CHAPTER 4

Participatory low-emissions land-use planning: the case of Ba Be landscape in Northeast Viet Nam

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Abstract

Land-use planning plays an important role in reconciling the often contradictory targets of conservation and economic development. This study demonstrates the use of the Land-use Planning for Low-Emission Development Strategies (LUWES) framework in multi-stakeholder negotiations for developing a low-emissions land-use plan for Ba Be District, a poor rural landscape in northern Viet Nam. Twenty-year land-use scenarios were created for each of four planning zones: production forest; protection forest; special-use forest; and land outside forest. By comparison with the LUWES approach, 'top–down' land-use planning tends to maximize the potential for conservation and mitigation by restricting certain forest uses and encouraging forest plantations without due consideration of local livelihoods. Land-use plans developed in a participatory way, albeit offering moderate carbon benefits, are more practical and feasible through incorporating the interests of local communities in rehabilitating landscapes through carbon-rich land-use practices.

We suggest that Ba Be's low-emissions development strategy should include approaches for 'land sharing' to balance trade-offs between conservation targets, mitigation benefits and the livelihoods of forest dwellers. Benefits from 'carbon farming' within a broader carbon-accounting framework should also be fully recognized and equally shared among stakeholders across the landscape. The chapter highlights the vital role of local stakeholders in emissions-reduction planning and the need to aggregate land-use strategies. Finally, we conclude that provincial and district governments need to address discrepancies in forest allocation and management and engender greater stakeholder participation to develop more realistic low-emissions land-use development plans.

1. Introduction

Land-use planning has been recognized as a key policy instrument for sustaining rural landscapes and improving the livelihoods of rural communities (Rydin 1998, Bourgoin and Castella 2011, Bourgoin et al 2012), ensuring landscape multifunctionality and ecosystem services (Nelson et al 2009, Reyers et al 2012), and enhancing efficiency in carbon sequestration, in particular (Cathcart et al 2007, Bourgoin et al 2013). It is also considered critical to the successful implementation of land-based climate mitigation efforts, such as Reducing Emissions from Deforestation and Forest Degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries (REDD+) (Venter et al 2009, Lin et al 2013). However, in many developing countries, conventional 'top–down', centralized planning approaches have been widely practised with very little success, as a result of a lack of flexibility in adapting to local peculiarities (Kauzeni et al 1993, Amler et al 1999, Ducourtieux et al 2005). Participatory practices, on the other hand, often enhance planning quality and feasibility (Trung et al 2006, Reed 2008, Luyet et al 2012). Thus, enhancing the participation of local stakeholders should be earnestly sought as part of larger debates on local empowerment and decentralization of decision making in REDD+ (Chhatre and Agrawal 2009, Phelps et al 2010, Toni 2011, Bourgoin et al 2013).

It has also been well noted that mitigating climate change through land-use management will likely incur trade-offs between economic benefits, for example, delivering more food and employment opportunities, and environmental benefits, such as saving, restoring and managing forests for climate benefits, including carbon sequestration (Chan et al 2006, Chhatre and Agrawal 2009, Dewi et al 2011, Lin et al 2013, Mulia et al 2013). Hence, an inclusive, integrated and informed planning approach is required that considers ecosystem dynamics to simultaneously achieve conservation and development goals (Dewi et al 2011, Hein and van der Meer 2012). The challenges is how to reconcile these two seemingly contradictory dimensions (van Lier 1998, Müller and Munroe 2005, Jackson and Baker 2010).

'Land sparing' and 'land sharing' have been the two main approaches in meeting these demands (Fischer et al 2008, Phalan et al 2011, Chandler et al 2013). 'Land sparing' separates land for conservation from land for crops, striving for high productivity of farm land to reduce the need for agricultural expansion into preserved areas. 'Land sharing' integrates conservation and food production on the same land. Either of the two can result in positive conservation outcomes depending on local conditions (Chandler et al 2013, Grau et al 2013). A combination of the two strategies could be deployed (Dewi et al 2013). Literature on the land sparing versus sharing debate has mostly focused on the trade-offs inherent in biodiversity versus production (Lusiana et al 2012). Similar issues were raised in debates around forests and carbon (Minang et al 2011). Unfortunately, there a limited number of studies that compare the impact of land sparing and sharing on landscape carbon stock. In any event, outcomes are usually necessarily specific to each case presented.

Viet Nam is a part of large REDD+ initiatives under the United Nations Collaborative Programme on REDD and the World Bank's Forest Carbon Partnership Facility. In 2012, the Government announced an ambitious National REDD+ Action Programme (called the National REDD Strategy in many international documents) that orders the development, and implementation, of provincial REDD+ action plans. However, as REDD+ is under development and pilot activities are only at early stages, provinces are struggling with setting up REDD+ targets and, more importantly, mainstreaming such targets into their own socio-economic development plans, particularly, land-use and forestry plans. This is a challenging assignment considering a long history of traditional top–down planning in the land-use and forestry sectors (Castella et al 2005, Ohlsson et al 2005, Lambin and Meyfroidt 2010) and the implementation of poorly designed incentive mechanisms in afforestation, reforestation and protection that often left out the poorest groups (Landell-Mills and Porras 2002, Clement and Amezaga 2009). Additionally, while emissions and emission reductions are relatively well studied at global and national levels, such data and assessments are unavailable at provincial and lower levels in Viet Nam.

This chapter reports on the use of participatory land-use planning as a platform for mainstreaming local priorities and demands into a district-level emission reduction plan. A broader approach addressing all land uses, that is, Reducing Emissions from All Land Uses (REALU), which promotes emission reductions through the establishment and maintenance of high carbon-stock land uses (van Noordwijk et al 2009), was employed to develop future land-use scenarios. Our study objectives were twofold: (i) observe how a participatory land-use planning process can lead to more realistic emission-reduction/sequestration targets compared to the existing top–down land-use plan; (ii) explore land-use scenarios that provided mitigation potential; and (iii) explore the suitability of the land sparing and sharing approaches in the context of agricultural production, forest conservation, and climate mitigation in a rural landscape in Viet Nam. The results provide valuable insights into local land-use planning for REDD+ and other low-emission development strategies that are drawing considerable attention in many developing countries.

2. Methods

Study site description

Ba Be District is located in Bac Kan Province, Northeast Viet Nam (Figure 16). The district size is 68,545 ha, with a population of approximately 47,000 in 11,000 households (Bac Kan Statistical Office 2011). Agriculture and forests play a central role in households' livelihoods. Eight-eight percent (88%) of the total area is forest land and most of the district is mountainous. Productive agricultural land is in short supply, which has impeded local livelihoods and led to a poverty rate as high as 37.17% in 2010 (Bac Kan Statistical Office 2011). In the past, forests were either converted to shifting cultivation or heavily logged for economic purposes, thus, a major part of 'forest land' (66%) is now either regenerated forest with limited tree density or bare land. Forest planting started in the middle 1990s as a part of national reforestation programmes to simultaneously improve ecological functions and local livelihoods (Sikor 2001, Meyfroidt and Lambin 2008). Up to 2010, the total area of planted forest was about 4,600 ha (7.6% of total forest land), mostly monocultural plantations of fast-growing species, such as *Acacia mangium* and *Manglietia glauca*. There were concerns that monocultural plantations did not provide biodiversity benefits (Lambin and Meyfroidt 2010).

