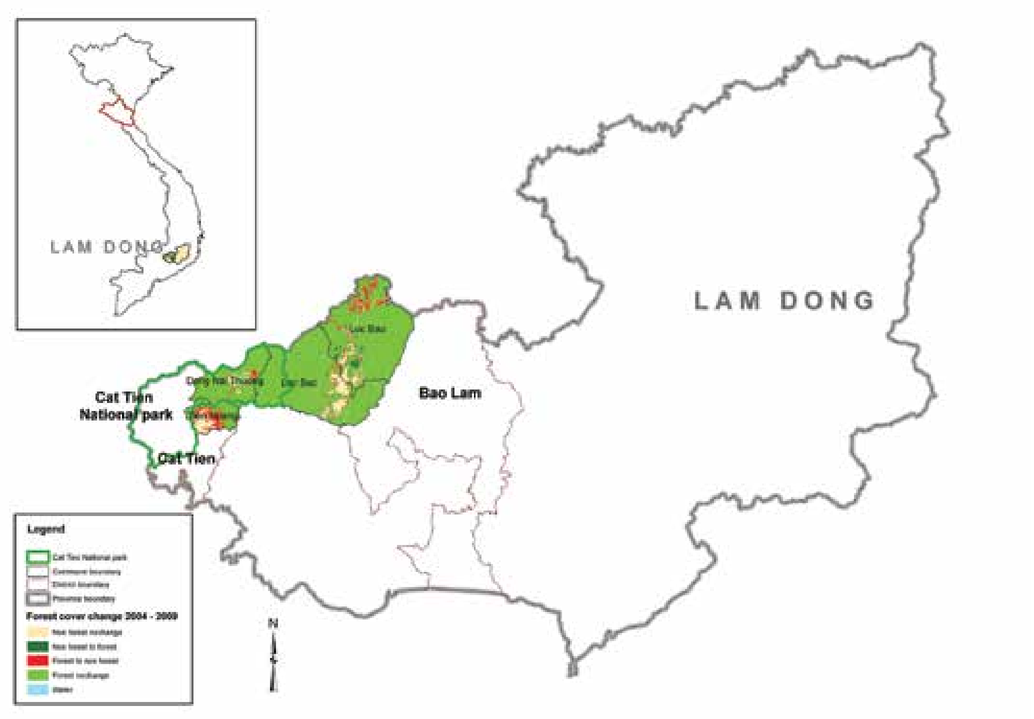
Although opportunity costs may help to identify opportunities for implementing a pro-poor approach to REDD+ (see Box 1), many other costs are associated with implementing and operating the intervention. One key cost influencing the implementation of pro-poor REDD+ will be those associated with the benefit distribution system (BDS).

The BDS will be responsible for the delivery of benefits (either cash or in-kind) to those either directly or indirectly involved in REDD+ activities. The BDS will need to engage local actors, including poor constituents, in decisions around the most efficient and effective BDS. This

2. See e.g. UN-REDD (www.un-redd.org) and World Bank Forest Carbon Partnership Facility (www.forestcarbonpartnership.org).
3. See e.g. Norway-Indonesia Partnership (www.norway.or.id/Norway_in_Indonesia/Environment/-FAQ-Norway-Indonesia-REDD-Partnership-/) and World Bank Carbon Finance Unit (www.wbcarbonfinance.org).

engagement and the systems put in place to deliver benefits will come at a cost. Yet the size of these costs – and the implications they have for the viability of pro-poor REDD+ – are largely unknown in the context of Vietnam. Part II of the report therefore takes a preliminary look at some of the key costs associated with implementing pro-poor BDS. The results will be explored in terms of their effect on the viability of REDD+ in Cat Tien and Bao Lam and balanced with a set of options for reducing these costs.

Figure 1. Map of Bao Lam and Cat Tien Districts, Lam Dong Province, Vietnam



Box 1. Guiding principles for pro-poor BDS

A 'pro-poor' approach has been defined in a range of different ways in the context of REDD+, other payments for ecosystem service systems and pro-poor development (see Mohammed 2011; Pernia 2003; Lindhjem *et al.* 2010 and Pagiola 2007). Here a 'pro-poor BDS' is considered as being guided by five key principles:

1. The inclusion of stakeholders in decisions around benefit types, timing and distribution methods, recognising their individual and collective identities.
2. Promoting cost-effective distribution methods, efficiency and transparency.
3. REDD+ has a net positive effect on poorer stakeholders involved in REDD+ activities and promotes sustainable livelihoods.
4. REDD+ benefits are shared in accordance with considerations of distributional justice, equity, equality and need.
5. Local BDS mechanisms should be compatible with existing government arrangements where appropriate.

Source: Enright *et al.* (2012)

Assessing pro-poor opportunity costs and applications to LEDPs

1.1 Opportunity cost analysis of REDD+ in Bao Lam and Cat Tien districts

1.1.1 Methodology and assumptions

SNV previously conducted two first-order opportunity cost analyses for the districts. The first was conducted by Holland and McNally (2010). This preliminary analysis largely relied on interviews with sub-national authorities to help to establish estimates of net present value (NPV) and patterns of recent land use and rates of deforestation. The second analysis conducted in 2011 set out to build on the 2010 results by establishing more site-specific economic estimates. It was based on a survey of 280 households engaged in agriculture, along with SNV's own research of prices and costs associated with key crops and land-use options (Nguyen and Enright 2012). Each household provided data on the area harvested, annual output and quantity sold for one or more individual crops for a given year. Information was provided to develop bottom-up estimates of net annual profits using assumed prices and production costs for cashews, coffee and tea. This and other information was then used to develop the following sets of inputs:

- **Net present value of key land-use options:** Using spreadsheet analysis, an estimate of the net present value (NPV) of the associated profits was developed for each major natural forest/land type and land-use option already used in the districts. This analysis assumed a 30-year revenue stream holding current prices and production costs constant in real terms, using a 10% discount rate.[4] This value was also considered a conservative compromise of the range of discount rates in the relevant opportunity cost literature (e.g. Grieg-Gran 2008; Borner and Wunder 2008). The NPV for the three crops (cashews, coffee and tea) was estimated using the average net annual profit of households in the survey.[5] NPVs for forests and all other agricultural and land-use options were estimated based on SNV's experience, and similar exercises by Hoang *et al.* (2010) and JICA (2011). For forests and shrub land, the NPV was developed primarily from the potential income that could be received from harvesting and sales of non-timber forest products (NTFPs).[6]

- **Treatment of timber cleared for agricultural operations:** Current conditions in the districts suggest that a portion of the timber cleared from forested areas for conversion into crop lands is often sold in a one-off deal at the start of operations, with the remainder burned as fuel or used for construction. SNV conducted research into this area but encountered significant difficulties with measuring the different values of these timber sales. In addition, despite interviews with a number of key stakeholders, SNV was unable to identify a consistent pattern from which a general assumption regarding use of the cleared timber could be made. It was therefore assumed that 100 per cent of the timber cleared in the first year for agriculture or other development activities was used directly by the landholder and not sold, hence the cash income from felling timber is assumed to be zero (although the landowner will receive some non-cash benefits through the use of the timber). SNV did however conduct a sensitivity analysis that evaluated the potential impact of including the forgone profits from potential sales of timber. This analysis is presented in the results section.

- **Carbon content estimates** for each major natural forest type and land-use option were developed with values used in other opportunity cost estimates for Vietnam, namely from Hoang *et al.* (2010). The analysis assumed that agricultural or other development would require clear

4. A 10% discount rate was used to remain consistent with previous estimates conducted by SNV (Holland and McNally 2010).
5. The NPV is calculated as follows: $NPV = \sum [(Q*P/A) - C)] / (1 + 0.1)r$ where Q =quantity sold, P = price per unit sold in US$ per tonne, A = area cultivated in ha, C = production cost per ha, and r = year, summed from year 1 to year 30.
6. Further details on the NPV assumptions and data are included in Annex 1 and section 1.1.3 Checks on assumptions.

cutting of forest lands, therefore it was assumed that 100 per cent of the carbon content in the natural forests would be released (this serves as the business-as-usual scenario).

- A land-cover transition matrix was developed for each district based on land-use maps for 2000, 2005 and 2010 for the two districts. These datasets were then converted into land-use change matrices for the decade 2000 to 2010 by the Centre for Remote Sensing and Agricultural Planning, National Institute of Agricultural Planning and Projection (NIAPP). The matrices for each district illustrated the total area of each forest type and land-use option in the districts for 2000 and 2010, and displayed how each individual category has changed over the ten-year period. The transition matrices with the data used for this study are presented in Annex 2.

The original data and assumptions were used for the updated analysis described in this paper, subject to several modifications. These changes are detailed in the next section.

1.1.2 Changes made to the previous SNV analysis

To produce improved and more up-to-date estimates of opportunity costs, the following changes were made to the original input data used with the REDD Abacus model:

- Updated land-cover transition matrices were obtained and input for both districts. This data includes the changes in land-cover from 2000–2010 for 18 land-use categories in Bao Lam and 15 categories in Cat Tien. The data was sourced from the Lam Dong Department of Natural Resources and Environment (DONRE) and processed by NIAPP.

- The updated transition matrices included a new category, shrub land, which was not in the original SNV data analysis. It was therefore necessary to develop NPV and carbon content assumptions for this category. For the NPV, it was noted that compared to forest land, shrub land generally has a low value due to the limited availability of NTFPs. To be conservative the cost was therefore set at zero. The carbon content was obtained by taking the general Intergovernmental Panel on Climate Change (IPCC) above-ground biomass value for tropical shrub land in continental Asia (60 tonnes per ha) and applying a carbon content factor of 0.47. The carbon content was thus set at 28 tonnes per ha.

A significant change involved the carbon content assumptions used for crops and other non-forest areas. In the original analysis, SNV included assumed carbon contents for these categories in the model, so estimates of emissions from deforestation were net of the carbon sequestered by crops. This was considered to give a conservative estimate of the emission reductions achievable and was reflected in a somewhat higher opportunity cost per tonne of emissions reduced. In this new study, it was considered useful to make estimates excluding the carbon stocks of agricultural land uses. This is because there is uncertainty over the carbon contents of agricultural land uses, given that they are location- and crop-specific, and because discussions on national reference level estimation have focused on changes in the extent and quality of forest cover, rather than the carbon content of the land uses replacing forest. This has the effect of lowering the opportunity cost per unit of emission reduction.

The carbon contents of all categories that are not natural forests were set to zero. The carbon content assumptions for natural (medium, poor, conifer, mixed, bamboo and young) forest were kept as before; the value for shrub land was set at the (non-zero) value discussed above. While it remains unclear whether shrub land by itself could qualify under a REDD+ scheme, it is reasonable to assume it might be eligible if part of a larger forest ecosystem. For transitions leading to a net increase in carbon stocks (sequestration options), however, the net change in carbon stocks was used to calculate the opportunity cost.

It should be noted however that the carbon content of some crops can be substantial, especially in tree crops such as forest plantations and rubber. To illustrate the importance of carbon accounting and baseline determination for the estimation of carbon stocks, a second analysis was conducted using carbon sequestration values for the key crops grown in Bao Lam and Cat Tien. These values were derived from Hoang *et al.* (2009) and JICA (2011), and are illustrated in green in Table 1 below.

The above data was fed into the REDD Abacus model and analysed offline to develop initial estimates of carbon emissions and opportunity costs per unit of carbon dioxide equivalent (CO_2e) for each land-use type in the districts. Table 1 below displays the NPV and carbon content assumptions used in this analysis; Figure 2 overleaf plots the NPVs. Note that, for simplicity, this analysis assumes that forest quality remains constant over the 30-year period of the analysis. In reality, the quality of forest stands would in many cases decrease over time due to degradation from NTFP harvesting. This will in turn produce a decline in the corresponding NPV values and carbon contents for each category shown in Table 1.[7] In some medium forests, NPV values may rise in the near term as NTFP harvesting increases from a very low level. Over time, however, these forests will also experience a decrease in NPV. The classification of some forests will change as well due to NTFP harvesting, degradation, changes in local climate and other factors (the transitions between forest types already observed in the districts can be seen in Annex 2). On the other hand, protected forests with minimal NTFP harvesting would see an increase in carbon stocks as lower-quality forests recover – an option that will be explored later in this report.

