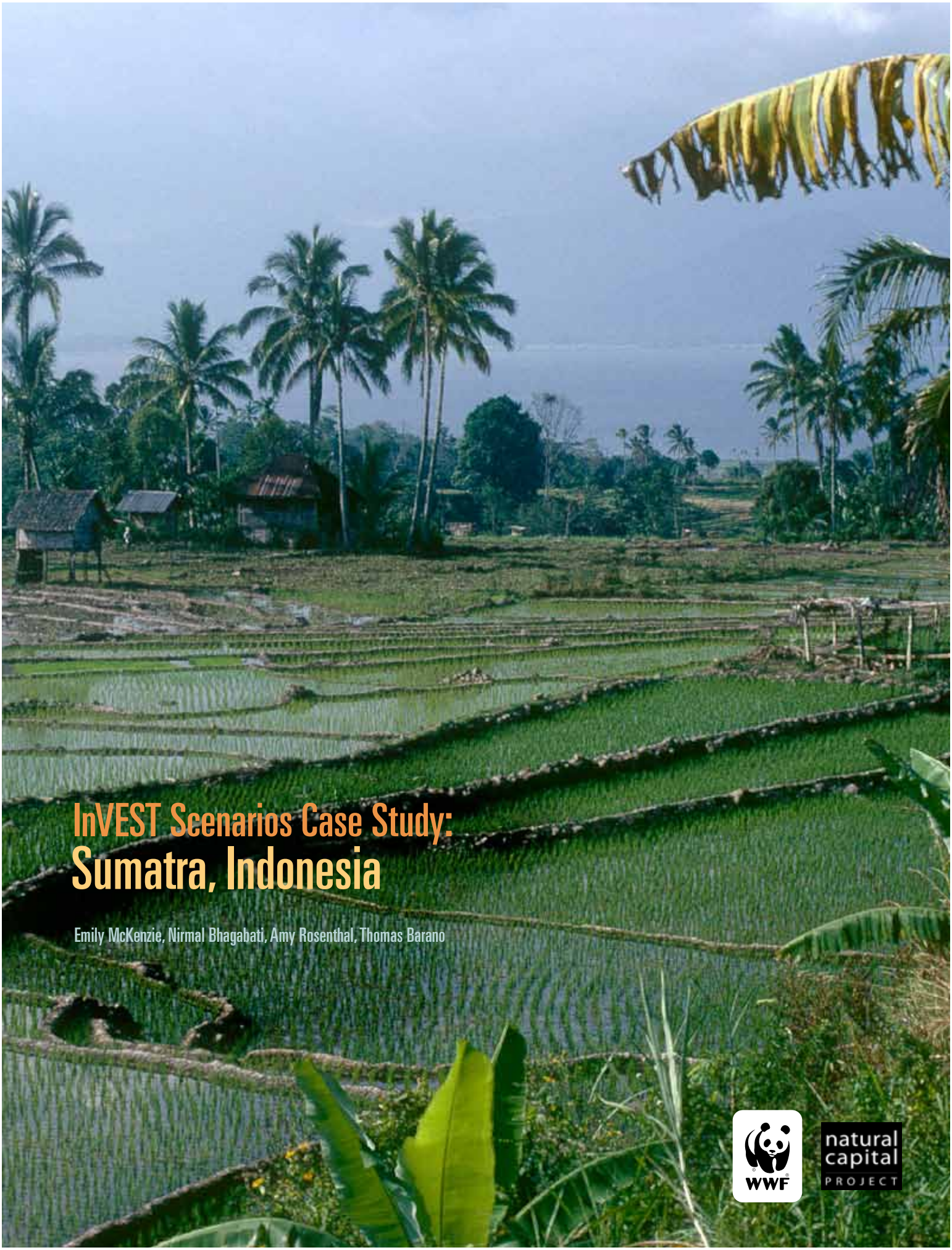

InVEST Scenarios Case Study:
Sumatra, Indonesia

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WWF

natural capital PROJECT

excerpted from

Developing Scenarios to Assess Ecosystem Service Tradeoffs

This case study highlights a real-world example of using InVEST scenarios to inform decisions about land use. In this example, scenarios were developed, ecosystem service impacts were assessed, and the results were used to make sound policy decisions. The case study offers background on the policy context and goals, and then delves deeply into the experience with scenarios and draws out lessons.