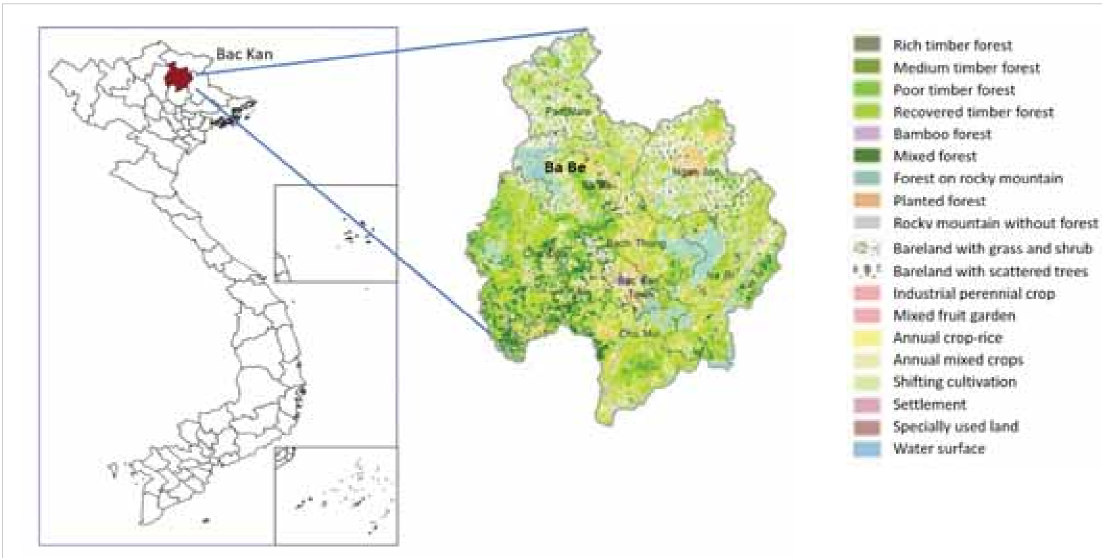


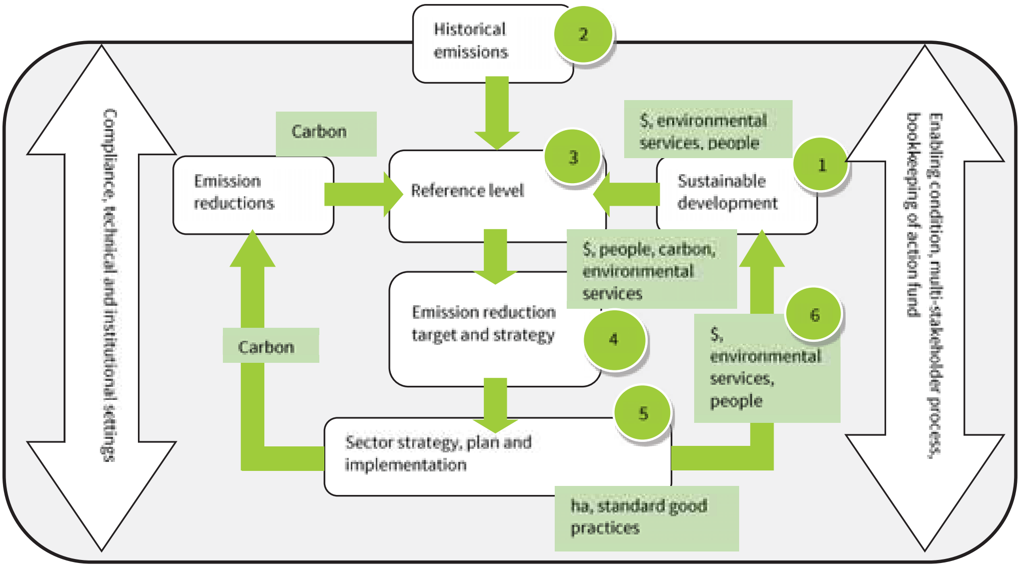
Figure 16. Location of the participatory land-use planning study site in Ba Be District, Bac Kan Province

A sizeable part of the Ba Be landscape, Ba Be National Park, is dedicated to biodiversity conservation. The core zone consists of 7610 ha of forest on limestone along with lowland evergreen forest. This is an unique ecosystem with many endangered flora and fauna (Hill et al 1997, Hill 2000).

Ba Be can be seen as a hotspot for REDD+ for several reasons: (i) its large forest area with high potential for carbon sequestration and other environmental services; (ii) its reliance on unsustainable subsistence agriculture that threatens an upland forest ecosystem valuable for conservation; and (iii) it is economically one of the poorest, but ecologically one of the richest, districts of Bac Kan, which was chosen to pilot REDD+ in Viet Nam.

Methodological framework

We applied the Land-use Planning for Low-Emission Development Strategies (LUWES) method, a participatory planning framework developed by Dewi et al (2011), to enhance emission reductions and removals while providing economic benefits to local communities (Figure 17). We also used the REDD ABACUS SP software (version 1.1.4) developed by ICRAF to (i) estimate the historical greenhouse-gas emissions and carbon sequestration from all land-use changes in Ba Be District and develop baselines; (ii) analyze trade-offs between emissions and financial gains of land-use conversions (opportunity cost analysis) and produce abatement cost curves to project ex-ante emissions and financial impacts of land-use changes; and (iii) compare zone-specific policies and other emission-reduction scenarios within the landscapes and estimate their potential for reducing emission.



Source: Dewi et al 2011

Figure 17. LUWES framework

The LUWES cycle consists of several steps.

1. Compilation of the district's land-use (2010–2020) and forestry (2010–2015) plans and identification of planning zones
2. Analyse past land-use changes (1990–2010) and calculate opportunity costs as the trade-off of financial gain and emissions from land-use changes based on baseline scenarios
3. Develop baseline scenarios for each zone and the whole landscape based on a linear projection of historical land-use changes
4. Develop participatory land-use scenarios and estimate ex-post emission reduction
5. Revise scenarios based on analysis of cost–benefits, the feasibility of selected scenarios and identification of development priorities across the landscape
6. Identifiy policy interventions needed to support local strategic and action plans for emission reduction in order to implement the agreed scenarios

Assessment of land-use carbon stock

To assess the impact of land-use change on a landscape's carbon stock, the typical carbon-stock value is needed for each land use (IPCC 2000 called this 'time-averaged carbon stock'). A typical carbon stock value integrates the gains and losses over a life-cycle of a land use and, thus, reflects the equilibrium of carbon stock of a particular land use (Merger et al 2012). It also allows for a comparison of land-use systems with different rotation times (Ziegler et al 2012). In this study, we calculated aboveground carbon stock of land uses using ICRAF's Rapid Carbon Stock Appraisal method developed by Hairiah et al (2011). Typical aboveground carbon-stock values (in ton C ha^{-1}) of all land uses in Bac Kan are presented in Table 15.