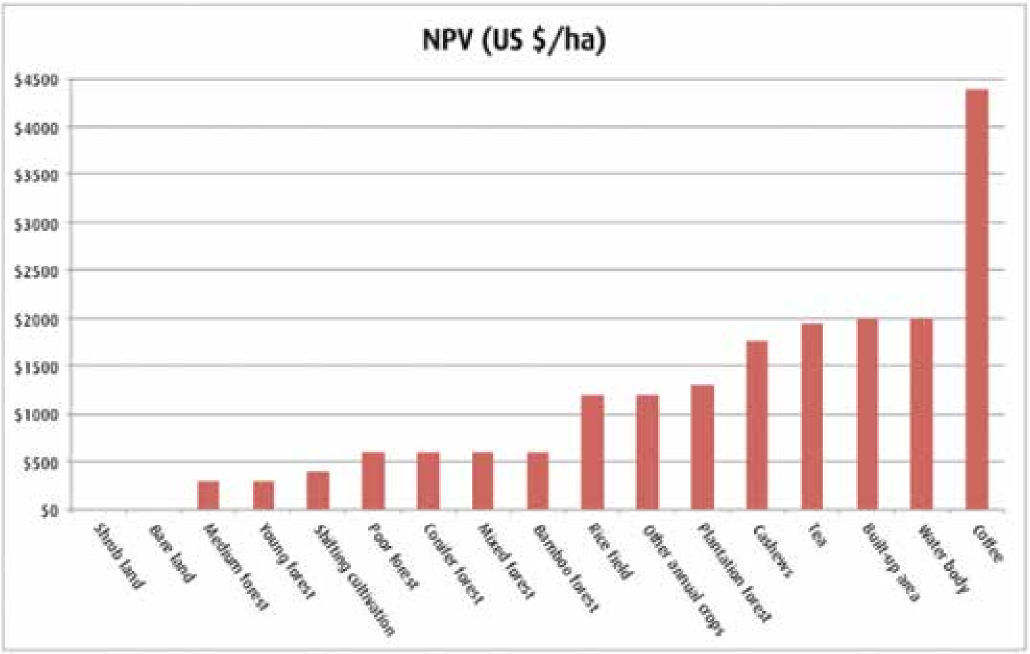
Table 1. NPV and carbon contents by land type/use

Land type/use	NPV (US$/ha)	Carbon (tonnes/ha)[8]	Carbon (tonnes/ha) – inclusive of crop values
Medium forest (80–150m³/ha)	300	103	103
Poor forest (<80m³/ha)	600	87	87
Conifer forest	600	87	87
Mixed forest	600	87	87
Bamboo forest	600	87	87
Young forest (regeneration)	300	35	35
Shrub land	0	28	28
Bare land	0	0	4
Shifting cultivation	400	0	15
Rice field	1200	0	5
Other annual crops	1200	0	5
Forest plantations	1300	0	33
Cashews	1753[9]	0	50
Tea	1951	0	15[10]
Coffee	4384	0	50
Rubber*	31000[11]	0	50
Built-up area	2000	0	0
Water body	2000	0	0

* Due to limitations on the availability of data, the NPV for rubber is for a large-scale, modern industrial plantation. The actual opportunity cost for small-scale individual rubber projects in the districts are likely to be significantly lower. This analysis did not account for the time lag (typically 5–7 years) between the initial planting and harvesting of rubber.

7. The extent of degradation will depend on the harvesting methods used; negative impacts could be lessened through local training and capacity-building related to sustainable techniques.
8. All carbon stock values are sourced from Hoang *et al.* (2010) unless indicated.
9. See www.businesstimes.com.vn/domestic-cashew-prices-top-vnd30000kg; www.21food.com/news/detail36424.html.
10. Assumed to be the same as shifting cultivation.
11. JICA Vietnam (2011).

Figure 2. NPV by land type/use



The (high) NPV for rubber was omitted for clarity.
The use of the same NPV and carbon assumptions in both districts in turn gives the same costs per tonne of carbon preserved for each land-cover transition. The total carbon emissions for each type will differ in the districts, however.

1.1.3 Checks on assumptions

In addition to the above changes, a check of several key factors in the estimation of the NPV assumptions for the main land uses was conducted for this study.

Crop yields

A check of the annual yields (in kg/ha) for each crop in the SNV survey was conducted. They were compared to national average yields for Vietnam, taken from the UN FAO FAOSTAT database for 2008, 2009 and 2010.[12] Given that the households targeted under the SNV REDD+ intervention are considered poor and the plots are mostly small farms, it would be expected that yields in the SNV data would be somewhat below the national average, which includes larger and more modern farms.

The check confirmed this expected result for cashews and coffee. For tea, however, the analysis produced an anomalous result. While the yields in FAOSTAT ranged from approximately 1600kg/ha to 1750kg/ha over the three-year period, the average yield for tea in the SNV dataset (2772kg/ha) was over 60 per cent higher. Of the 188 farms growing tea, 85 had yields above the FAO maximum, while over 40 farms had yields more than double this value. Given that small individual tea farms do not typically employ up-to-date production methods and equipment, based on the FAO data it appears that the yields in the SNV dataset are likely too high. This could be the result of the reported outputs being too high and/or the reported areas farmed being too low, but would need a follow-up study to confirm this observation.

A check was also conducted on the NPV of shifting cultivation as this stood out as high, especially relative to forest types (namely young forests). The comparison was done with figures

12. FAOSTAT, Food and Agriculture Organisation of the United Nations, Rome. See faostat.fao.org/default.aspx?lang=en.

from JICA (2011) which estimated some of the costs and benefits of shifting cultivation practices in Luong Minh and Yen Na communes, Nghe An Province. Here, the equivalent NPV was found to range between US$245–640. This suggests that the US$400 NPV used for this analysis is well within the range of other areas of Vietnam.

Crop prices

The prices used in the SNV analysis (in US$/kg) were checked as well. The FAOSTAT database does not include price data for Vietnam, so national price information for coffee and cashews was collected from public sources through Internet research. Reliable price information for tea was not readily obtained.

- Coffee: Two 2011 sources gave domestic prices just under US$2.30, which compares reasonably well with the SNV assumption of US$2.05.[13] Prices obtained at the local level would be expected to be somewhat lower than the national, so the lower SNV price provides a further check.

- Cashews: Several 2011 sources gave prices in the $1.20 to $1.50 range.[14] Cashew prices increased markedly in 2010–2011 (nearly doubling from 2010 levels), in part due to shortages of cashews. These prices are two to three times higher than the SNV assumption (US$0.50).

Based on the analysis of yields and prices, it was decided that two sensitivity scenarios would be evaluated in addition to the base scenario. The first sensitivity reduced the tea yields for all farms by 61 per cent, the ratio of 1700 (based on the FAO data) to the average yield (2772) of all farms in the original survey. In the second sensitivity, the cashew price received by all farms was doubled to US$1.00/kg.

NPV of forest types

The NPV of the different forest types were derived from Hoang *et al.* (2010). Checks against other published sources were conducted, and found to be generally consistent with the trend of the numbers used by SNV. In particular, Hansen and Top (2006) investigations into the economic valuation of Cambodia's natural forests illustrates how forested areas of higher carbon sequestration potential had lower NPV associated with the NTFP coming from these areas. This is consistent with the results shown in Table 1 for Vietnam.

A follow-up with the authors of Hoang *et al.* (2010) also confirmed that the reason for providing higher NPV for poorer quality forests was due to the higher accessibility and use of the resources in these forests, relative to higher quality forests. Here, it is assumed that areas of higher quality forest are typically in areas which are difficult to access. Therefore, although the potential value of the NTFPs from these forests is high, they are not realised because of the difficulties associated with accessing the resources. Similarly, areas of poorer forest quality are more likely to be within close proximity to villages, making them easier and less costly to exploit. It should also be acknowledged, however, that less accessible forests will also be less attractive to agriculture given that market access can be assumed to be lower in such areas. As such, these areas of richer, less accessible forest will also likely have lower returns associated with agriculture because of the higher costs associated with land conversions and marketing (i.e. transport costs).

It is also acknowledged that studies in other areas of Vietnam suggest an alternative view. JICA (2011), for example, suggests that for Binh Phuoc Province, the NTFP values of natural

13. See www.coffeemarketnews.com/2011/07/28/vietnam-coffee-domestic-prices-above-london-amid-thin-stocks; www.ineximdaklak.com.vn/portal/content/view/180/31.
14. See www.businesstimes.com.vn/domestic-cashew-prices-top-vnd30000kg; www.21food.com/news/detail36424.html.

medium forests are significantly higher that the value of natural forest of poorer quality. These figures, however, are calculated based on the operations of an agroforestry company, as opposed to small-landowners. As such, issues like accessibility can be thought of as less of a problem for larger-scale operators than for smallholders due to the availability of capital such as large machinery and transport. For this reason, the method used in the analysis for poorer landowners in Cat Tien and Bao Lam was considered more appropriate than assuming the same trend as for larger operators.

Carbon sequestration

Carbon values used for this analysis were checked against estimates from JICA (2011). These included a detailed assessment of changes in carbon stocks across different land types in three communes across three different provinces. Although the ranges of carbon detailed in the study varied depending on the geographic location, the carbon estimates used for Cat Tien and Bao Lam were comparable with the ranges given across other provinces. Only coffee estimates from the JICA study appeared significantly different, with ranges of between 18–23 carbon tonnes/ha. Therefore, the coffee opportunity cost estimates for Cat Tien and Bao Lam should be considered in view of this potentially inflated carbon value and may be higher than estimates in other areas of Vietnam.

Young forests

The classification of young forests was used on the basis of the available land-use matrices provided by NIAPP. Cross-checking this classification with Circular 35/2009/TT-BNNPTNT on criteria for forest classification and identification, it is obvious that young forests are more a description of the phase of a forest's growth rather than a classification type. Values for the carbon stock were again sourced from Hoang *et al*. (2010) which were calculated on the basis of fallow/regenerating forest. However, it is acknowledged that, assuming such forests achieve maturity over the 30-year time-horizon, the carbon value will be much higher. As such, the values for young forests are likely to be an underestimate of the true carbon value potential. Therefore, the opportunity cost estimates for young forests are likely to be overstated, since the true carbon value from such areas of land will be higher than assumed here.

1.2 Limitations of opportunity cost analysis

The following analysis and other studies demonstrate that estimates of opportunity costs can be an important tool to determine the viability of REDD+ and identify some of the key drivers of deforestation and forest degradation. Implementers of REDD+ should nonetheless understand that opportunity cost estimates have certain limitations. The results of any analysis should be considered in view of these. Some key limitations include:

- By themselves, opportunity costs will not provide a complete picture of the full impact of land-use changes on local and national incomes. This is because opportunity costs do not account for variables such as changes in employment. Direct on-site opportunity costs also understate the total opportunity costs, and do not account for changes in land-use activities, prices and other factors from REDD+ that can impact the wider economy (World Bank Institute 2011).

- Opportunity costs can be an important input into land-use decision-making, but should always be considered in light of political or other non-economic criteria (e.g. infrastructure development). It will be especially important for LEDP managers to consider the full range of possible drivers and motivations when a given forest or land area is under consideration for multiple uses, some of which may be motivated by profit potential (where opportunity costs can be of use) and others by political concerns.

- Opportunity costs analysis can provide estimates of the up-front investment required for agricultural and other development, as well as the potential minimum revenues needed as incentives for REDD+ projects. However, the willingness of farmers and other landholders to undertake investments and assume the risks will also depend in part on payback periods, credit availability, levels of investor confidence and other factors. Experience to date has shown that smallholders in developing countries tend to be risk-averse, and their ability to access loans and credit is often limited. In many cases they will require up-front financial assistance or risk guarantees to agree to undertake REDD+ and other low-emission activities, a factor which will not be captured by basic opportunity cost analysis.

- Opportunity costs will need to be considered amongst a broader understanding of the socio-economic conditions of the related areas. Used alone, opportunity costs may indeed identify low-cost opportunities for REDD+ activities, but fail to realise the important context in which the existing land uses play in terms of livelihood benefits such as food and fuel provision for local people. Similarly, in many countries, local people have a strong cultural connection to certain areas of land that are very difficult to factor into opportunity cost estimates. For the purpose of identifying REDD+ opportunities that are indeed 'pro-poor', such considerations will need to be well understood alongside of opportunity cost estimates.

- As noted earlier, opportunity cost analysis will be more difficult to conduct in the case of illegal activities. In addition, the extent to which LEDP managers are willing and able to engage and work with illegal actors may make opportunity costs less useful in developing policies to address such activities.[15]

- Using opportunity costs to compensate landholders for revenues forgone can raise concerns over equity. In the design of payments for ecosystem services (PES) programmes, opportunity costs can be used to determine the minimum level of payment needed to provide an effective incentive for REDD+ and other conservation actions. But setting payments based directly on opportunity cost levels can lead to social conflicts and disputes when actors with similar landholdings receive different payments. Partly for this reason, many PES schemes set payment levels using a flat rate. LEDP managers using PES programmes may therefore need to balance equity concerns with potential effectiveness.[16]

- Although not a limitation specific to opportunity cost analysis, care must be taken when using opportunity costs in the context of different reference-level methodologies. REDD+ projects use forward-looking emission baselines, in which it is assumed that all of the reductions in emissions below this level would be available for crediting and sale (though some projects deduct a portion of the credits to account for potential leakage). A future international REDD+ compliance market, however, would likely credit national reductions in emissions relative to a historical reference level (with potential adjustments for specific national circumstances). It remains very uncertain how existing or future individual REDD+ projects would function after the start of a national REDD+ programme. It is foreseeable that some individual projects would either elect or be required to use a historical emissions baseline for crediting. In such cases, the application of opportunity cost analysis would need to account for the portion of reductions that would not be eligible for sale, as well as for the presumably higher carbon prices obtained.