Background

In Indonesia, the government creates land-use plans every five years that dictate which land uses are permitted, such as timber harvest, plantation development and conservation. The Indonesian government creates spatial plans at national, island, province and district scales, but influential decisions, such as the granting of plantation concessions, are increasingly devolved to the province and district level. Ten provincial governors in Sumatra committed in 2008 to "save the Sumatra ecosystem" (WWF 2008). Spatial planning was deemed a critical policy instrument to achieve this ambitious goal. When the InVEST analysis began in 2009, provinces and districts in Sumatra were beginning to develop their spatial plans.

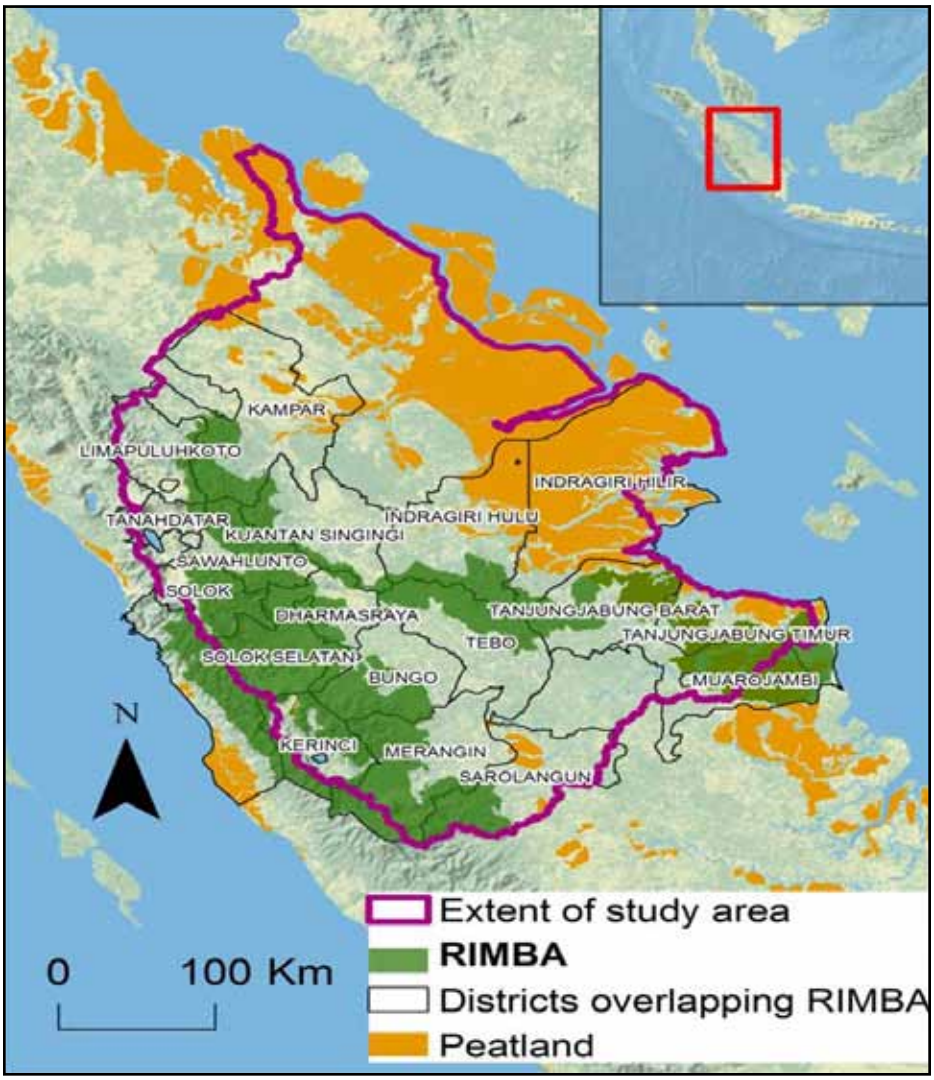
The national government agreed to establish ecosystem-based land-use planning in Sumatra; restore critical areas to protect ecosystem services; and protect areas with high conservation value to protect ecosystem services, biodiversity, and the global climate. Despite these ambitious goals, support for sustainable spatial planning was not unanimous among the district governments. With high revenues from palm oil and timber harvest, increasing the area of land conserved had limited appeal for some districts.