Assessment of land-use profitability

The profitability of land uses was assessed based on Net Present Value (NPV) which is the discounted future cash flow (benefits–costs) during the life cycle of the land-use system. In our study, NPV was calculated for each land-use type as per hectare discounted future cash flow, expressed in USD per hectare (Table 15).

$$NPV = \sum_{t=0}^{n} \frac{B_t - C_t}{(1+r)^t}$$

Where: r = discount rate, B_t = total benefit of year t, C_t = total cost of year t, t = year (t ranges from 0 to n). In this study we applied a discount rate of 10% for all land-use types.

Land-use change analysis

In order to analyze both current and past land-use changes and predict future changes, spatial analysis was employed. Spatial analysis used Landsat TM, ETM data, recent SPOT-5 images and land-use maps from 1990 to 2010 for every 5 years to increase accuracy at the same point in time. ArcGIS software was used to produce digital land-cover maps with consistent classification and overlays. We combined every two time series to find the rate and area of deforestation, reforestation and the conversion within Ba Be district's forest boundary between natural forest and planted forest. Land-use maps were obtained from the Ministry of Natural Resources and Environment (MONRE) and combined with forest maps from the Forest Inventory and Planning Institute of Viet Nam to cover the wide range of forest classifications. To identify the boundary of forest management units—including special-use forest, protection forest, production forest and other land—we overlaid our updated land-use map with the forest management map from the Ministry of Agricultural and Rural Development (MARD) for Bac Kan. We used the scale of 1/10,000 for commune level, 1/50,000 for district level, and 1/100,000 for provincial level through the periods 1990, 1995, 2000, 2005 and 2010.

Land-use/-cover classification

In Viet Nam, two land-use classification systems exist (Hoang et al 2010, Pham et al 2013). One is managed by MARD and the other by MONRE. In this study, we combined the two. MARD's land-use classification was used to describe forest land uses while MONRE's was used to describe agricultural and other land-use types. There are 20 land-use types in total, of which 11 are different types of forest (from bare land to rich timber forest), five are agriculture (from paddy rice to perennial crops) and four are other land-use types (Table 15). Although agroforests are not officially recognized as a land-use class, in this study we used it as an independent land-use type separate from both forest and agriculture given the practice's distinguishable typical carbon stock and NPV values as well as its importance from local perspectives. The most common agroforestry system found in Ba Be was maize and/or cassava intercropped with timber species, such as *Melia* and *Acacia* spp.

Table 15. Observed time-average carbon stock and profitability of each land-use type in Ba Be

Land-use type	Time-averaged carbon stock (ton/ha)	NPV (USD ha^{-1})			
		Production forest	Protection forest	Special-use forest	Non-forest
Rich timber forest	203	265	62	48	265
Medium timber forest	157	221	49	40	221
Poor timber forest	118	177	37	32	177
Recovered timber forest	58	110	25	16	110
Bamboo forest	13	132	37	16	132

Mixed forest	85	132	37	16	132
Forest on rocky mountain	117	88	12	8	88
Planted forest	85	296	49	40	296
Rocky mountain without forest	13	0	0	0	0
Bareland with grass and shrub	6	0	0	0	0
Bareland with scattered trees	17	0	0	0	0
Industrial perennial crop	11	8,490	8,490	8,490	8,490
Mixed fruit garden	10	2,184	2,184	2,184	2,184
Annual crop, rice	5	142	142	142	142
Annual mixed crops	5	152	152	152	152
Shifting cultivation	4	234	234	234	234
Settlement	0	0	0	0	0
Specially used land	0	0	0	0	0
Water surface	0	0	0	0	0
Agroforest	11	1,299	1,299	1,299	1,299

Engaging local stakeholders in the land-use planning process

Participatory land-use planning was conducted through field surveys and local consultations at provincial, district and village levels. Two consultation meetings at provincial level were carried out for the same group of policy makers (land-use planning, forestry, forest protection, planning and investment) and forestry enterprises to gain insights into the province's land-use and forestry planning processes. The provincial and Ba Be district's land-use and forestry planning documents, including maps, were also collected in this step. Three consultation meetings at district level (representatives of local land-use department, forestry department, Ba Be National Park, forestry enterprises, district's people committee and some commune's people committees) aimed at adding to results from village-level consultations and facilitating two-way discussions between villagers and district authorities on the development of land-use scenarios. At the commune and village levels, we organized six consultation meetings with representatives (farmers) from three communes and 35 villages to develop, and/or revise, low-emission land-use plans for each commune. During the meetings, concepts of REDD+, carbon payments, land-use planning and the impact on carbon emission and sequestration were introduced. In developing future scenarios with carbon payments, we asked the participants to provide their preferred development and conservation activities, grouped them into categories, and then asked them to rank activities individually as well as in groups (Table 16). Participants also located sites on the maps for interventions when possible or indicated areas of land where interventions were feasible according to their knowledge and experience. We also used visual media, including photos of different land-use and land-cover types, maps and terrain simulations, to stimulate discussion. At the final stage, a consultation workshop was held with participation from all levels to validate the locally-developed land-use plans and extrapolate the district's plan. In total, 159 people were consulted.

We then translated existing government land-use plans and results of local consultations into land-use transition matrixes in REDD+ ABACUS SP by adjusting the land-use transition matrix of the 'business as usual' scenario (linear projection of past land-use change). Projections were made for a 20-year period (2010–2030). The government's land-use and forestry plans were made only for 2010–2020 and 2010–2015, respectively, so we assumed linear projections of these for post-2020 and -2015. Carbon emission and sequestration in each scenario were recorded and compared.

3. Results

Planning zones and issues

Consultation on land zoning for emission-reduction purposes led to the division of the Ba Be landscape into four planning zones: 1) special-use forest; 2) protection forest; 3) production forest; and 4) land-outside forest (Figure 18). Geographically, three of these forest zones precisely corresponded with three forest types categorized by MARD. Managing land outside forests was not the mandate of MARD's forestry sector, hence, forest conversion (if any) in this zone was inadvertently tolerated.

The choice of planning units was homogeneous among the participants. Two reasons were given: (i) a management policy for each of the three types of forest (three zones) had been developed and imposed by the Government and local authorities and communities had no choice but to accept this; and (ii) land-use and forestry plans had been developed earlier based on the forest zones regulated by the provincial and central governments and any future planning had to be based on the same zoning. More specific characterization of the four zones is shown in Table 16.