15. For a discussion of potential approaches to addressing illegal activities in the context of payments for ecosystem services (PES) programmes, see Ogonowski *et al.* (2009).
16. For a related discussion of setting PES payment levels, see Ogonowski *et al.* (2009), pp. 13–15.

1.3 Results

1.3.1 REDD+ forest and opportunity cost analysis

The key results of the analysis are discussed below. Note that many different types of land conversion occur in the districts, not all of which involve forest areas. For example, the transition matrices show that from 2000 to 2010 some land planted with coffee was converted to cashews by 2010, and vice versa. This analysis focuses on two types of land-use changes:

- afforestation, reforestation and other activities leading to an increase in carbon stocks; and
- converting natural forests to cash crops and other non-forest areas, the avoidance of which could potentially be included as part of a REDD+ programme or project.

The latter is of most relevance to pro-poor REDD+, whereas the former is of interest to LEDP more broadly.

Forest cover change and CO_2 emissions

Both districts experienced a considerable loss in forest cover.[17] In Bao Lam, the total area of natural forest (medium, poor, conifer, mixed, bamboo and young) declined from 93.2 to 81.4 thousand ha in the 2000–2010 period, a loss of 13 per cent (see Table 2 below). Over four-fifths of the total decline in forest area occurred from 2000–2005; deforestation slowed considerably after 2005. Coffee was the major driver, with over 7.5 thousand ha planted on land that was natural forest in 2000.

Table 2. Change in natural forest cover in Bao Lam District, 2000–2010

Type	2000 cover (ha)	2010 cover (ha)	Net loss (ha)	Net loss (%)
Medium forest (80–150m^3/ha)	24,211	15,280	8931	37%
Poor forest (<80m^3/ha)	18,813	16,607	2205	12%
Conifer forest	10,228	10,146	82	1%
Mixed forest	27,194	25,695	1499	6%
Bamboo forest	10,942	10,663	280	3%
Young forest	1849	3033	(1184)	-64%
TOTAL	93,237	81,424	11,813	13%

As shown in Table 3, Cat Tien District's natural forest area of 31.3 thousand ha declined over the same time period by a smaller amount compared to Bao Lam (6.1 thousand ha). The proportional decline was greater however – nearly one-fifth of the 2000 total. In contrast to Bao Lam, most of the decline in forest area (80 per cent) occurred after 2005. The largest driver was cashew cultivation, with 4.2 thousand ha planted on land that had been natural forest.

- In Bao Lam, the loss of relatively high-carbon medium forest accounted for three-quarters of the net decline in natural forest cover. These forests also suffered significant degradation: nearly 4.1 thousand ha of medium forest became poor forest over the period, with an estimated loss of 16 tonnes carbon per ha. In Cat Tien, bamboo forest experienced the largest decline in area (nearly 60 per cent of the total), followed by mixed forest (17 per cent).

- The most significant conversions of forested areas into crops came from the conversion of conifer, bamboo and mixed forests. In Bao Lam, major drivers were the expansion of coffee and tea plantations which accounted for roughly 7000ha and 2000ha of conversions

17. The forest cover change estimates in this section were calculated directly from the original data in the land-cover transition matrices for each district. In addition to the natural forest area cleared, the values include changes that occurred between forest types due to degradation and recovery, as well as conversion of crop and other non-forest lands into forest.

Table 3. Change in natural forest cover in Cat Tien District, 2000–2010

Type	2000 cover (ha)	2010 cover (ha)	Net loss (ha)	Net loss (%)
Medium forest (80–150m³/ha)	3343	2636	707	21%
Poor forest (<80m³/ha)	3719	3235	484	13%
Conifer forest	0	0	NA	NA
Mixed forest	7984	6952	1032	13%
Bamboo forest	8313	4719	3594	43%
Young forest	7908	7646	262	3%
TOTAL	31,267	25,188	6079	19%

respectively. In Cat Tien, cashews accounted for around 3000ha of conversions from mixed and bamboo forests.

- The CO_2 emissions from clearance and degradation of the above six forest types over the 2000–2010 period totalled 5.3 million tonnes in Bao Lam and 2.1 million tonnes in Cat Tien.[18]

Opportunity cost analysis: enhancing forest carbon stocks and reducing deforestation and forest degradation

Tables 4 and 5 show the results of the opportunity cost analysis. Table 4 includes the forest and land transition options that lead to a net increase in carbon stocks (net sequestration options). In electing to enhance the carbon stocks of forests or other undeveloped lands, a landholder forgoes the revenues that could otherwise be obtained from agricultural or other development. The opportunity costs in this analysis therefore represent the difference in net present value between the NTFPs in the final forest, shrub or bare land, and an agricultural activity not undertaken. This analysis used one low-NPV crop (rice) and one high-NPV crop (coffee) for each net sequestration option; the opportunity cost estimate represents the ratio of the net change in NPV to the net increase in carbon stocks.[19] The results for rice and coffee are shown in each cell in Table 5 (p.17) as the upper and lower values, respectively.

Table 4. Opportunity costs for Bao Lam and Cat Tien districts: enhancement of carbon stocks in forests and undeveloped lands (US$/tonne CO_2)

Original land-cover*	Alternative land-cover						
	Medium forest	Poor forest	Conifer forest	Mixed forest	Bamboo forest	Young forest	Shrub land
Poor forest (<80m³/ha)	15.3 69.6						
Conifer forest	15.3 69.6						
Mixed forest	15.3 69.6						
Bamboo forest	15.3 69.6						
Young forest	3.6 16.4	3.1 19.8		3.1 19.8	3.1 19.8		
Shrub land	3.3 14.9	2.8 17.5	2.8 17.5	2.8 17.5	2.8 17.5	35.1 159	
Bare land	2.4 10.8	1.9 11.9	1.9 11.9	1.9 11.9	1.9 11.9	7.0 31.8	11.7 42.7

18. Calculated using the REDD Abacus model. Does not include carbon stock increases from sequestration.
19. More complete calculations would also factor in the costs of planting and other enhancement activities. However, due to resource and data constraints, these were not included here.

The analysis demonstrates that a number of options for enhancing carbon stocks exist in the districts, all of which would involve a net loss of NPV. Specific incentives to landholders (e.g. carbon payments) or public investment would therefore be required to encourage their implementation. For forests and lands likely to be converted to rice fields, the opportunity costs range from less than US$2 per tonne of additional CO_2 (carbon equivalent) sequestered to as high as US$35. The net costs for enhancing carbon on areas intended for coffee are much higher, ranging from a low of US$10.80 per tonne CO_2 to a high of US$159. The high US$ value results from the minimal increase in carbon stocks (7 tonnes per ha) that results from enhancing shrub land to young forest. With the large decline in potential NPV achieving a very low level of enhanced sequestration, this action yields a very high opportunity cost and will not be an attractive option for REDD+. In general, however, the costs of afforestation of non-forest areas (bare land and shrub land) are lower than for enrichment or recovery of existing forests.

In terms of carbon sequestration, afforestation of bare land would increase carbon stocks by over 100 tonnes per ha (for transition to medium forest) and 87 tonnes (for transitions to forest other than young forest). Transitions from shrub land or young forest to medium forest would sequester some 70 tonnes per ha, while transition to other forest types would sequester over 50 tonnes per ha. A much lower level of sequestration (16 tonnes per ha) would be achieved by enhancing poor, conifer, mixed or bamboo forest to medium forest. However, sequestration gains would also be made in terms of the avoided deforestation that would occur under such enhancement activities. The size of the emissions reductions would roughly correspond to the sequestration potentials for each forest type that are shown in Table 1. Although not factored into the calculations shown previously, this would slightly reduce the size of the opportunity cost of the conversions.

Enhancing forest carbon stocks to reverse degradation and preserve natural forest ecosystems will therefore be more expensive than afforestation of non-forest areas. On the other hand, reforestation and/or enrichment planting on bare land, shrub land and young forest intended for conversion to rice fields or other low-NPV crops will cost less than US$5 per tonne CO_2, approximately the current carbon price on the voluntary market. If implemented as part of a REDD+ project, such options could therefore help to boost rural incomes and rehabilitate forests.

Table 5 (p.17) displays the results for land-use transitions that produce an increase in carbon emissions and are therefore potential targets of REDD+ projects. Where there is an increase in the NPV from the original land use to the alternative, the opportunity cost of avoiding this transition will be positive – i.e. compensation would need to be given to avoid the land-use transition. Conversely, if the land-use transition results in a loss of NPV, the opportunity cost will be negative.

Under normal market conditions where all exchanges of goods involve payments and the prices of goods are known, transitions that reduce NPV of land would not be expected to occur. The opportunity costs of restricting land-use transitions from sustainable forest management to unsustainable forest management or from forest cover to agriculture are usually positive.

Several factors likely account for the opportunity costs obtained here. First, as already noted, the benefits from extracting timber in year one are not included in the cost calculations. These benefits can include revenues from the sale of timber, or direct use of harvested wood for fuel or construction materials, which can offset other expenses that would have been incurred. The section below indicates that these benefits are substantial. Second, NTFPs are often used directly rather than sold and landholders may not be aware of their relative market value, a factor that may be of particular importance in cases involving transitions between forest types or from forest to shrub or bare land. In the case of shifting cultivation, another factor that may contribute to the negative result is the relatively small magnitude of the NPV (US$400). As suggested earlier, this value was checked against similar figures for communes in Nghe An Province and found to be within the range of NPV for shifting cultivation there. In the JICA (2011) study, the value of shifting cultivation was found in some cases to be less than that of forested areas, suggesting the value of NTFPs and the potential sale of carbon credits for certain forested areas was more profitable than conversions into agriculture. This result is consistent with what is demonstrated here for Cat Tien and Bao Lam. However, additional research into the practices, uses and market transactions related to timber and NTFP harvesting would be needed to provide more definitive results.

The opportunity cost results for key REDD+ options include:

- Shifting cultivation is the only agricultural option with an NPV so low that the opportunity costs of avoiding conversion of poor, conifer, mixed or bamboo forest to this type of agriculture would be negative. This indicates that such conversions are not profitable, though the caveats noted above regarding harvested timber and the relative value of shifting cultivation over time suggest that they may in fact produce a net benefit overall. This result is nonetheless interesting in the context of land-use planning and LEDP given that investing in alternative land uses to shifting cultivation may not only be more profitable for the farmers involved, but also less emissions-intensive. The opportunity costs for avoiding the conversion of medium or young forest to shifting cultivation are positive but very low (less than US$1 per tonne). With such slim profit margins, these conversions may not be profitable after accounting for implementation (e.g. labour for land clearing and soil preparation) or other costs. However, converting shrub land would be profitable, with an opportunity cost of nearly US$4 per tonne.

- Rubber has the highest opportunity costs in the districts. The opportunity costs for rubber range from US$95 per tonne CO_2 avoided from conversion of poor, mixed or bamboo forest to US$302 for conversion of shrub land.

- For most natural forest types (medium, poor, conifer, mixed and bamboo), opportunity costs from conversion to crops (other than rubber), forest plantations or settlements/infrastructure are less than US$12 per tonne CO_2, with a low of US$1.90 for conversion to rice or other annual crops.

- With the exception of young forest, opportunity costs for conversion of natural forests to rice, other annual crops, plantations, cashews, tea, settlements/infrastructure or water bodies are all below US$5 per tonne CO_2, the current average carbon price on the voluntary REDD+ market (this is discussed in more detail in the next section). Coffee has higher opportunity costs in the US$11–12 range.

- Conversion of young forest has higher opportunity costs for each category, ranging from US$7 per tonne CO_2 for conversion to other annual crops to US$32 for coffee and US$239 for rubber. The opportunity costs from conversion of shrub land are higher still.

- The analysis also identified losses resulting from degradation of natural forest areas over the 2000–2010 period. Degradation of medium forest (which primarily changed to poor and mixed forest) in the districts is associated with an increase in NPV and a reduction in carbon stocks. Avoiding degradation of medium forest therefore has a positive opportunity cost of US$5.10 per tonne of CO_2. Degradation and conversion of other forest types to shrub land or bare land result in a loss of both economic value and carbon. This was likely due to unsustainable harvesting of fuel wood (and possibly NTFPs as well). If this trend continues, both fuel wood and NTFPs will likely become less available and their collection more difficult and expensive going forward.

- Table 5 (p.17) displays the results of the analysis. The abatement cost curves for the two provinces generated with the REDD Abacus model are shown in Figures 3 and 4 (see p.18).[20]

20. In Figures 3 and 4, both include all transitions from natural forest, bare land and shrub land to agriculture, settlements and water bodies. They also include positive cost transitions (degradation) of medium forest. They do not include transitions between other forest types, bare land and shrub land.