Five policy programs—including market-based mechanisms that could potentially provide alternative revenues from sustainable land uses—were approved by the Indonesian national government for implementing and financing ecosystem-based spatial planning: forest carbon payments, payments and programs for watershed services, forest restoration, best management practices for forestry, and best management practices for plantations. However, there was limited understanding of whether and where such policy programs might be feasible.

What policy questions did the InVEST analysis set out to address?

It was in this context that the team defined two policy goals for using InVEST in the RIMBA Integrated Ecosystem Area of Sumatra: (1) do the potential benefits of sustainable spatial planning justify the costs of foregone development? (2) how and where can sustainable spatial planning be implemented and financed? First, the InVEST analysis needed to demonstrate the social benefits of sustainable spatial planning to district governments and their constituents,

FIGURE 1 Study area in Central Sumatra



The extent of the study area in Central Sumatra, covering 18 districts and six watersheds, and overlapping with the RIMBA priority area. *Figure i from Bhagabati et al. (2012) WWF.*

thereby convincing them to revise their existing plans. Second, the InVEST analysis needed to recommend where policies to finance and implement sustainable land management would be feasible, based on their potential to enhance or maintain ecosystem services.

What scenarios were selected?

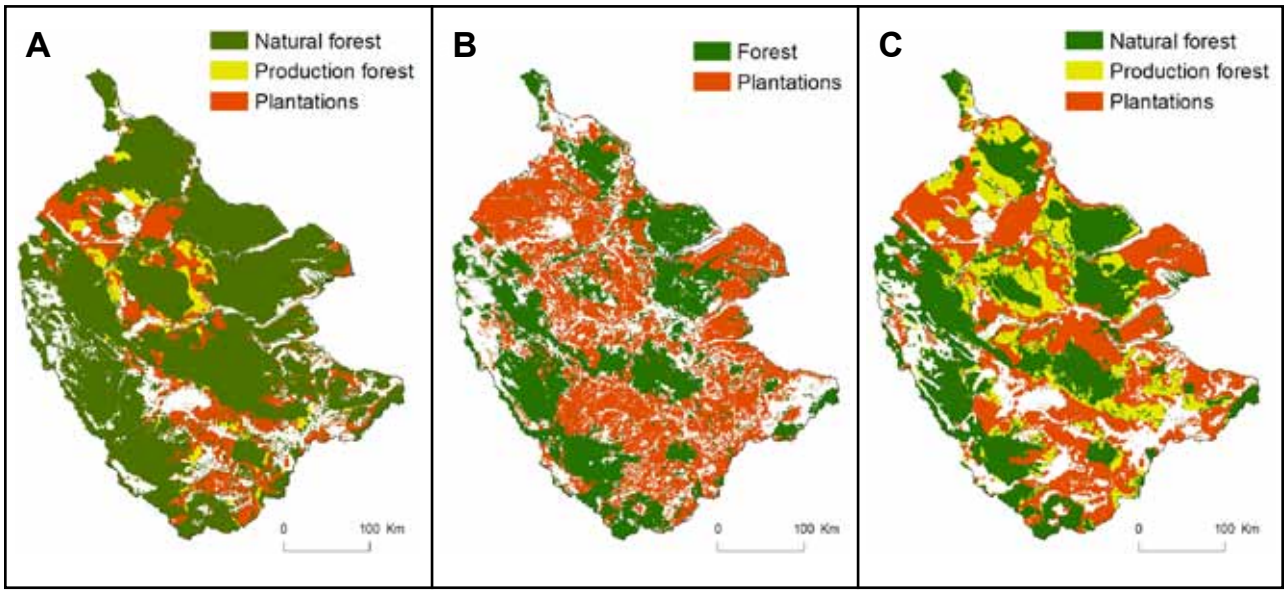
Scenarios were needed to highlight the implications of alternative future development trajectories on the provision of ecosystem services. At the time of the InVEST analysis, an ecosystem-based spatial plan—the Sumatra Ecosystem Vision—had already been developed by national government agencies and a coalition of NGOs and government departments called ForTRUST (Roosita et al. 2010). This vision was based on conservation priorities for species and habitats

of concern. Provincial governments also had their own spatial plans which were extensions of past plans with no explicit consideration of ecosystem priorities.