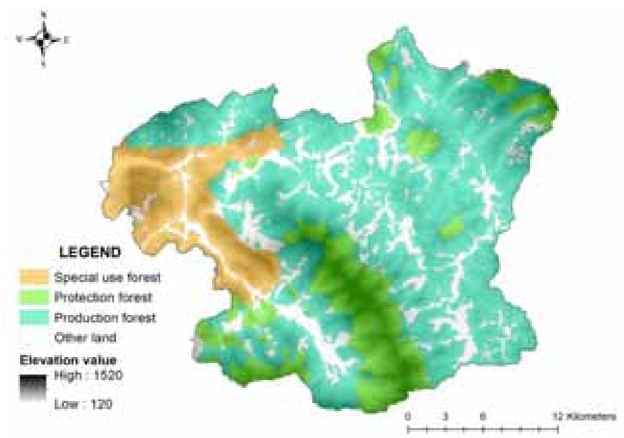


Figure 18. Planning units of Ba Be landscape

Table 16. Characteristics of planning unit of Ba Be landscape

Planning units	Production forest	Protection forest	Special-use forest	Outside forest
Area (ha)	37,034	11,528	8,796	10,838
Main land-use types	A combination of regenerated forests, bare land with shrubs, and planted forests	A combination of regenerated forests, medium and poor forests, bare land with shrubs or scattered trees	Forests on rocky mountains and bare land with shrubs	Annual crops (mainly terraced rice) and bare land with shrubs
Management policy by the Government	Natural forest exploitation and forest plantations for economic purposes by land tenants	Conservation for watershed protection; (very) limited exploitation, mostly non-timber products	Strict protection for biodiversity conservation, no exploitation or conversion allowed	Agricultural production and settlements
Tenure type	Individual households and state forest enterprises	Communal people's committees (for unallocated forest land) and state entities	Ba Be National Park (state entity)	(Mostly) individual households

Emissions from past land-use changes for each zone and impact on carbon emission/ sequestration

An opportunity cost analysis of land-use changes in the Ba Be landscape from 1990 to 2010 (Figure 19) showed that net emissions from land-use changes had been reducing over time. From 2005 to 2010, the carbon sequestration rate outweighed the emission rate. The Ba Be landscape had a net carbon credit owing to reforestation efforts. Both emission and sequestration rates were positively correlated with the total land-use change rate (Figure 20). From 2005, both total emissions and sequestration were reducing as the rate of land-use change stabilized. However, total emissions for the whole period of 1990–2010 were still larger than total sequestration, resulting in average net emissions of 30,370 tCO_2eq per year. From an economic perspective, almost all emissions were avoidable at a carbon price of USD 5 per tCO_2eq.

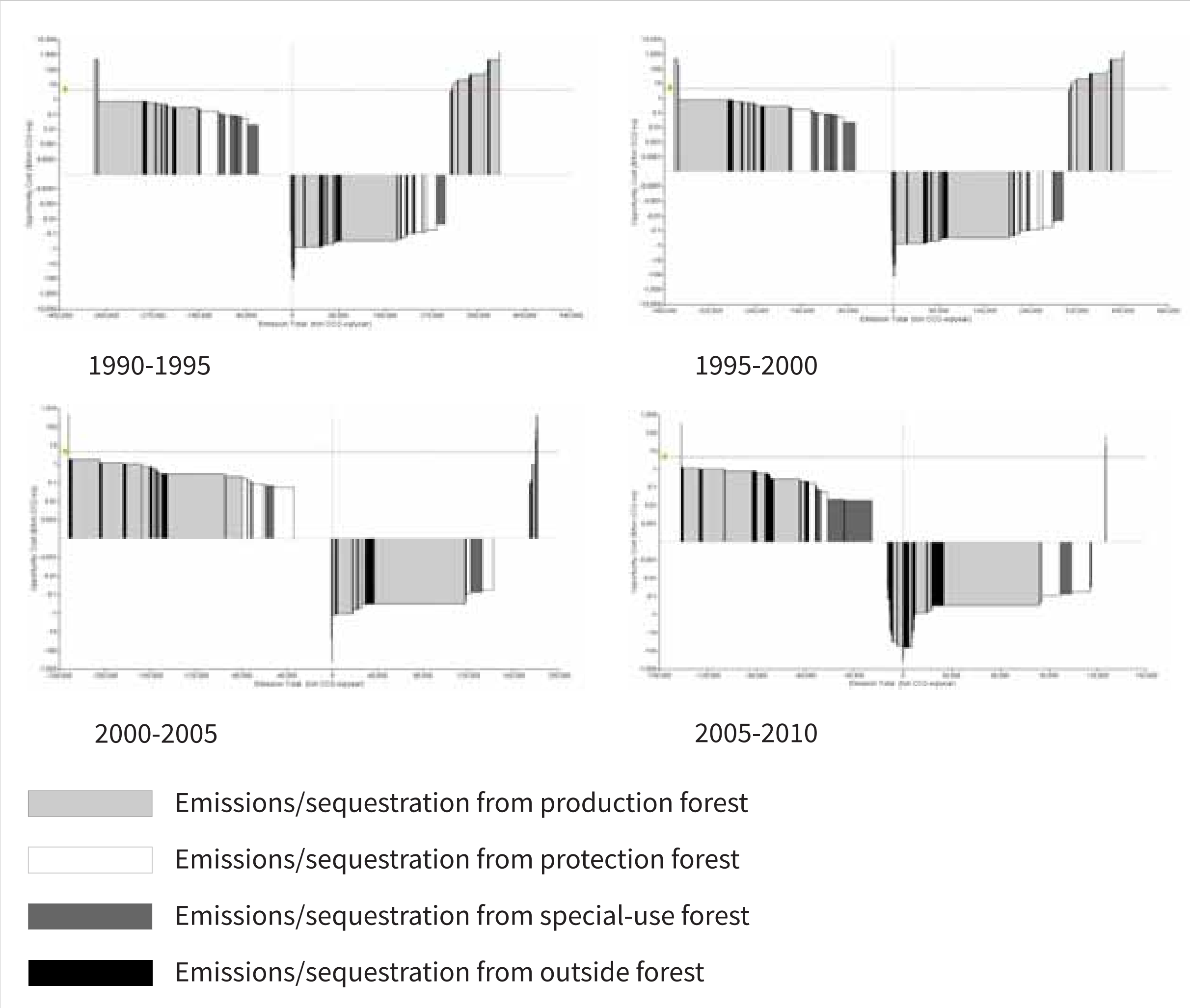


Figure 19. Opportunity cost curve of land-use changes in Ba Be landscape, 1990-2010

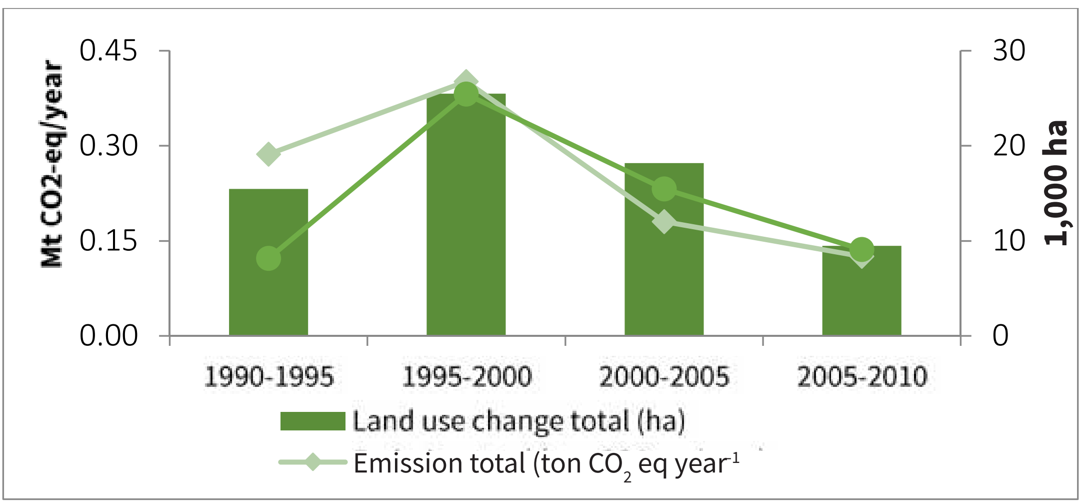


Figure 20. Net greenhouse-gas emissions from the Bac Kan landscape in Viet Nam, 1990–2010