The two crop sensitivity scenarios were evaluated next. In Scenario 1, the 30-year NPV for tea falls from US$1950 to US$1200 per ha, a decrease of nearly 40 per cent. The opportunity cost for conversion of natural forests falls by a larger proportion. Opportunity costs for the conversion of forest types other than young forest decrease from over US$4 per tonne CO_2 to between US$1.90 and US$2.40 per tonne. For the conversion of young forest to tea, the opportunity cost falls from US$13 to US$7 per tonne.

In Scenario 2, increasing the cashew price by 100 per cent throughout the 30-year period more than doubles the NPV, which rises from US$1753 to US$3836 per ha. The opportunity cost for conversion of most forest types increases significantly, from less than US$4 per tonne to US$9–US$10 per tonne CO_2 – close to the opportunity cost for coffee. Converting young forest rises from US$11 to US$28 per tonne.

Effect of including carbon sequestration potential of different crops

For the reasons outlined earlier, the opportunity cost estimates conducted in this analysis did not include the carbon sequestration values of the different crops in the study sites. However, a brief analysis was added to explore the effect of adding in default values for the carbon sequestration potential of these crops. Results are shown in green brackets in Table 5, alongside the corresponding carbon values used shown in Table 1.

Predictably, the impact of including the carbon sequestration values of crops was to increase the opportunity cost of the different land-use scenarios. By accounting for the carbon sequestration potential of crops, the net carbon loss from the land-use transitions is smaller. This means that the opportunity cost becomes relatively more dependent on the effect of the NPV. This is most apparent in the case of high value crops such as coffee, which also have a relatively large carbon sequestration potential. Here, opportunity costs increased well beyond the US$10/tonne price and upwards of US$28/tonne.

Although the opportunity costs of conversions into forestry plantations, cashews and tea increased, they remained less than US$4/tonne, US$8.50/tonne and US$7.80/tonne respectively. This suggests they would still be viable options under current expectations for future international carbon prices. For the case of young forest conversions to plantations, however, the very marginal difference between the carbon sequestration potential between the two land uses meant that the opportunity cost was heavily influenced by the much higher NPV generated by plantations. This caused the opportunity cost of this land use to increase significantly, well beyond US$100/tonne. Rubber also experienced a significant increase, suggesting that REDD+ will be largely uncompetitive with rubber plantations regardless of whether the carbon sequestration potential of the plantation is factored in or not.

Some results for young forests and shrub land are not shown under Table 5 using the new assumptions around the different carbon sequestration of crops. These results relate to land-use transitions where there is a significant increase in the carbon sequestration potential. As both the NPV and carbon sequestration rate under the alternative land use were higher than the existing land use, very large negative opportunity costs were produced by the model. This highlights a key problem associated with the assumptions around young forests, in so far as the carbon sequestration rate does not change over time as it matures. As such, this overstates the actual divergence in sequestration rates which would be expected to decline as the young forest moves into a higher classification of forest. Subsequently, this exaggerates the size of the opportunity cost. For shrub lands, these results also indicate methodology challenges when dealing with a very low carbon existing land use. With the inclusion of the carbon values of crops, it would appear not to make sense either in terms of carbon or agricultural income to retain the existing land use. However, the large extent to which this occurs here suggests the estimated values for carbon and NPV for shrub land needs revisiting. This could be the subject of further research.

Table 5. Opportunity costs for Bao Lam and Cat Tien districts: conversion of forests and undeveloped lands (US$/tonne CO_2)

Current land-cover	Alternative land type/use																	
	Medium forest	Poor orest	Conifer forest	Mixed forest	Bamboo forest	Young forest	Shrub land	Bare land	Shifting cultivation	Rice field	Other annual crops	Forest plantations	Cashews	Tea	Coffee	Rubber	Built-up area	Water body
Medium forest	NA	5.1	5.1	5.1	5.1	0.0	-1.1	-0.8 (0.83)	0.3 (0.31)		2.4 (2.5)	2.6 (3.9)	3.8 (7.5)	4.4 (7.1)	10.8 (21)	NA	4.5	4.5
Poor forest	NA	NA	0.0	0.0	0.0	-1.6	-2.8	-1.9 -1.97	-0.6 (-0.7)	1.9 (2)	1.9 (2)	2.2 (3.5)	3.6 (8.5)	4.2 (7.8)	11.9 (27.9)	95.3 (224)	4.4	4.4
Conifer forest	NA	0.0	NA	0.0	0.0	NA	-2.8	-1.9 (-1.97)	-0.6 (-0.7)	NA	1.9 (2)	2.2 (3.5)	NA	4.2 (7.8)	11.9 (27.9)	NA	4.4	4.4
Mixed forest	NA	0.0	0.0	NA	0.0	-1.6	-2.8	-1.9 (1.97)	-0.6 (-0.7)	1.9 (2)	1.9 (2)	2.2 (3.5)	3.6 (8.5)	4.2 (7.8)	11.9 (27.9)	95.3 (224)	4.4	4.4
Bamboo forest	NA	0.0	0.0	0.0	NA	-1.6	-2.8	-1.9 (1.97)	-0.6 (-0.7)	1.9 (2)	1.9 (2)	2.2 (3.5)	3.6 (8.5)	4.2 (7.8)	11.9 (27.9)	95.3 (224)	4.4	4.4
Young forest	NA	NA		NA	NA	NA	-11.7	-2.3 (-2.6)	0.8 (1.4)	7.0 (8.2)	7.0 (8.2)	7.8 (136)	11.3	12.9 (22.5)	31.8	239.2	13.2	13.2
Shrub land	NA	NA	NA	NA	NA	NA	NA	0.0 (0.0)	3.9 (8.4)	11.7 (14.2)	11.7 (14.2)	12.7	17.1	19.0 (41)	42.7	301.9	19.5	19.5
Bare land	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

The table includes values for land-use transitions that result in either a net decrease in carbon stocks (potential REDD+ options) or no-change projects (transitions between some forest types). Positive values show the gain in profitability with the conversion to the final land use per tonne of CO_2 emissions. This indicates that a minimum level of compensation would be needed to prevent this land conversion taking place. Negative values show that the land-use transition resulted in a loss of NPV. Blank cells indicate no transition took place in either district during the 2000–2010 period (see Annex 2). This analysis aims to relate the opportunity costs to the actual situation observed on the ground, so potential transitions that have not yet been observed were not included. Figures in brackets show unit costs if carbon stocks in alternative land uses are included.

Figure 3. Bao Lam abatement cost curve (excluding carbon sequestration values of crops)

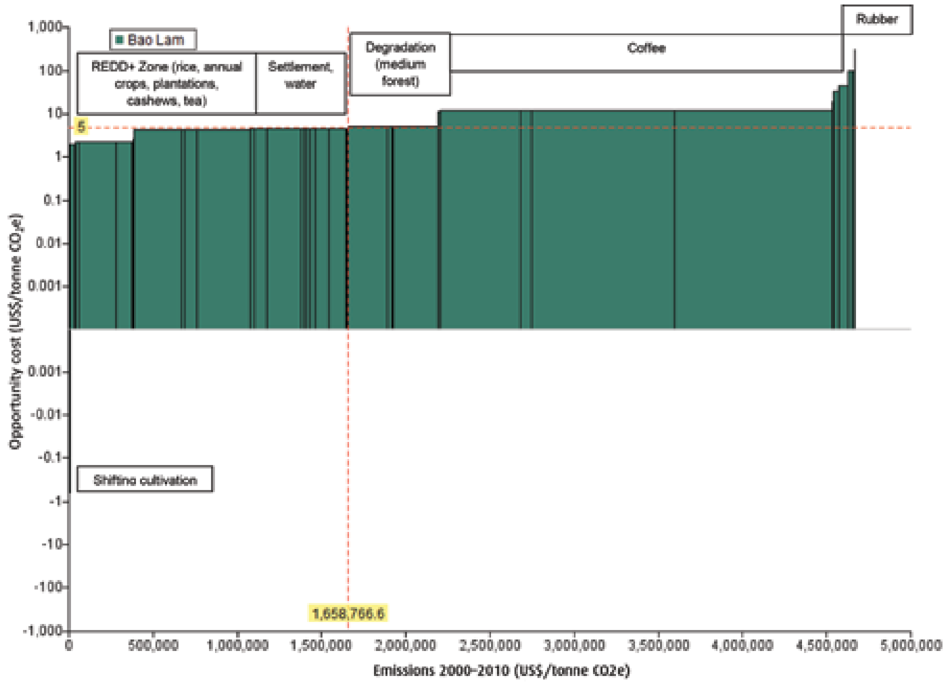
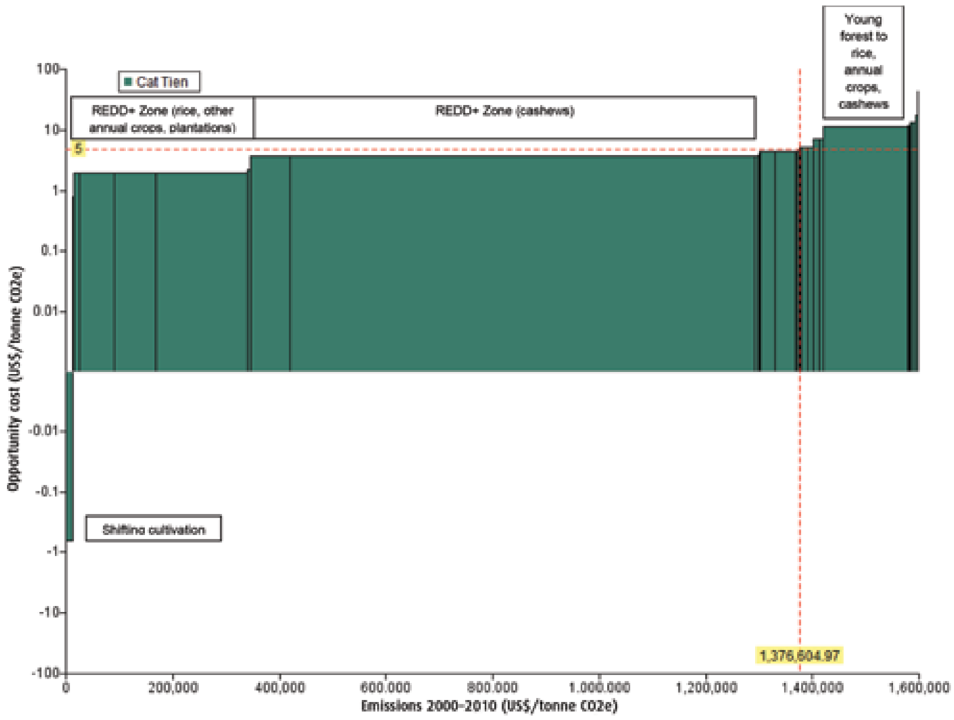


Figure 4. Cat Tien abatement cost curve (excluding carbon sequestration values of crops)



In addition to the land-use transitions evaluated above, opportunity costs for another set of potential options for enhancing carbon stocks were analysed. These options involve discontinuing existing activities on developed lands and converting the land back into forests to sequester carbon. Table 6 displays the opportunity costs for transitions that took place in the two districts between 2000 and 2010.

All results under Table 6 excluding those for shifting cultivation suggest a net loss in profitability from the existing land use to the alternative. However, the size of the loss, and the size of the opportunity cost, varies considerably. Almost all of the options for reforestation are below the US$5/tonne threshold. For coffee, the opportunity costs are higher due to the larger value of coffee relative to other crops, especially rice. For conversions into young forests, the opportunity costs are much higher due to the smaller sequestration rate of younger forests.

However, it is likely best to consider the results of medium forests and young forests as being indicative of the range of opportunity costs that will prevail over the course of the reforestation effort. For example, transitions from a tea plantation into a medium forest stand will take time in which the forest will transform from a young forest into a more mature, high-quality forest type. Therefore, the opportunity cost will likely change over time. Also, it is important to note these figures do not include the costs associated with reforestation efforts, such as planting, pest control and seedlings. As such, these estimates are more likely to represent a lower-bound of the actual opportunity costs for reforestation efforts.

Table 6. Opportunity cost results for Bao Lam and Cat Tien districts: carbon sequestration options on developed lands (US$/tonne CO_2)*

Current land use/ activity	Alternative land type					
	Medium forest	Poor forest	Conifer forest	Mixed forest	Bamboo forest	Young forest
Shifting cultivation			-0.6		-0.6	0.8
Rice field		1.9		1.9	1.9	7.0
Other annual crops	2.4	1.9	1.9	1.9	1.9	7.0
Plantation forest		2.2	2.2	2.2	2.2	0.8
Cashews	3.9	3.6		3.6	3.6	11.3
Tea	4.4	4.2	4.2	4.2	4.2	12.9
Coffee		11.9	11.9	11.9	11.9	31.8
Built-up area	4.5	4.4	4.4	4.4	4.4	13.2
Water body	4.5	4.4	4.4	4.4	4.4	13.2

*Excludes land-use transitions that did not take place between 2000 and 2010

In addition, some of the transitions identified will likely be impractical to undertake. This can be due to their very high profit margins (e.g. rubber plantations), the cost and difficulty involved in converting some developed lands to forests (e.g. roads, settlements and other built-up areas), or the potential for adverse environmental impacts (e.g. conversion of wetlands or reservoirs). Decisions to undertake conversions of agricultural and other developed lands may also be based in part on non-economic criteria. Finally, it is important to keep in mind that the specific activities that would qualify as eligible enhancement of carbon stock actions under the United Nations Framework Convention on Climate Change (UNFCCC) REDD+ provisions and the associated requirements have not yet been elaborated. The transitions in Table 6 should therefore be thought of as 'second tier' REDD+ and LEDP options.