Given this policy context, the study team decided to use InVEST to assess the current situation (as of 2008) and two scenarios:

- **Government plan:** This scenario reflects the existing spatial plans of provincial governments, which are similar to past plans. Although the government plans call for some habitat restoration, most currently existing plantations will remain, expand, or convert to other non-forest use.
- **Sumatra Vision:** This scenario represents an ecosystem-based spatial plan for sustainable land-use, based on the Sumatra Ecosystem Vision for 2020. This Vision prioritizes habitat restoration and high value conservation areas, but includes some economic development and oil palm plantation expansion.
- **Baseline:** The team also assessed the current situation—using the most recent land-use/land-cover information from 2008—to provide a baseline for comparison.

FIGURE 2 Forests and plantations under the current situation and two scenarios in Sumatra



Distribution of forests and plantations in 2008 (A), and under two alternative future scenarios of land use that represent the Sumatra government spatial plans (B) and the Sumatra ecosystem vision (C). Both scenarios have more forest cover than in 2008—the government plan scenario has 59% more forest area than 2008, while the vision scenario has 132% more than 2008. The increase in forests in the government plan is driven primarily by an increase in production forests, where logging and conversion can take place. *Figure 1.4 in Bhagabati et al. (2012) WWF.*

How were scenarios developed?

The scenarios selected for the Sumatra InVEST analysis were based on existing spatial plans and stakeholder vision maps. The scenarios did not consider exogenous drivers of land-use and land-cover change that could not be directly influenced by district governments. The scenarios also did not consider surprising or unexpected events, or climate change impacts. The scenario outputs were therefore neither narrative descriptions nor quantitative model outputs, but mapped depictions of existing policy documents. This made the process of

developing scenarios relatively simple. This was, in part, a tactical decision by the study team, who had limited time and resources for scenario development.

The scenarios were selected by the study lead, who was well connected with the policy questions facing the Indonesian government at all levels and was familiar with the capacities of InVEST. There was no direct stakeholder engagement in the initial scenario development phase. However, the Sumatra Ecosystem Vision was based on a vision for the future developed by ForTRUST. The 2008 LULC map was based on interpretation by a consultant of Landsat TM images from 2007 for Riau and 2008 for Jambi and West Sumatra.

How were scenarios translated into land-cover maps?

Both the government plan and the Sumatra Vision were already depicted as land-use maps following zoning designations. These maps defined what land use would be allowed to occur in any given area. This made the process of developing scenarios for input into InVEST relatively simple. All that had to be done was to translate land-use categories into appropriate land-cover classifications (i.e., the inputs required for InVEST). Roads were assumed to be the same across all three scenarios.

A workshop was held with government stakeholders to demonstrate the results of an initial InVEST analysis comparing the two scenarios. Beyond this workshop, there was no additional review of the land-cover scenarios to check that they accurately reflected the Sumatra Vision and the government plan or to ensure they made sense in the local context.