The largest emissions in all periods were caused by conversion of poor timber forest to regenerated timber forest. FGDs at the village level revealed two reasons for this change: (i) clear cut or heavily logged forest; and (ii) slash-and-burn practices for a short period (3–5 years) on poor timber forest land. This emitting land-use conversion also resulted in a loss in economic benefits in the long term and, therefore, had a negative opportunity cost. Conversion of poor timber forest to bare land, and forest degradation from medium timber forest to poor timber forest, were also important sources of emissions. On the other hand, forest plantations on bare land and natural forest regeneration (for example, regenerated forest to poor timber forest) were the two land-use changes accounting for carbon sequestration.

Land-use change in the production forest zone was both the largest carbon sink and the biggest source of emissions (relative to other land uses) from 1990 to 2005. However, during 2005–2010 land-use changes in the protection forest zone became the largest emission source while those in the special-use forest zone became the largest sequestration source. Such changes in land-use-change patterns can be explained by the national reforestation program phasing out during this period along with government-supported forest plantations and protection projects being scaled down in the production and protection forest zones. Forest protection was, however, maintained in the special-use forest zone because it received a separate budget from the Government. Finally, the contribution of land-use changes outside the forest zones was not significant in all periods.

Land-use plans and scenarios

Land-use scenarios

We developed four land-use scenarios (Table 17). In the first, the Optimistic Plan scenario, we assumed that all poorly-managed land uses in the forest zones, for example, bare land or land under shifting cultivation, would be rehabilitated by either establishing forest plantations on bare land or converting shifting cultivation into agriculture. In the Department of Agriculture and Rural Development (DARD) Plan scenario (Scenario 2), we assumed land-use changes as imposed by the provincial DARD. The District Plan (Scenario 3) was an outcome of the consultations with local authorities in Ba Be District. Finally, the LUWES scenario (Scenario 4) was that produced through the consultation process wherein local people were asked to rank their preferred activities with REDD+ support and the feasibility and potential of such activities on the ground according to their perceptions. We also developed a Business As Usual (BAU) scenario, which was a linear projection based on land-use-change rates for 2005–2010.

Table 17. A brief description of the four scenarios

	Production forest	Protection forest	Special-use forest	Land outside forest
OPTIMISTIC PLAN	Production forest plantations on 7,084 ha of bare land (grass and shrubs)	Protection forest plantations on 1,226 ha of bare land (grass and shrubs)	Special-use forest plantations on 1,113 ha of bare land (grass and shrubs)	Enrichment of recovered timber forests to poor timber forests (area same as BAU)
	Production forest plantations on 5,863 ha of bare land (scattered trees)	Protection forest plantations on 1,236 ha of bare land (scattered trees)	Special-use forest plantations on 689 ha of bare land (scattered trees)	Enrichment of poor timber forests (small area, ignorable)
	Enrichment of 2,517 ha of recovered timber forests (to poor timber forests)	Enrichment of 884 ha of recovered timber forests (to poor timber forests)	Enrichment of all 723 ha of recovered timber forests (to poor timber forests)	Conversion of 646 ha of bare land (grass and shrubs) to mixed fruit gardens
	Enrichment of 689 ha of poor timber forests (to medium timber forests)	Enrichment of 774 ha of poor timber forests (to medium timber forests)	Enrichment of all 99 ha of poor timber forests (to medium timber forests)	Conversion of 358 ha of bare land (grass and shrubs) to agroforestry
	Conversion of 245 ha of shifting cultivation to agroforestry (maize and timber trees)	Conversion of 44 ha of shifting cultivation to agroforestry (maize and timber trees)	Conversion of 51 ha of shifting cultivation to agroforestry	Conversion of 490 ha of bare land (scattered trees) to agroforestry
	Forest plantations on 171 ha of shifting cultivation	Complete stop of degradation (rich and medium timber forests) from 2010	Complete stop of degradation of all types of forest (rich and medium timber forests) from 2010	Conversion of 312 ha of shifting cultivation to agroforestry (maize and timber trees)
	Conversion of 220 ha of shifting cultivation to mixed fruit gardens (mandarin orange, persimmon etc)	Reduction by 50% of deforested areas in all forest types in the first 5 years		Conversion of 203 ha of shifting cultivation to mixed fruit gardens
	Reduction by 50% of deforested areas in all forest types in the first 5 years	Reduction by 50% of deforested areas in all forest types in the next 5 years		Complete stop of degradation of the small remaining forest area
	Reduction by 50% of deforested areas in all forest types in the next 5 years	Complete stop of deforestation from 2020		
	Complete stop of deforestation from 2020	Other land uses: as for BAU scenario		
	Other land uses: as for BAU scenario			

	Production forest	Protection forest	Special-use forest	Land outside forest
DARD PLAN	Production forest plantations on 5,980 ha of bare land (grass and shrubs)	Protection forest plantations on 1,185 ha of bare land (grass and shrubs)	Special-use forest plantations on 60 ha of bare land (scattered trees)	As for BAU scenario
	Production forest plantations on 5,972 ha of bare land (scattered trees)	Enrichment of 1,319 ha of bare land (scattered trees) to recovered timber forests	Enrichment of 48 ha of bare land (scattered trees) to recovered timber forests	
	Enrichment of 600 ha of recovered timber forests (to poor timber forests)	Enrichment of 1,995 ha of recovered timber forests (to poor timber forests) up to 2020	Protection and natural regeneration of 1,057 ha of recovered timber forests	
	Conversion of 1,600 ha of recovered timber forests to planted forests	Enrichment of 1,730 ha of poor timber forests to medium timber forests up to 2020	Complete stop of deforestation from 2010	
	Enrichment of 1,850 ha of poor timber forests (to medium timber forests)	Complete stop of deforestation from 2020		
	Complete stop of deforestation from 2010	Other land uses: as for BAU scenario		
	Other land uses: as for BAU scenario			
DISTRICT PLAN	Production forest plantations on 6,877 ha of bare land (grass and shrubs)	Protection forest plantations on 136 ha of bare land (grass and shrubs)	Special-use forest plantations on 700 ha of bare land (grass and shrubs)	Enrichment of 841 ha of recovered timber forests to poor timber forests
	Production forest plantations on 4,605 ha of bare land (scattered trees)	Protection forest plantations on 62 ha of bare land (scattered trees)	Enrichment of all 527 ha of recovered timber forests (to poor timber forests)	Enrichment of 34 ha of poor timber forests to medium timber forests
	Enrichment of 7,680 ha of recovered timber forests (to poor timber forests)	Enrichment of 1,770 ha of recovered timber forests (to poor timber forests)	Complete stop of degradation of all types of forest (rich and medium timber forests) from 2010	Conversion of 402 ha of bare land (grass and shrubs) to mixed fruit gardens
	Conversion of 35 ha of shifting cultivation to mixed fruit gardens (mandarin orange, persimmon etc)	Conversion of 23 ha of shifting cultivation to agroforestry		Conversion of 818 ha of bare land (grass and shrubs) to agroforestry
	Forest plantations on 35 ha of shifting cultivation	Complete stop of deforestation and forest degradation from 2020		Conversion of 490 ha of bare land (scattered trees) to agroforestry