Despite these limitations, some useful conclusions can be drawn. Converting shifting cultivation to forest would likely be only marginally unprofitable, and in the case of conversion to conifer or bamboo forest could even lead to a net economic gain depending on the implementation cost. Also noteworthy is the fact that for the land-use transitions identified, converting the first six agricultural options in Table 6 to medium, poor, conifer, mixed or bamboo forest would sequester carbon at less than US$5 per tonne. The costs for converting coffee lands to forest would be higher, as would converting most crops to young forest. These would be less promising as sequestration options.

1.3.2 Considering the value of timber harvested

The opportunity cost analysis conducted for this paper assumed that 100 per cent of the timber harvested during the first year of agricultural operations would be burned or used for other purposes (e.g. housing construction). This assumption was based on SNV's discussions with key actors involved in forestry in Lam Dong Province, including SNV field staff and government officials from the department of forestry and other agencies. These discussions yielded a range of responses as to the current use of cleared timber in the province. They indicated that there was no general pattern, and that decisions regarding cleared timber vary significantly depending on the specific needs, experience and location of the landholder. It should also be kept in mind that such forest clearing is technically illegal, and obtaining accurate and consistent information on this practice is therefore difficult. Based on this situation, SNV decided not to include potential market values of timber harvesting in the analysis. However, a sensitivity analysis was conducted to illustrate the potential impact of such activity on the opportunity costs. The assumptions and results are presented below.

Assumptions

- Potential wood volumes per hectare were taken from the Rainforest Alliance/SNV report, *The Feasibility of Carbon Financing for Improved Forest Management at Loc Bac State Operating Company, Lam Dong Province, Vietnam* (Gibbon *et al.* 2009). These wood volumes are estimates for Loc Bac district, where forest conditions are reasonably similar to those in Bao Lam and Cat Tien where the current analysis was based. The timber volumes (in m^3 per hectare) used for medium and poor forest were 160 and 66, respectively. This value for medium forest is slightly higher than the high end of the range shown for this forest type in Table 1. The table provides an average range for Vietnam as a whole, and does not reflect regional differences.

- The final market price for timber was obtained from discussions with the Huong Son State Operating Company in Ha Tinh Province. We believe these to be a good proxy for prices that would be obtained at the Loc Bac State Operating Company in Lam Dong Province.

Table 7. Current timber market prices, Ha Tinh Province (million VN$ per m^3)

Log type*	Price
Large	6.8
Small	6.5
Lower quality	3.5

*Large logs are defined as greater than 8.5 metres in length; small logs are shorter than this value.

- Timber cleared illegally by local landholders would be sold to middlemen buyers; the price that would be obtained will therefore be lower than that obtained by state-operating companies. To obtain an estimate of the actual household price, SNV used the differential between household and final market prices for three key crops sold in the central highlands (coffee, pepper and cashews) in 2010. As shown in Table 8, the average of the price differentials received by households for these crops was about 36 per cent that of the final market price. This factor was applied to the timber prices from the Huong Son State Operating Company to estimate the household timber price.

- An exchange rate of 20,700 Vietnamese dong per US dollar was used.

- Ninety per cent of the total potential timber volume was assumed to be useable after logging, and 20 per cent of this usable volume is assumed to be sold on the market. The 20 per cent share was based on field discussions between SNV, the forest protection department and other stakeholders in Loc Bac.

- The cost of clearing the timber was estimated, assuming that the daily pay rate for each logger would be about the same as that for patrolling the forest, about US$5 per day. The labour

Table 8. 2010 market and local crop prices in the central highlands (US$)

Crop	Market price	Source	Local price (assumed received at household)	Source	Difference
Coffee	1.50	http://festivalcafe.vn/index.php?option=com_content&task=view&id=101&lang=en	1.14	Ministry of Natural Resources and Environment (MONRE)	31.6%
Pepper	3.50	www.agroviet.gov.vn/en/Pages/news_detail.aspx?NewsId=492&Page=1	1.42	MONRE	40.6%
Cashews	1.30	As above for pepper	0.47	MONRE	36.2%

needed to clear one hectare of medium forest was set at 12 people for 3 days each; labour for clearing poor forest and young forest was set at 6 people for 3 days each.

- Revised opportunity cost estimates were developed for four forest types (medium, poor, conifer and mixed) and four crop types (shifting cultivation, rice, tea and coffee). The timber price for smaller logs was used for medium forest; the price for lower-quality logs was used for poor forest. Following on the original data used for NPV and carbon (see Table 1), timber volumes and log types for conifer and mixed forest were assumed to be the same as for poor forest. Bamboo forest and young forest were not included due to a lack of data and some apparent inconsistencies with the existing NPV and carbon assumptions.

Results

The results of the analysis are shown in Table 9.

Table 9. Opportunity costs for Bao Lam and Cat Tien districts, including potential timber sales (US$/tonne CO_2)

Original forest cover	Year one timber profit (US$/ha)	Final land use			
		Shifting cultivation	Rice field	Tea	Coffee
Medium	3076	8.4	10.5	12.5	19.0
Poor/conifer/mixed	633	1.4	3.9	6.2	13.8

The results show that the potential profit from selling timber clear-cut from medium forests is huge. At over US$3000, the value obtained in year one is greater than the 30-year NPV for each of the crops in this analysis except for coffee and rubber (see Table 1). The inclusion of these timber profits increases the opportunity cost significantly above the values obtained in Table 5. Converting and selling timber from medium forest raises the original opportunity costs for shifting cultivation, rice and tea well above the US$5 per tonne CO_2 carbon payment threshold, while the opportunity cost for coffee nearly doubles to US$19 per tonne. The timber profits for poor, conifer and mixed forest (over US$600) are much lower than for medium forest, but are still significant and close to the 30-year NPV of NTFPs from these forests. Including this profit raises the opportunity costs by about US$2 per tonne CO_2. The opportunity costs for converting these forests to shifting cultivation and rice remain below US$5 per tonne, but including the timber value pushes the cost for tea above the US$5 level to US$6 per tonne.

This sensitivity analysis demonstrates the potential importance of timber sales for landholders making decisions on whether to clear forests or undertake a REDD+ project. In the case of medium forest, it is clear that the profits to be made from selling even a small portion of the timber will likely render the incentives from REDD+ projects inadequate. In fact, under the above assumptions, carbon prices would have to be over US$7 per tonne CO_2 simply to compensate landholders for the forgone timber profits alone. The impact will be less significant for the other forest types, and REDD+

would still provide an adequate incentive for preserving them in many cases. However, it should be emphasised that this analysis only considers the profits from selling a portion of the timber, and therefore likely understates the potential benefits from timber cutting.

Research conducted by SNV indicates that much of the timber that is cut but not sold is used as fuel or in construction. Ideally, the value of other fuels (e.g. coal) or building materials (e.g. metal) that would have been purchased but have been offset by the use of timber/wood should therefore be included in the opportunity cost as well. Additional research would be required to address this question. Issues that would be useful to explore include:

- deeper analysis of the quantities of timber sold and the average local prices received;
- the types and costs of fuel used in the districts when wood is unavailable (for example, animal dung that farmers might use as fuel may not have monetary value);
- the types and costs of construction materials used; and
- the extent to which cleared timber used for construction is based on prior needs, or whether the clearing itself creates new demand for additional houses/structures.

These factors could all impact on the effective value of the timber cleared, and with it the opportunity costs.

1.4 Discussion: implications for pro-poor REDD+ and poverty reduction

In communities in areas such as Bao Lam and Cat Tien, REDD+ can potentially offer local farmers a pathway to a sustainable livelihood that can also contribute to national and global climate change objectives. To do so, however, REDD+ must provide adequate financial incentives to farmers to maintain forests in their natural state. While the actual full costs of REDD+ will include transaction, implementation and other costs, opportunity costs will represent the largest share of the total in many cases, on the order of 80 per cent or more (Boucher 2008). Acknowledging that little is still known about the transaction and implementation costs of REDD+, opportunity costs can provide a meaningful estimate of the minimum level of incentive needed. In this regard, it is useful to compare the results from the above analysis with the carbon prices currently available on the voluntary REDD+ market, assumed here to be around US$5 per tonne CO_2, and with potential prices that might be obtained on a future compliance market.

This analysis shows that REDD+ is competitive with most of the key agricultural land-use options explored. Of the seven main options – rice, other annual crops, forest plantations, cashews, tea, coffee and rubber – all but the last two crops have opportunity costs less than US$5 per tonne. For coffee, while the opportunity cost is more than double the assumed carbon price, the US$11–12 per tonne CO_2 value is well within the range of prices that would be anticipated on a future international compliance market for REDD+. For example, Australia's Carbon Tax has placed a levy on carbon emissions equivalent to roughly US$24 per tonne. It also has plans to link to the European compliance market as of 2018, lending to speculation around future higher carbon prices than the current rate that hovers around US$5 per tonne (BBC 2012).

Only rubber remains far outside the current and potential future carbon price ranges for REDD+. It is clear that in the case of large, efficient and highly profitable rubber plantations, a REDD+ market alone will be ineffective at preventing conversion of natural forests. Up until 2010, rubber production in the districts was minimal: none was undertaken in Cat Tien, while in Bao Lam the total area of rubber cultivated in 2010 was less than 0.5 per cent of the total remaining natural forest. However, under current forestry development plans for Lam Dong Province, this is set to change. For example, by 2020 more than 9000ha of rubber plantation will be established through four communes falling within the districts of Bao Lam and Cat Tien.[21] A large proportion of this is likely to be developed in areas previously under cashews.

21. This is according to the Provincial People's Committee (PPC) of Lam Dong's Decision 2495/QD-UBND dated 22 October 2010 for the approval on adjustment of rubber planning for Lam Dong Province until 2020.

However, the outlook for REDD+ appears bright when considering the current state of the forests in the districts. Of the six main natural forest types considered, only one (young forest) is associated with an opportunity cost for avoiding conversion higher than US$12 per tonne CO_2 and in this case as discussed earlier, the estimates are likely to be overstated because they do not take into account the increase in carbon content of this type of forest over time. Young forest represents less than 4 per cent of natural forest area in Bao Lam and just 10 per cent across the two districts; the opportunity costs for 90 per cent of the forests will thus be relatively low. In Cat Tien, however, the total area of young forest is 30 per cent of the total natural area of the district. The opportunity costs for this land will be higher on average than in the rest of the districts.

The results of this analysis have significant implications for rural poverty reduction in the two districts. Afforestation/reforestation (A/R) and forest regeneration can improve rural livelihoods and increase carbon stocks at the same time. Opting to convert bare land, shrub land or young forest areas to higher-carbon density forest instead of engaging in low-NPV agriculture (e.g. shifting cultivation, rice) can be profitable for small farmers, if implementation and other costs of tree planting projects can be kept low enough. Sales of carbon sequestration credits could then raise incomes. However, sequestration projects will be less attractive for farmers intending to grow coffee or other high-value crops.

In addition to A/R, this project also identified important pro-poor agricultural options. As noted earlier, agricultural projects undertaken by poor farmers often start with lower than average yields. These yields tend to decline fairly rapidly after the first few years of harvest, leading many farmers to increase the area cultivated to make up for declining revenues. Low and declining yields can thus drive deforestation (as the poor clear additional forest areas for new harvests) and degradation (as they undertake other income-generating activities such as NTFP harvesting at a more rapid pace). The latter can accelerate existing degradation, resulting primarily from the gathering of wood for fuel. By providing a sustainable source of income to poor communities, REDD+ can avoid this damaging cycle of expanding deforestation and degradation, and in doing so protect forests and associated NTFPs and co-benefits – but only if REDD+ can be competitive with the crops most likely to be planted by poor farmers.

The results obtained here indicate that this is indeed the case in the two districts evaluated. Rice, other annual crops, cashews, tea and coffee are commonly planted by poor farmers in districts such as Bao Lam and Cat Tien. This can be illustrated by the fact that the average land holding for tea and coffee across the households interviewed in this analysis was only half a hectare. Furthermore, earlier socio-economic studies by Nguyen and Enright (2012) – using the same data source as for the opportunity cost estimates – suggested between 25–45 per cent of households across the study communes were considered poor, almost all of whom relied on agriculture for their livelihoods.

The opportunity costs for all of these crops except coffee are around US$4 per tonne CO_2 reduced or less for many forest transitions, making them appropriate as targets for REDD+ projects. At a carbon price of US$5 a tonne, REDD+ can allow poor farmers to potentially increase their incomes by choosing to preserve natural forests instead of cutting them down.

Other pro-poor options exist as well. For shifting cultivation, the results show that such activities are at best only marginally profitable in the two districts. Working with poor shifting cultivators to conserve forests for REDD+ instead would likely produce a large boost in farmer incomes. Studies into the drivers of deforestation and degradation in Lam Dong Province have indicated that shifting cultivation is a major driver within Cat Tien and Bao Lam districts (Nguyen and Enright 2012). The exact numbers involved is difficult to estimate due to the discrete nature in which encroachment is carried out. However, ground observations reveal the practices are common and that population growth is continuing to drive further land demand and shifting cultivation (Huynh 2010). This suggests that REDD+ efforts to target shifting cultivation have the potential to deliver considerable social and environmental benefits. Such efforts will need to be conducted in a way that is integrated alongside future land-use planning to successfully tackle perceived land shortages. Furthermore, JICA (2011) suggests that: 'It is generally accepted that it is difficult to change the attitude of farmers who are engaged in shifting cultivation'. Close collaboration alongside of local villagers will therefore be vital to any efforts to address the rate of land conversions into shifting cultivation.

The importance of harvesting and sales of NTFPs for both poverty reduction and REDD+ was illustrated quantitatively through a sensitivity analysis. The original REDD+ scenario was re-run, with the NPVs for the natural forest categories now set to zero. With revenues from NTFPs removed, the opportunity costs per tonne CO_2 for converting most of the five main forest types (excluding young forest) to rice, other annual crops or forest plantations nearly double (though they remain below the assumed US$5 per tonne threshold for REDD+). The opportunity costs for cashews and tea also increase to just above the US$5 per tonne level (in the US$5–6 range). Opportunity costs which are relatively low but close to the US$5 threshold can affect decisions regarding REDD+: many farmers will typically be risk averse and may require a 'cost buffer' to convince them to undertake a REDD+ project. Higher opportunity costs also make it more difficult to cover the initial investment and other costs of REDD+ projects. Therefore it is key that NTFP harvesting be made a central focus of efforts to evaluate and promote REDD+.

Results from the analysis including timber values also have important implications for the viability of pro-poor REDD+. In particular, the potential profit from selling timber that is clear-cut from medium forests is very significant. Even values for lower-quality forests are relatively high, requiring a carbon price of around US$7 per tonne even just to compensate for the potential revenue from timber sales alone. This highlights the importance of factoring in the potential revenues from timber sales into thinking about the viability of REDD+ for poorer stakeholders. Further analysis could also explore the non-marketed value of this timber to poorer stakeholders, based on on-the-ground observations which suggest many poorer stakeholders use the timber felled for domestic fuel and construction.

This analysis shows that REDD+ remains a useful and viable option for farmers in the two districts who are considering converting natural forests to agricultural uses. REDD+ project developers in Vietnam should endeavour to identify and target those forest areas that appear likely candidates for developing crops with low opportunity costs. These include rice, other annual crops, forest plantations, and tea. For crops with higher opportunity costs such as coffee and potentially cashews, a sound approach would include monitoring trends in local commodity prices, and promoting REDD+ if prices (relative to the prevailing carbon price) should fall. REDD+ projects should also focus on developing projects in the forest types with higher carbon values. REDD+ actions aimed at avoiding conversion of young forest areas in Cat Tien will have higher unit costs and be less competitive than REDD+ actions focused on conserving other types of forests. If resources are limited, it may be advisable to direct them to other forest areas first.

In addition to the implications for REDD+, the results also suggest how opportunity cost analysis can more broadly be useful in developing and implementing LEDPs. REDD+ will be a key tool in protecting natural forests, but successful LEDPs will also need to consider the total change in greenhouse gas emissions (GHG) between different types of land-use activities. In addition to impacts on forests, plant and soil carbon this will include emissions of CO_2 from fossil fuel combustion in farm equipment, vehicles and buildings, and methane from plants and livestock, N_2O from fertiliser and others. For example, as shown in Table 6, sequestering carbon by converting existing rice lands to several types of forest can be done at an opportunity cost of less than US$2 per tonne CO_2, well below the US$5 carbon price threshold. Equally significant, however, is the benefit from reducing emissions of methane, a gas with a global warming potential 21 times that of CO_2 – a much larger GHG 'bang for the buck' than would be obtained from enhancing carbon stocks alone. As such, LEDPs would need to consider coupling REDD+ activities with improved agriculture techniques aimed at lowering the emissions associated with rice production.

Additional costs of pro-poor REDD+

Part I of this analysis explored the application of opportunity costs for REDD+. It illustrated some of the benefits and limitations of applying this measure in assessing the viability of different REDD+ activities. The analysis also highlighted the different REDD+ opportunities with low opportunity costs, which are most relevant to poorer stakeholders. In doing so, a key risk was highlighted: opportunity costs could lead to the targeting of low opportunity cost land-use opportunities in poorer areas. This might threaten existing livelihoods and practices in these areas at the expense of the pursuit of low-cost REDD+ projects.

To illustrate, Table 10 shows the relative importance of different income sources to a sample of 280 households in Loc Bac and Loc Bao communes (Bao Lam district), with tea and coffee standing out as highly important across the six villages. The opportunity cost assessment also highlighted that coffee and especially tea expansion may be economically inferior options relative to REDD+. This result highlights that although tea and coffee may be low opportunity cost options for REDD+, both crops are considered very important livelihood sources for poorer stakeholders. Any future REDD+ activities would therefore need to consider the impact of conducting REDD+ with respect to the potential displacement or reduction of important livelihood activities.

This example illustrates the necessity of supporting structures and safeguards to ensure that livelihoods are not compromised in the pursuit of low-cost REDD+ options. One structure at the heart of the pro-poor approach will be the benefit distribution system (BDS).

Table 10. Relative importance of different crops in terms of income (where '1' is highest importance)[22]

Income source	Loc Bac			Loc Bao		
	Village 1	Village 2	Village 3	Village 1	Village 2	Village 3
1 Tea	1	2	1	1	1	2
2 Coffee	2	1	2	2	2	3
3 Hired work	3	3	3	3	5	1
4 Forest protection fee	6	4	4	4	3	4
5 Livestock	5	4	5	5	6	6
6 Forest products	4	5	3	6	4	3
7 Bamboo	N/A	N/A	N/A	N/A	N/A	7
8 Acacia	N/A	N/A	N/A	N/A	N/A	5

2.1 Benefit distribution systems for REDD+

The BDS in the context of REDD+ broadly describes the system which allocates international REDD+ finances down through national and sub-national structures to local actors in the form of a cash or in-kind benefit. A BDS will therefore be necessary at both national, sub-national (i.e. provincial) and local levels.

At the local level, the BDS will need to engage local actors in decision-making around the BDS format, including what types of benefits to deliver, how to deliver them, and at what point in time benefits are preferred to be delivered (Enright *et al.* 2012). The BDS will play an important role in shaping people's incentives to participate in REDD+, and ensuring that the benefits owed to local actors for their efforts flow through (ibid).

22. Source: Nguyen and Enright (2012).

2.2 Measuring the costs of pro-poor BDS

The importance of the BDS to REDD+ implementation requires a proper consideration of the costs of establishing and operating a local-level BDS, and what implications these costs have for the viability of pro-poor REDD+ activities. The approach followed below is the first attempt to conduct such estimates and therefore should be considered in view of the assumptions listed in Annex 3 and the limitations discussed below. In addition to drawing some preliminary conclusions, a list of key possible extensions to the exercise are included.

2.2.1 Methodology

The initial step to measuring the costs of the BDS was to determine the key cost categories involved in both the design and implementation of the BDS over a given period of time. Table 11 illustrates the six key cost categories alongside a classification of whether the cost is unique to a pro-poor BDS and the source from where the data came. The determination of whether the activity was considered unique to a pro-poor approach was used on the basis of the definition of 'pro-poor' from Enright *et al.* (2012) and their approach to pro-poor BDS advocated.

Table 11. Cost types and classifications

Activity	Activity unique to a pro-poor approach? Y/N	Source of cost data
1. Initial awareness-raising and consultations with local actors around REDD+ and BDS	Y	SNV/UN-REDD activities
2. Establishing an appropriate local-level fund for the receipt of funds and distribution in some form of benefit (i.e. regulation design etc.)	N	*
3. Involving local actors in benefit format decisions	Y	SNV/UN-REDD activities
4. Operating the local fund	N	UN-REDD Phase II (Appendix G)
5. Establishing supporting mechanisms		
5a. Recourse mechanism board	Y	EU cost norms
5b. Anti-corruption system	Y	**
5c. Distribution mechanism	N	CIFOR (unpublished data)
6. Calculation of commune-level R-coefficients	Y	SNV estimates

* Costs for Activity 1 are included in Activity 2 as they are seen as activities that are conducted concurrently.
** Assumes costs are absorbed at the national level, given that local-level anti-corruption measures are likely to be part of much larger national systems and policies.

All costs were considered over a five-year time horizon. This was seen as a reasonable period in which the BDS could be established and ready to distribute at least one performance-based payment. Here, we assume that a performance-based payment would be made in accordance with the actual emission reductions over the given time period (i.e. five years).[23]

Next, each major activity was considered in terms of the different costs associated with the activity. Costs included staff time, participation payments, transport and accommodation etc. The detail of these costs depended on the quality of the available data. Those costs relating to actual SNV activities could be estimated using budgeted figures. Assumptions for other costs were needed for both the types and sizes. These are detailed in Annex 3.

The total costs for each activity were then normalised to a single household unit. The way in which individual households have been defined depends on the source of the data collected, which is also detailed in Annex 3. It is important to note that two different estimates of the total

23. It is well known that proxy-based measures of performance may also be used to reward actors for REDD+ efforts. For the purpose of simplicity in measuring the disbursement rate and timing, we assume here that benefits will be made on the basis of actual carbon emissions. Thus, a five-year time horizon would allow for at least one payment period to take place.

number of households were used to analyse the cost categories 2, 4, 5 and 6. The first uses the definition contained in the UN-REDD (unpublished) Phase II proposal of 'Max number of forest users affected' (equal to 14,713 households). The second definition takes a second estimate of the 'Households' listed under the intervention packages contained in the UN-REDD Phase II document (equal to 27,788 households). Efforts to clarify which figure was most likely to be the target number of future beneficiary groups with the proposal's authors were unsuccessful. As such, both scenarios are represented to provide a 'low' and 'high' range estimate.

The normalised costs for each activity were then summed to provide a total cost estimate for establishing and operating both a pro-poor and a non-pro-poor approach to the BDS over the five-year time horizon.

To analyse the costs in a similar format to the opportunity cost analysis the costs were then converted in terms of the cost per tonne of CO_2e. The method used includes:

- Taking the total intervention area for Lam Dong Province (as per the UN-REDD Phase II proposal) and calculating the total expected carbon gain over 5 years, assuming the expected gains in carbon stocks amount to 4 tonnes/ha/year (including natural growth of 2 tonnes/ha/year and another 2 tonnes/ha/year reduction in deforestation or forest degradation) (from Sikor *et al.* 2012).
- The total carbon gains over the five years were then expressed per household by dividing throughout by the number of households (both high and low estimates).
- The individual carbon sequestration amount could then be used to divide through the cost per household of both the pro-poor and non-pro-poor estimates to give a final estimate of the cost of the BDS per household in terms of CO_2e.

2.2.2 Limitations

The results shown in this section of the report should be considered in view of the assumptions listed in Annex 3 and as such are indicative, rather than conclusive of some of the costs associated with pro-poor BDS.

It should also be acknowledged that the costs of the pro-poor approach are not necessarily bound by the considerations suggested in Table 11. Instead, pro-poor approaches could have different interpretations and forms depending on the local context. The results shown here are based on SNV's experiences with developing pro-poor approaches in Vietnam, and more specifically on its experiences in Lam Dong province. It may be appropriate to include additional costs that have not been considered here. Similarly, some costs may be higher or lower depending on the individual context. For example, more remote areas will obviously require a larger number of resources, time and effort to conduct awareness-raising activities and processes to encourage local participation in benefit selection.

The results here are limited to a five-year time horizon. If the analysis was conducted over a longer period, we can assume the costs per year would be greatly reduced, due to the fact that there is a high up-front cost associated with establishing a local BDS. Subsequent years would incur much lower costs associated with the operation of the BDS.

Despite several attempts, it was not possible to contact the authors of the UN-REDD Phase II proposal which was used to calculate several of the cost categories. The assumption therefore needed to be made that the 'maximum number of forest users affected' represented individual beneficiaries of REDD+. Although this may be true in most cases, it will possibly exclude other forest user groups such as state-operated companies and national park authorities. However, this was considered a better alternative to using numbers quoted for the 'total intervention population' which was more likely to include individuals and groups separate from REDD+ activities, and as such, potential non-beneficiaries.