	Production forest	Protection forest	Special-use forest	Land outside forest
	Complete stop of deforestation and forest degradation from 2010	Other land uses: as for BAU scenario		Conversion of 11 ha of bare land (scattered trees) to planted forest
				Conversion of 74 ha of shifting cultivation to agroforestry (maize and timber trees)
				Conversion of 177 ha of shifting cultivation to mixed fruit gardens
				Complete stop of degradation of small remaining forest areas
				Other land uses: as for BAU scenario
LUWES	Production forest plantation on 6,877 ha of bare land (grass and shrubs)	Protection forest plantations on 135.7 ha of bare land (grass and shrubs)	Special-use forest plantations on 902 ha of bare land (grass and shrubs)	Enrichment of 840 ha of recovered timber forests to poor timber forests
	Production forest plantations on 4,605 ha of bare land (scattered trees)	Protection forest plantations on 62 ha of bare land (scattered trees)	Protection contracts for natural regeneration of 523 ha of bare land (scattered trees)	Protection contracts for natural poor and medium timber forests
	Enrichment of 1,010 ha of recovered timber forests (to poor timber forests)	Protection contracts for natural regeneration of 1,770 ha of recovered timber forests (to poor timber forests)	Protection contracts for natural regeneration of 523 ha of recovered timber forests	Conversion of 402 ha of bare land (grass and shrubs) to mixed fruit gardens
	Conversion of 245 ha of shifting cultivation to agroforestry (maize and timber trees)	Conversion of 23 ha of shifting cultivation to agroforestry (maize and timber trees)	Conversion of 41 ha of shifting cultivation to natural forests	Conversion of 817 ha of bare land (grass and shrubs) to agroforestry
	Forest plantations on 35 ha of shifting cultivation	Protection contracts for 187 ha of rich timber forests	Protection contracts for 64 ha of medium timber forests and 537 ha of recovered timber forests	Conversion of 284 ha of bare land (scattered trees) to agroforestry
	Conversion of 86 ha of shifting cultivation to mixed fruit gardens (mandarin orange, persimmon etc)	Protection contracts for 418 ha of medium timber forests		Conversion of 74 ha of shifting cultivation to agroforestry (maize and timber trees)

	Production forest	Protection forest	Special-use forest	Land outside forest
	Natural regeneration of 7,680 ha of recovered timber forests Protection contracts for 40% area of medium timber forests (67 ha) Protection contracts for 10% area of recovered timber forests (1,097 ha) Other land uses: as for BAU scenario	Other land uses: as for BAU scenario		Conversion of 177 ha of shifting cultivation to mixed fruit gardens

The impact of land-use changes in each planning zone, and in each scenario, on Ba Be's carbon stock are shown in Figure 20. For reasons of simplicity, the BAU was used as a Reference Emission Level to estimate carbon benefits generated by each land-use scenario.

Emission reductions by land-use scenarios

Emission reductions as a result of land-use changes in the whole Ba Be landscape and in each planning zone are shown in Figure 20. The Optimistic Plan scenario resulted in the highest net sequestration for the whole landscape, as much as 1,425,281 tCO_2eq in a 20-year period (2010–2030). This was followed by thae DARD (1,193,432 tCO_2eq), District (1,153,022 tCO_2eq) and LUWES (926,913 tCO_2eq) scenarios. A similar trend of emission reduction was found for the two largest planning units, Production Forest and Protection Forest. In these zones, DARD tended to impose an ambitious forest plantation and forest care program on almost any available plot. The DARD scenario is, therefore, similar to the Optimistic Plan scenario. Interestingly, for the Special-use Forest zone, local authorities and others were even more ambitious than the provincial DARD that directly manages this zone (Ba Be National Park) and were often found to be more aggressive in special-use forest protection planning.