To balance this assumption, a second analysis was also completed using a higher estimate of the total households impacted by planned UN-REDD Phase II interventions. This estimate was also included in the UN-REDD Phase II proposal, but again could not be clarified as to which was most relevant. As such, it was decided to use this latter estimate as a 'high' impact scenario in the analysis.

The costs of the distribution mechanism were obtained from empirical evidence drawn from a recent unpublished study conducted by CIFOR in Son La Province. Although preferable to use estimates from Lam Dong, a lack of data required the use of data from Son La, the second payment for ecosystem services (PES) pilot site in Vietnam. It is known, however, that the administrative costs associated with PES distribution in Son La are higher than those in Lam Dong (Pham Thu 2012). As such, the estimates used here are likely to be an overestimate of the real cost. Given the comparatively small size of the costs of the distribution mechanism to other costs measured here, the impact of these costs on the final estimates is likely to be marginal.

2.3 Results

The key results of this analysis are illustrated in Table 12. The results are shown in terms of the two 'high' and 'low' estimates, representing the higher and lower targeted household groups contained in the UN-REDD Phase II proposal.

Table 12 suggests that the total cost of establishing and operating the pro-poor BDS for the first five years ranges roughly between US$39–52 per household compared to US$14–26 for a BDS which is not inclusive of pro-poor approaches. The additional cost of the pro-poor BDS approach per REDD+ beneficiary is therefore around US$25 per household over five years, or approximately US$5 per beneficiary per year for the initial five years.

Of this additional cost, roughly 98 per cent can be attributed to costs associated with conducting the self-selection activities. Given this will be a one-off cost at the beginning of the project, this suggests the costs for the pro-poor approach in the following years will be marginal. This is illustrated in Table 11, which shows that the additional cost of the pro-poor approach falls to between US$0.30–0.56 per household over five years when the cost of the self-selection exercises are removed.

However, the cost of the BDS, even with the self-selection activities removed, still remains relatively large per household. The results suggest that even the non-pro-poor approach will cost between US$14–26 per household over five years. The largest proportion of this cost would be derived from the management of the local fund used to disperse benefits. This is depicted in Table 13 which shows the beak-down of the different cost estimates for each of the individual costs measured.

Finally, the costs of the BDS have also been expressed per tonne of CO_2e. Note these cannot be directly compared to the opportunity cost estimates as they are expressed in terms of US$/tonne/household. The results suggest that a pro-poor BDS system across five years will cost an additional US$0.53–0.99/tonne/household.

For the results pertaining to the costs per household per tonne of CO_2e, it is immediately noticeable that the 'high' household estimate has a higher proportional cost to the 'low' estimate. This is simply due to the fact that the same number of calculated emissions reductions for the chosen area (see Annex 3) is spread across a large number of households for the 'high' estimate. As such, there are fewer emissions per household.

Table 12. Results of the BDS cost analysis

	Low (US$)	High (US$)
Total 5-year cost/household pro-poor	51.96	39.10
Total 5-year cost/household non-pro-poor	26.87	14.27
Additional cost of pro-poor approach	25.09	24.83
Total 5-year cost/household (excluding self-selection exercise) pro-poor	27.42	14.57
Total 5-year cost/household (excluding self-selection exercise) non-pro-poor	26.87	14.27
Additional cost of pro-poor approach/household (excluding self-selection exercise)	0.56	0.30
Total 5-year cost/household/tonne CO_2e pro-poor	1.09	1.56
Total 5-year cost/household/tonne CO_2e non-pro-poor	0.57	0.57
Additional cost of pro-poor approach/tonne CO_2e	0.53	0.99

Table 13. Breakdown of different cost components

	Activity	Pro-poor approach Y/N	Cost unit	Cost estimate Low (US$)	Cost estimate High (US$)
3.	Involving local actors in benefit format decisions	Y	$/HH	24.53	24.53
4.	Operating the local fund	N	$/HH	26.76	14.17
5a.	Recourse mechanism board	Y	$/HH	0.34	0.18
5b	Anti-corruption system	Y	NA	Costs absorbed at national level	Costs absorbed at national level
5c	Distribution mechanism	N	$/HH	0.10	0.10
6	Calculation of commune-level R-coefficients	Y	$/HH	0.22	0.12

2.4 Discussion

The results of this analysis should be considered as preliminary and indicative of the potential range of costs that might be attributed to establishing and operating a pro-poor benefit distribution system for REDD+ over the initial five years. By no means are these results final or definitive. Instead, they are a first attempt at trying to measure some of the costs associated with establishing the BDS, and the additional costs of implementing pro-poor BDS. The results should be seen in the context in which the data was collected. This is explained in Annex 3, but should be emphasised to ensure the results are not taken out of the local context.

In view of the limitations and assumptions, the results suggest that the cost of establishing the pro-poor BDS model will be considerable. A large proportion of this cost (98 per cent) can be attributed to the cost of conducting the self-selection activities; a key component of the pro-poor approach advocated by SNV (see Enright *et al.* 2012).

However, this result should be considered in view of the fact that economies of scale can be achieved with costs such as those relating to the self-selection activities. In particular, SNV's estimates are based on a very small group exercise conducted within 15 groups across seven villages. If conducted across a wider group of participants, it is reasonable to assume that the marginal unit cost would decline substantially (see section 2.5 on further extensions). This was the first time this approach was tested, and therefore it is also reasonable to assume that efficiency gains would be made through replication, again lowering the marginal cost of the activities per household.

Furthermore, future self-selection activities should find ways to reduce costs and lower the per unit cost. For example, hiring local organisations to conduct the activities would significantly lower the costs associated with travel and translators. Exploring ways to incorporate the self-selection activities with complementary activities, such as free, prior informed consent (FPIC) processes would also help to improve the cost effectiveness of the BDS design. The results from this analysis also suggest that the up-front costs of establishing the BDS will be high, whereas the operational costs comprise a much smaller fraction of the total costs. This is important in terms of thinking about who might bear these different costs.

For example, it is reasonable to assume that financing for the self-selection activities and other pro-poor related aspects of the BDS design could be covered by NGOs who have an interest in ensuring the rights of poorer and more marginalised groups are heard. Finances for initial start-up costs could also be supported through other means such as bilateral REDD+ support through the UN-REDD Programme or World Bank Forest Carbon Partnership Facility funds. This would significantly lower the costs of investing in pro-poor approaches for BDS, making them more attractive at a national level.

2.5 Further extensions to this work

This work is a first attempt at measuring some of the key costs associated with establishing and operating a key component of the REDD+ architecture in a manner that is considered to be pro-poor. Because of their preliminary nature, these estimates lend themselves to some potential areas of extension and improvements. These are summarised below:

- Improving estimates of the management costs of the funds used to disperse benefits: The preceding estimates rely on high-level estimates of the costs to manage the flow of finances from the national level, through to the sub-national (provincial) level and downwards, in the form of a cash or in-kind benefit to local actors. These estimates are speculative in so far as they are not based on an actual REDD+ benefit delivery system, as no such benefit flows exist in Vietnam at this point in time. Future estimates could build-in actual costs once payments are being made, through either project-based approaches, or through programmes such as the UN-REDD Programme Phase II pilot trials.

- Lowering the cost of self-selection activities: As discussed above, the costs used in this exercise to measure the per unit cost of the self-selection activities are high due to the small scale at which these activities were conducted. Future calculations should explore the impact of lowering the marginal costs of these exercises on the total costs of implementing pro-poor BDS models.

- Consideration of additional components of the pro-poor approach: These estimates identify four components of the BDS design that are uniquely pro-poor. However, depending on the context of the REDD+ intervention, there could be additional aspects of a pro-poor model that may need consideration. Alternatively, some of the costs considered in this approach could be shared across other activities (i.e. FPIC – see section 2.4) depending on the local context, therefore excluding them (fully or partially) from consideration.

- Improving estimates of recourse mechanisms boards and R-coefficient calculations: Given REDD+ recourse mechanism structures are yet to be established in Vietnam, in addition to the on-ground testing of the R-coefficient, the estimates for these values needed to rely on hypothetical structures of the recourse mechanism and calculators of the R-coefficient. Although these hypothetical structures were based on knowledge of similar governance structures at the sub-national level, future estimates could look to use actual costings from future pilot activities for REDD+.

- Using a carbon stock measure more applicable to the Vietnamese context: A general estimate of the potential carbon stock potential was used from Sikor *et al*. (2012) to help establish the costs shown per tonne of CO_2e. Future estimates should aim to use more context-specific estimates of the carbon stock potential.

Conclusion

The intention of this report was two-fold, and important conclusions can be drawn from each. The report intended to extend SNV's earlier work around opportunity costs for Bao Lam and Cat Tien districts and explore the results in terms of their implications for pro-poor REDD+. It also explored the application of opportunity costs in broader low emissions development plans (LEDPs). From this work, some general conclusions include:

- REDD+ appears to be competitive with most of the key agricultural land-use options explored. Of the seven main options – rice, other annual crops, forest plantations, cashews, tea, coffee and rubber – all but the last two crops have opportunity costs less than US$5 per tonne.
- Afforestation/reforestation (A/R) and forest regeneration can improve rural livelihoods and increase carbon stocks at the same time. Opting to convert bare land, shrub land or young forest areas to higher-carbon density forest instead of engaging in low-NPV agriculture (e.g. shifting cultivation, rice) can be profitable for small farmers, if implementation and other costs of tree planting projects can be kept low enough.
- The viability of REDD+ for poorer stakeholders is greatly influenced by the potential value stakeholders can receive from the sale of timber clear-cut from both medium- and low-quality forests. The inclusion of this value drives up the opportunity cost for most land uses beyond US$7 per tonne of CO_2. Further analysis should also explore the non-marketed value of this timber in terms of the benefits it provides to poorer stakeholders (e.g. fuel wood and construction materials).
- The results for shifting cultivation show that such activities are at best only marginally profitable in the two districts. Working with poor shifting cultivators to conserve forests for REDD+ instead would likely produce a large boost in farmer incomes.
- With revenues from NTFPs removed, the opportunity costs per tonne CO_2 for converting most of the five main forest types (excluding young forest) to rice, other annual crops or forest plantations nearly double (though they remain below the assumed US$5 per tonne threshold for REDD+).
- Opportunity cost analysis is just one tool in the REDD+ box, and opportunity costs are only part of the overall cost picture. To get the full benefit of opportunity cost analysis, REDD+ implementers need to recognise its limitations. It is important to combine it with analysis and understanding of other political, social and economic factors, and to keep in mind that some decisions will (and should) not always be made on a purely economic basis.

The second part of this analysis undertook a preliminary analysis of some of the costs associated with the design and implementation of local-level benefit distribution systems (BDS). Here, the comparison was made between some of the key costs associated with what was considered as a possible pro-poor model of the BDS, versus a model without the pro-poor considerations. Key findings from this analysis suggest:

- The additional costs of the pro-poor BDS are significant, and could equate to within the range of US$25 per household across the initial five years. However, a significant proportion of this additional cost is derived from consultative exercises with local households around benefit types, timing and governance structures.

- Several ways to reduce the per unit cost of these activities were identified, including bundling the exercises with related activities such as FPIC, engaging local staff to conduct activities, and achieving economies of scale in the implementation of the exercises across a larger suite of potential future REDD+ actors.
- Methods to fund a pro-poor approach to BDS should consider co-financing from NGOs or related national-level REDD+ funds. This would significantly improve the cost effectiveness of pro-poor approaches to BDS design and implementation.
- Further work needs to be conducted in order to improve the estimates provided in this initial analysis. In particular, a similar analysis could be conducted in areas where funding mechanisms have already been established for REDD+. This will help to improve the estimates used to account for the costs per household, and any other related governance structures that have been measured through this analysis.

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Annex 1. Assumptions for crop types, prices and net present value

Table A1-1 overleaf illustrates the major crop types reported across the 280 households in Bao Lam and Cat Tien districts. From this, we see that although both acacia and cacoa were reported to be grown in the areas studied, no amount was sold in the year studied. For acacia, this is reasonable given that it will take time for the plantation to grow and be marketable. Although the opportunity cost for acacia could not therefore be calculated directly, the analysis does include 'forest plantations' as distinct from 'rubber' which can be considered as a reasonable measure of the opportunity cost of acacia given that acacia plantations are prevalent in the study area. The NPV for plantations relied on a measure of a Vietnam-specific value sourced from Hoang *et al.* (2010).

Other key supplementary notes to the calculation of NPVs include:

- NPVs were calculated using a 10 per cent discount rate over a 30-year time horizon. Crop yields were assumed to be stable over this period, and reflective of the quantities measured at the point in time in which household surveys were conducted.
- There was significant variation in the amount of the crops sold due to a large variance in individual's land area, effort and other inputs. For this analysis, the average quantities of the 280 households were used to calculate the NPV.
- Vietnam experienced a recent spike in the price of cassava, inflating the NPV well beyond previous SNV estimates of NPV conducted by Holland and McNally (2010).
- Cashew prices were the subject of one sensitivity analysis after it was found that the price of cashews from SNV-collected field data was at least half that given in sources.
- NPVs assumed that crops were already established, and therefore the time-lag for some crops to yield returns was not considered. For example, cashews and coffee plantations typically require an initial four-year set-up period (Holland and McNally 2010). As such, the NPVs are likely to be marginally higher than their actual amount.
- Most NPVs for natural forests were taken from Hoang *et al.* (2010). These values suggest an inverse relationship between NPV and forest quality. This suggests that people are obtaining a value from the collection of NTFPs (i.e. for personal use and sale) and the level of extraction of NTFPs contributes to the forest quality. For example, a poor forest has a higher NPV than medium forests since it provides value through consistent NTFP collection, but remains poor because of this ongoing extraction. The assumption made here, however, is that the level of extraction is not intensive enough to reduce the quality of the forest further, but is instead at a level where the forest quality is sustained.

Table A1-1 Crop sales, cost and price assumptions

Land-use type	Amount sold across 280 households in 2010 (kg)	Price (VN$/kg)	Cost of production (VN$/kg)	Source of price/cost information	NPV (US$/ha)
Acacia	*				
Cashew	65,898	10,000–20,000	14,250	External market data[24] and Lam Dong DARD	1753
Cassava	98,850	3000	300	SNV field surveys/Lam Dong DARD	10,398
Coffee	76,632	41,000	21,500	Lam Dong DARD	4384
Cocoa	*				
Tea	230,509	3500	2000	Lam Dong DARD	1951

* Not sold in the year surveyed.
1 US$ = VN$20,000

24.See www.businesstimes.com.vn/domestic-cashew-prices-top-vnd30000kg; www.21food.com/news/detail36424.html

Annex 2 Land-cover change data for Bao Lam and Cat Tien districts, 2000–2010

Figure A2-1 Bao Lam transition matrix (ha)

Original land cover in 2000	Final land type/use in 2010																		
	Medium forest	Poor forest	Conifer forest	Mixed forest	Bamboo forest	Forest plantations	Rice field	Other annual crops	Bare land	Shrub land	Built-up area	Water body	Young forest	Cashew	Coffee	Rubber	Shifting cultivation	Tea	TOTAL
Medium forest	14586.5	4084.1	140.0	4554.1	378.5	1.3	0.0	0.0	93.7	3.0	13.6	19.2	244.3	0.0	32.0	0.0	0.0	60.9	24211.3
Poor forest	285.6	10737.3	58.9	5345.2	788.4	36.5	0.0	0.2	37.3	88.5	235.1	642.9	292.1	2.3	204.8	9.9	3.2	44.3	18812.6
Conifer forest	0.6	62.3	6626.6	194.8	33.8	71.7	0.0	83.0	61.4	18.9	104.8	46.5	0.0	0.0	2673.4	0.0	4.0	246.5	10228.2
Mixed forest	371.8	1552.4	1602.6	14011.8	3227.2	681.5	1.0	14.2	309.7	94.3	250.7	316.7	807.0	1.1	2918.4	42.9	10.0	980.6	27193.9
Bamboo forest	18.2	99.9	36.2	1179.0	6007.4	298.1	0.1	5.6	243.2	2.5	57.1	48.5	489.8	11.3	1481.4	74.3	6.3	883.7	10942.3
Forest plantations	0.0	1.0	1.9	3.6	0.8	91.9	0.0	0.0	0.1	0.1	1.2	0.0	0.0	0.0	5.5	0.0	0.0	0.0	106.1
Rice field	0.0	0.0	0.0	0.2	0.0	0.0	28.1	0.0	0.0	0.0	0.5	0.0	0.0	0.0	2.2	0.0	0.0	0.0	31.0
Other annual crops	0.0	0.3	15.9	2.2	0.9	0.4	0.1	284.2	3.9	0.0	9.1	0.9	0.1	2.2	76.0	9.1	0.2	6.9	412.2
Bare land	1.8	23.8	306.1	57.2	14.4	107.0	0.0	33.1	791.2	11.1	366.1	38.0	6.9	18.6	712.7	32.3	35.3	1253.4	3808.8
Shrub land	1.0	0.6	937.4	32.3	2.1	0.9	0.0	1.7	5.0	14.5	6.2	3.0	1.6	0.7	548.4	4.5	0.1	87.6	1647.5
Built-up area	3.5	5.4	25.6	16.7	2.0	1.9	0.2	3.0	6.9	0.0	5735.9	34.3	0.0	2.4	199.7	1.1	2.4	52.6	6093.7
Water body	2.3	12.2	4.4	27.5	55.4	0.6	0.0	0.5	6.8	0.0	16.3	1406.9	0.3	1.2	67.4	0.2	0.3	37.8	1640.2
Young forest	8.9	22.6	0.0	186.1	124.0	5.8	0.0	0.0	53.3	0.1	6.1	0.2	1183.2	11.9	243.9	2.4	0.0	0.2	1848.7
Cashews	0.0	0.0	0.0	0.2	0.8	1.3	0.0	0.0	0.6	0.0	0.3	0.9	0.0	90.8	2.0	0.0	0.0	0.8	97.7
Coffee	0.0	2.3	314.9	73.0	25.0	24.6	2.5	17.5	68.6	0.4	403.3	384.4	7.2	17.5	22728.4	126.2	60.5	163.9	24420.0
Rubber	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shifting cultivation	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.1	0.1	0.0	0.0	20.0	0.0	13.9	6.6	46.7
Tea	0.0	3.4	75.7	10.7	2.0	74.5	0.0	4.6	16.4	0.0	58.4	30.4	0.2	1.0	354.9	0.0	0.8	14486.0	15119.1
TOTAL	**15280**	**16607**	**10146**	**25695**	**10663**	**1398**	**32**	**447**	**1698**	**233**	**7271**	**2973**	**3033**	**161**	**32271**	**303**	**137**	**18312**	**146660**

Figure A2-2 Cat Tien transition matrix (ha)

Original land cover in 2000	Final land type/use in 2010														
	Medium forest	Poor forest	Mixed forest	Bamboo forest	Forest plantations	Rice field	Other annual crops	Bare land	Shrub land	Built-up area	Water body	Young forest	Cashew	Coffee	Shifting cultivation	TOTAL
Medium forest	2341.2	203.5	196.9	60.8	0.0	0.0	3.0	2.2	0.3	0.1	4.6	522.1	8.1	0.0	0.2	3343.0
Poor forest	183.3	2658.4	565.5	122.3	0.2	0.2	33.7	3.0	0.4	1.5	5.9	124.4	20.4	0.0	0.1	3719.3
Mixed forest	96.8	308.2	5704.7	890.1	0.1	3.0	243.2	65.6	5.4	2.8	12.5	418.9	228.9	1.0	2.6	7983.9
Bamboo forest	8.5	33.9	224.1	3082.3	18.2	206.9	533.6	219.8	1.5	85.4	119.9	1002.1	2733.2	4.6	39.0	8313.0
Forest plantations	0.0	0.0	0.0	0.0	4.3	5.8	0.5	0.0	0.0	1.7	0.1	0.1	24.1	0.0	0.0	36.6
Rice field	0.0	0.4	0.0	3.1	0.6	4356.8	46.6	13.0	0.0	57.3	16.7	1.9	79.3	0.2	5.0	4580.9
Other annual crops	0.0	0.2	0.9	2.2	4.8	12.4	401.7	10.6	0.0	22.7	7.8	3.6	133.7	0.4	1.8	602.7
Bare land	0.0	0.4	2.0	5.7	0.5	14.8	15.9	185.5	0.0	62.4	5.0	5.2	270.9	0.4	12.5	581.2
Shrub land	0.0	0.1	1.1	9.5	0.0	0.5	15.1	6.7	27.2	0.5	0.3	9.9	29.8	0.0	0.2	101.0
Built-up area	0.0	0.0	0.0	1.0	0.2	42.7	9.7	1.4	0.0	1872.4	10.4	0.6	32.0	0.6	2.2	1973.0
Water Body	1.0	1.7	4.6	18.8	0.2	15.1	7.7	4.7	0.0	11.9	626.0	4.2	7.0	0.0	0.5	703.4
Young forest	4.2	26.6	245.2	512.9	2.7	76.0	56.5	77.4	25.1	44.1	47.5	5531.6	1237.7	7.6	12.8	7907.7
Cashews	0.6	1.9	6.5	9.4	3.5	42.3	3.4	10.6	0.2	47.0	8.5	19.7	2582.6	1.3	4.7	2742.1
Coffee	0.0	0.0	0.2	0.0	0.0	0.1	0.0	0.3	0.0	1.0	0.0	0.5	0.6	9.7	0.1	12.4
Shifting cultivation	0.0	0.0	0.0	0.6	0.0	1.4	0.5	0.3	0.0	1.6	0.1	1.2	31.9	0.0	51.4	89.0
TOTAL	**2636**	**3235**	**6952**	**4719**	**35**	**4778**	**1371**	**601**	**60**	**2212**	**865**	**7646**	**7420**	**26**	**133**	**42689**

Annex 3 Key assumptions and notes relating to different cost categories

Activity number and name	Notes
1 Initial awareness-raising and consultations with local actors around REDD+ and BDS	See Activity 3.
3 Involving local actors in benefit format decisions	■ Total costs were sourced from SNV budgeting for activities conducted on behalf of the UN-REDD Programme in Vietnam. Total costs were divided by the 221 participants (one participant per household) involved in the activities and then by four (the average number of persons per household in Cat Tien and Boa Lam Districts (Huynh 2010; Nguyen and Vu Van 2010)) in order to reflect the cost per beneficiary. Although it will be likely that one person per household will be all that is necessary to involve in such activities, for the purpose of remaining consistent with other costs it was necessary to measure the costs per beneficiary (i.e. per person).
4 Operating the local fund	■ The estimates in use are the 'maximum number of forest users affected (by REDD+ activities)' (14,713 people). Here, 'forest users' are taken as a proxy measure for the number of households that will benefit under the proposed UN-REDD Programme Phase II activities in Lam Dong (UN-REDD unpublished). ■ A second estimate was used to estimate the total number of beneficiaries. This was done to account for a second, but higher (27,788 households) estimate of the total number of households impacted by the planned REDD+ interventions under the UN-REDD Phase II proposal. ■ Four different options are presented in the results to show the different proportions of the finances set aside for managing the fund. The most extreme (but also the most unlikely) scenario is that 100 per cent or even 75 per cent of the finances will be used for managing the local fund. More realistically, the management finances will need to be used for a range of different activities, such as awareness-raising, training, coordinating activities and workshops etc. In this case, a range of cost proportions are shown, presenting different possibilities for the overall cost of the fund management per beneficiary. An average of the costs for the estimates for 50 per cent and 25 per cent was taken as a reasonable estimate of the size of the cost that will be specifically needed for the fund management.
5a Recourse mechanism	■ Assumes that the chosen recourse mechanism will comprise of a board of local stakeholders. This is based on similar boards and governing groups existing at the local level in Vietnam for forest and natural resource governance. ■ Estimates assume the costs of the chosen recourse mechanism boards are not proportional to the number of households it represents. Instead, for ease of calculation, it is assumed that there is a fixed set of costs (labour costs) associated with each commune-level recourse mechanism, no matter how many people are represented by it. In reality, there is likely to be a relationship between the number of beneficiaries and the costs of the recourse mechanism – e.g. a larger number of people are likely to be positively related to a larger number of complaints. ■ Recourse mechanism is assumed to sit at the district level and be linked to a national recourse board. Only district-level boards are included here, given the costs of the national system are assumed to be paid for at this level.

	■ The cost per household has been derived by taking the total cost of a district recourse mechanism and dividing by the total average number of recipients per district. This uses the two totals for the number of households defined in the UN-REDD Phase II proposal divided by the eight target districts.
5c Distribution mechanism	■ Costs were based on estimates obtained by a CIFOR review in Son La for the first two years of implementation of payment for ecosystem services (PES) payments across nine districts. ■ All costs were multiplied by 2.5 to account for the five-year time period that the SNV estimates represent. ■ Commune-level representatives change every two years. As such, it is assumed that new training for commune representatives will need to take place every two years. Therefore, across five years, three sets of commune officials will require training. ■ Distribution costs are expressed per year, and therefore have been multiplied by five to obtain a total cost over the five years. ■ Distribution costs are assumed to be constant across households within different districts. In reality, these costs will vary depending on the number of beneficiaries and their area of residence. ■ A total of 64,000 households (HH) are eligible for PES payments in Son La, being downstream of the Hoa Binh hydroelectric station. ■ Assumes costs for Son La will be representative of those in Lam Dong.
6 R-coefficient	■ Assumes that data collection is conducted by relevant commune officials and stakeholders, and centrally managed at the commune level via a database (as per R-coefficient paper recommendations (Pham *et al*. 2012)) ■ Consultations with local stakeholders will be done through the benefit format discussions with local beneficiaries. ■ Costs are indicative of those needed to calculate a commune-level R-coefficient. ■ Assumes a total of 12 days' staff time for collection of data and calculation, with three days total follow-up for data check.