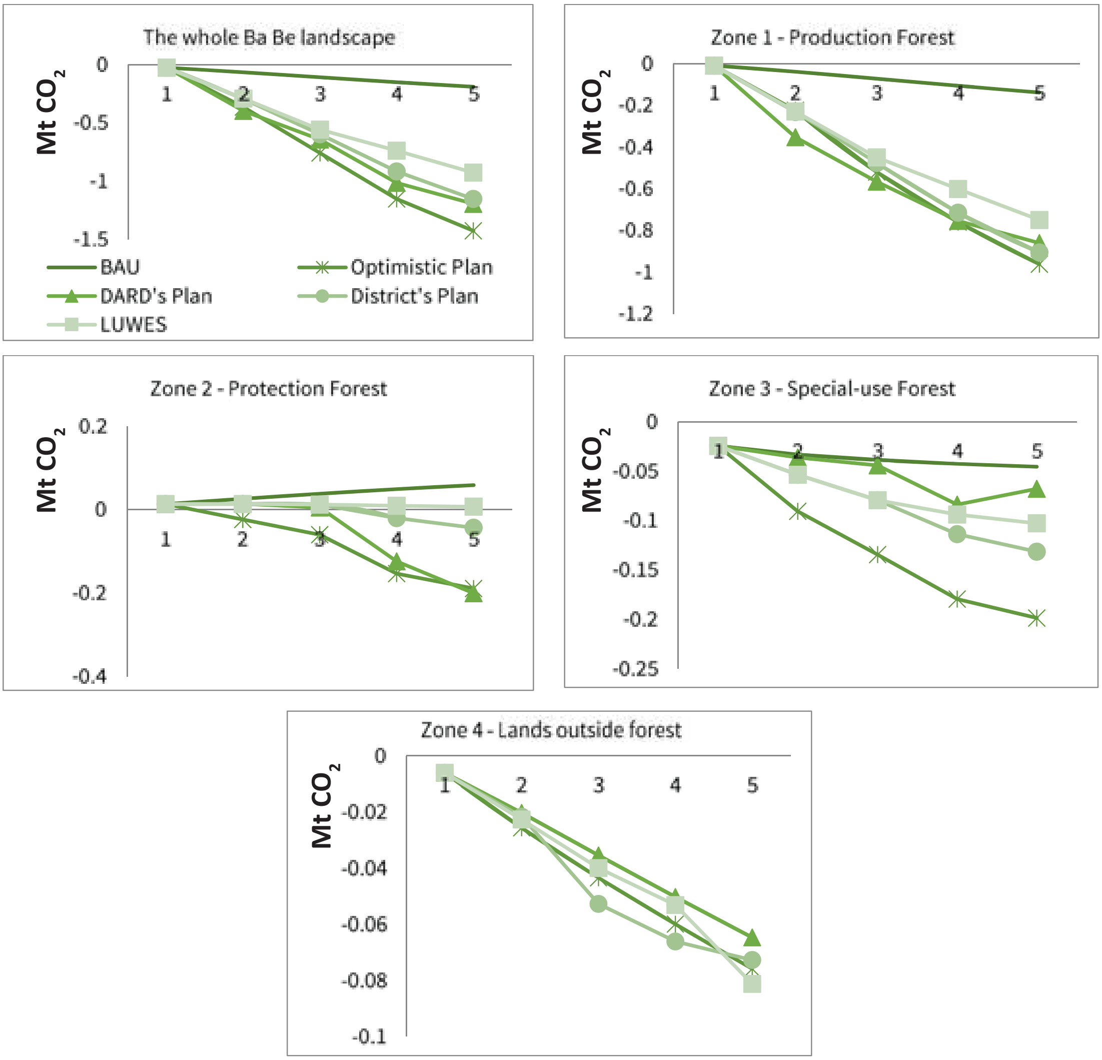


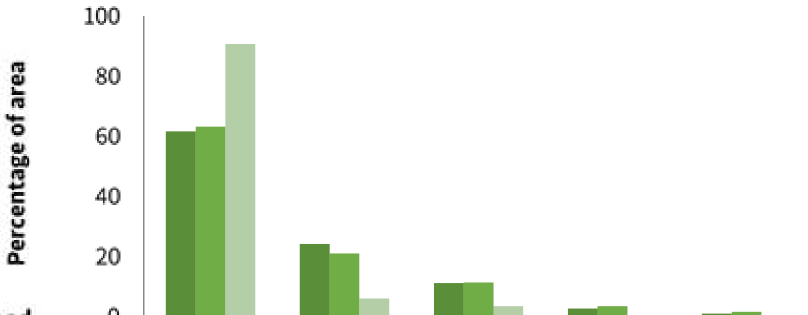
Figure 21. Net emissions from land-use changes in the Bac Kan landscape and each of planning units from 2010 to 2030 under different scenarios

4. Discussion

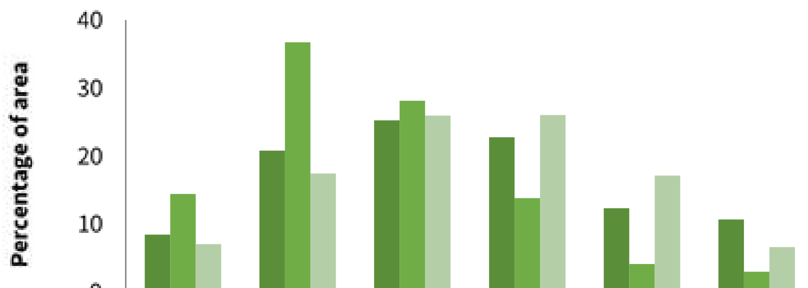
Our study illustrated the trend of decreasing the amount of potential land-based emissions through the increased participation of local people in land-use planning (Figure 21). Literature reporting this correlation is thin, although mismatches between top–down forestry and rural planning and actual land-use practices and local wishes in Bac Kan Province and elsewhere have been pointed out in earlier studies (Hibbard and Tang 2004, Castella et al 2005, Ohlsson et al 2005, Trung et al 2006, Castella et al 2007, Friederichsen and Neef 2010, Bourgoin et al 2012). Moreover, we found significant discrepancies between the top–down forestry plan and local willingness to put such a plan into practice. DARD planned to keep Ba Be a conservation landscape. Policy priorities seemed to be maximizing the extent of the forested area by planting more trees in forest zones wherever and whenever possible. On the other hand, local communities seemed hesitant to take large-scale interventions into forest zones.

It was revealed in local consultations that forest plantations, forest enrichments and even deforestation for agricultural land were only feasible in locations near roads and on slopes less than 25°. We verified this argument by examining the past distribution of both reforestation, afforestation and deforestation areas in Ba Be District for the period 1990–2010 (Figure 22). It was found that reforestation/afforestation and deforestation occurred mostly within 1 km from roads and hardly ever in areas more than 3 km. Similarly, more than 80% of reforestation/afforestation and deforestation areas were distributed on slopes ranging 5–25°. Therefore, it was likely that the participatorily-developed scenario (LUWES) was more realistic than the DARD and District scenarios as these limits were included in the LUWES scenario. Ohlsson et al (2005) studied the forest planning process in northern Viet Nam and found a similar result: that official planning data did not reflect reality and, therefore, it would be difficult for the 5 million hectare reforestation programme to materialize.

Such disparities between centralized and participatory planning have several implications for landscape conservation for



Distance to road	0-1km	1-2km	2-3km	3-4km	4-5km
Reforestation/Afforestation	61.56	24.03	11.05	2.54	0.82
Natural forest to planted forest	63.14	20.93	11.24	3.28	1.41
Deforestation	90.69	5.85	3.29	0.17	0.00



Slope	0-5	5-10	10-15	15-20	20-25	> 25
Reforestation/Afforestation	8.40	20.74	25.21	22.72	12.29	10.63
Natural forest to planted forest	14.39	36.71	28.10	13.78	4.07	2.94
Deforestation	7.00	17.41	25.91	26.01	17.08	6.58

Figure 22. Distribution of reforested, afforested, deforested, converted natural forest areas in Ba Be district from 1990 to 2010

both ecosystem services and livelihoods' improvement. First, as rational landscape planning is key to engaging people in their implementation (Bourgoin 2012), any future land-based low-carbon development programs should be developed in a participatory manner. Reconciling top–down and bottom–up approaches will be fundamental for benefits to be shared effectively and fairly. If these programs are only aimed at maximizing carbon storage, they will alienate communities and, hence, be less feasible (Bourgoin et al 2013). Furthermore, any such programs under the United Nations Framework Convention on Climate Change (UNFCCC) must comply with the principle of free, prior and informed consent where local communities' involvement is integral (Kanowski et al 2011, Bourgoin et al 2013). Second, there is a risk that the additionality of any further land-based low-carbon development program, such as REDD+, will be very likely minor in the Ba Be landscape. In other words, the DARD plan itself has already 'maximized' the land-based emission reduction potential of the landscape. DARD's ambition, thus, may be jeopardized by the rule of 'additionality' under the UNFCCC where credit can only be given for new actions, not ones already taken (Grainger et al 2009a). Viet Nam has already declared a national approach to REDD+ and it is likely that the REDD+ program will be mainstreamed into forestry and land-use plans rather than the other way around. Thus, the issue of additionality should be considered not only for the Ba Be landscape but also at wider scales. Third, if a future REDD+ program keeps focusing heavily on monocultural plantations, as in these scenarios, it will likely not help to promote but rather reduce biodiversity overall. Such unexpected outcomes of REDD+ programs solely based on carbon values, or of plantations on biodiversity, have been warned against (Grainger et al 2009b, Miles and Dickson 2010, Paoli et al 2010, Phelps et al 2012). Therefore, although plantations on bare land have contributed to the largest emission reductions in Ba Be, a more diverse set of actions (for example, mixed species' plantations with native species, natural forest generation etc) should be considered in future low-emission development strategies. Fourth, low-emission development and emission reductions should not be achieved only by restricting access or the use options of forests (Larson 2011, Hein and van der Meer 2012), for example, the DARD plan for Protection Forest. People living near to protection forests area have rights to benefit from their resources and services (for example, timber for household construction, non-timber products or other livelihoods' activities). So far, there seems to be no option but abiding by the very tight restrictions on protection forests, which are under the management of state entities. Hence, a future REDD+ program should consider enhancing tenure rights and matching local priorities to maintain communities' interests (Mustalahti et al 2012). For instance, it was suggested during consultations that instead of being solely entitled to either state entities or communal people's committees, a certain area of protection forest could be entitled to communities where community-based forest management could be applied. This could be considered a step toward creating incentives to change land-management practices from less intensive swidden systems and encouraging greater carbon sequestration in complex, mosaicked landscape (van Noordwijk et al 2008, Bourgoin et al 2013).

Land sparing or land sharing for REDD+: community choice

In the foregoing discussion, it appears that the four scenarios have income trade-offs. Achieving a balance between carbon sequestration and food production and increased income needs a different approach. The LUWES scenario, which not only reflects the aspirations of local people but also addresses their food and income needs while sequestering carbon through land sharing, such as agroforestry, tend to offer a more realistic picture.

In the Ba Be landscape, it appears that 'segregation' has been used as the key Government strategy during the last 20 years. The landscape has been distinctively zoned for forest preservation and agriculture development. In general, forest has been preserved in less accessible or protected areas while agricultural practices have been allowed on lowland near water sources and paved roads. This strategy has achieved certain success in maintaining, and indeed increasing, the district's forest area but modest in improving local livelihoods. For example, the poverty rate was still high (37.17%) as of 2010 and food scarcity was common. More importantly, even if Ba Be had obtained sufficient productivity from agriculture as the only strategy for forest conservation, it would have been unsure that its conservation targets could be achieved because increasing agricultural yields may not result in land 'spared' for nature but may instead favour further agricultural expansion and non-conservation uses (Grau et al 2013). There is considerable evidence supporting this argument (Matson and Vitousek 2006, Phelps et al 2013). Indeed, Ba Be seemed to fall into a trade-off between agricultural production and conservation: the more successful the policy was in halting agricultural expansion and reducing deforestation, the larger the reduction in production (Angelsen 2010). This trend was found in a similar landscape in Nghe An Province, Viet Nam by Jakobsen et al (2007), who showed that while the changes imposed on land use certainly lead to an increase in forest cover they would also likely lead to declining yields and reducing labour productivity.

Challenges for a future land-use plan for Ba Be, which aims at both emission reductions and multiple co-benefits, therefore relate to optimal mixes between 'sparing' and 'sharing' (Minang and van Noordwijk 2013). A more 'sharing' approach can be used here for reconciling conservation and development through interventions in different components of a landscape matrix (Sayer et al 2013) and may help to improve carbon stock of conservation areas (Lusiana et al 2012). Land sharing has actually been practised by farmers in the context of policy restrictions. The *de facto* use of degraded production forests, protected forests and even a small part of special-use forests for shifting cultivation and cattle grazing have been common practices in Ba Be. On the other hand, 21.82% area of the Land outside Forest zone is forest (as of 2010) and was being managed as forest rather than 'non-forest'. Although a part of this forest could be a result of mapping errors by DARD, its existence was confirmed by both local governments and forest users. Considering landscape multi-functionality, the use of 'degraded' or 'unused' forest land for agriculture may be acceptable if well managed. Restoration of 'degraded' land by a combination of afforestation and agricultural production can even reduce further degradation and eventually increase the provision of selected ecosystem services (Matson et al 2012, Rey Benayas and Bullock 2012, Verburg et al 2013).

The LUWES scenario in this study demonstrated local wishes to further rehabilitate a part of production and protection forests and land outside forests by promoting higher carbon-stock land uses, such as agroforestry on bare land and mixed fruit gardens on land formerly used for shifting cultivation. This shows a potential for 'carbon farming' both inside and outside forest. According to Thangata and Hildebrand (2012), agroforestry is capable of sequestering a large amount of carbon on farms while at the same time meeting the demand for other household food requirements and socioeconomic activities. Lin et al (2013) reviewed revegetation of agricultural landscapes as offsets to emissions and found that agroforestry offered reasonable co-benefits while reducing the likelihood of disadvantages, compared to plantation styles of revegetation. This range of practices is also likely to be suitable for Ba Be. 'Carbon projects' on degraded land were found to be much less disputed—and often successfully generated and sold offsets—than those sites with more favourable natural conditions, owing to their lower opportunity cost (Reynolds 2012).

However, the locally-developed LUWES scenario does require a broader scope of carbon accounting than REDD+. Figure 23

Figure 23. Proportion of emission reductions eligible for REDD+ in land-use planning scenarios

presents the contribution of REDD+-eligible emission reductions (that is, those related to forest land-use changes) of the whole landscape (that is, REALU) according to different land-use plans. The lower the level at which the plans are developed, the greater the contribution of non-forest land to total emission reduction. In the LUWES plan, about 8% of total emission reductions comes from non-forest land while in the District, DARD and Optimistic Plan it was only 6% and 5%, respectively. This provides empirical evidence for an increasing demand for REDD+ going beyond institutional forest and includes the role of eco-friendly tree farming (Bourgoin et al 2013, Dewi et al 2013, Minang and van Noordwijk 2013). It is also important to note that even in a participatory scenario, such as LUWES, local choices were still very much limited by laws and regulations on forest conservation. If such policy constraints are loosened, emission reductions from non-forest land could even be higher. A well-designed incentive scheme would then be needed for Ba Be to yield win-win outcomes where targeted emission reductions were met and agricultural production sustained and improved.

5. Conclusion

Our study discussed the use of LUWES for low-emission land-use planning in a rural landscape in Viet Nam, providing insights into the land-use planning process and how it affect a landscape's climate mitigation potential. The study showed that well-facilitated stakeholder engagement can lead to a more realistic emission reduction/carbon sequestration plan, thus, offering greater additionality and sustainability of REDD+. It also pointed to how people can shape their future low-emission development strategy, that is: (i) pursuing a more 'sharing' approach in forest conservation to achieve livelihoods' targets without harming the carbon-sequestration capacity of a landscape; (ii) paying due attention to local needs of sustainable carbon farming on degraded land inside forests and agricultural land outside forests; and (iii) applying a whole landscape carbon accounting framework to maximize local benefits from REDD+ and other mitigation programs. The lesson learned from this study is that provincial and district governments need to address the discrepancies in forest allocation and management and engender greater stakeholder participation to develop realistic low-emission land-use plans.

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