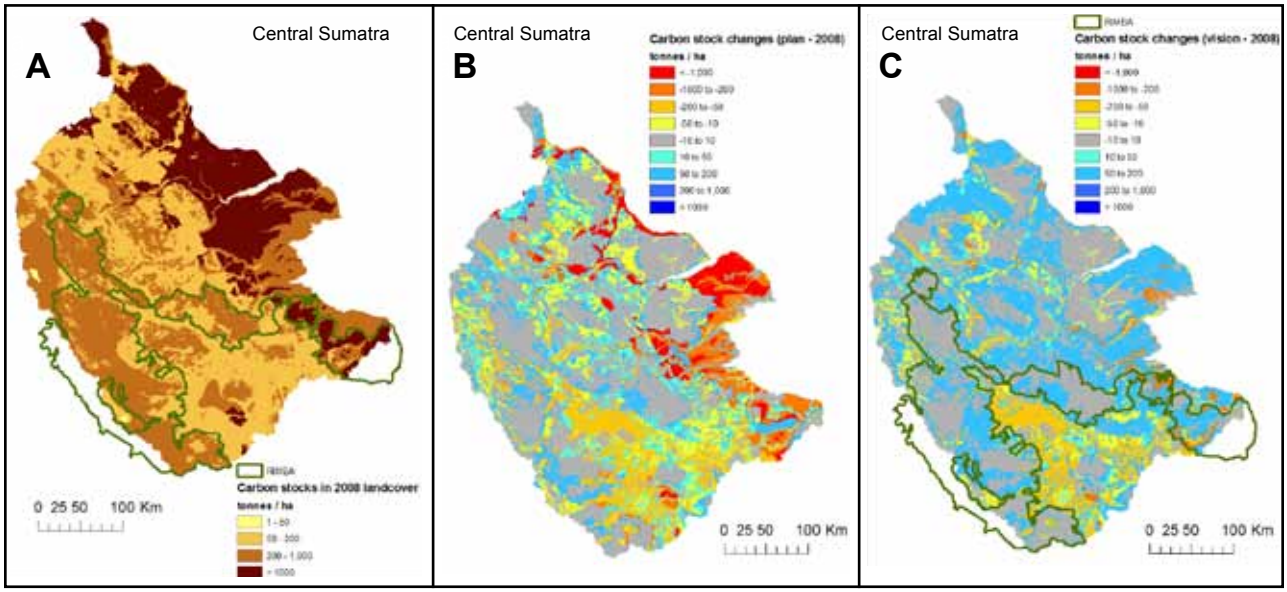
How did the scenarios shape the final results for policy makers?

InVEST was used to map the amount of high-quality wildlife habitat, carbon storage and sequestration, annual water yield, erosion control, and water purification (for both nitrogen and phosphorus) provided by the two scenarios and the 2008 baseline. Maps were developed showing the difference in ecosystem services between the two scenarios, and between each scenario and 2008 (see Figure 3, p. 5). These "change maps" show the gain or loss in ecosystem services or wildlife habitat quality from implementing the Sumatra Vision as compared to the government plan. Much of the analysis looked at the differences in changes from the baseline to the Sumatra Vision as compared to the changes from the baseline to the government plan.

TABLE 1 Interpreting comparisons of scenarios in Sumatra

Ecosystem service	Scenario comparison	Policy application
Habitat quality	Baseline vs. government plan	Areas likely threatened in the future
	Vision vs. government plan	Areas with better habitat quality in vision than in government plan
Carbon sequestration	Baseline vs. government plan	What forest likely to be converted
	Vision vs. government plan	Which forest conversion areas spared by implementing vision

FIGURE 3 Gains and losses in carbon stocks from 2008 to 2058 in Central Sumatra under two scenarios



Distribution of carbon stocks in Central Sumatra in 2008 (A). Carbon stock changes relative to 2008, under the government spatial plan scenario (B) and the ecosystem vision scenario (C). The vision would result in carbon sequestration while the plan would result in net emissions. *Figures 2.1 and 2.3 in Bhagabati et al. (2012) WWF.*

Based on the differences in the amounts and location of ecosystem services associated with each scenario, InVEST could show which land management policies are likely to provide ecological and economic benefits, and clarify the tradeoffs of implementing the government plan as compared to the Sumatra Vision. This enabled the InVEST results to address the question "why is sustainable spatial planning economically justified?" The "change maps" for each scenario also enabled InVEST results to support preliminary recommendations about where and what kinds of activities could be undertaken within each district to benefit each ecosystem service, based on where ecosystem services are predicted to occur across the landscape, and the expected impact. This enabled the InVEST results to inform the second policy question: how to implement and finance sustainable spatial planning. For example, districts at high risk of deforestation, with large biomass carbon stocks and relatively low agricultural value, were recommended for forest carbon projects.

Strengths

- The scenarios were closely aligned with policy context and questions of interest.
- The scenarios were easily understandable as they did not involve any complex interactions among drivers of change.
- The scenarios were distinct and created notably contrasting ecosystem service maps at scales relevant to district governments.
- The scenarios were for Central Sumatra as a whole, but assessed at district scales, providing outputs that were relevant to the primary users: district government decision makers.

- The government plan scenario was plausible, as it was based on real provincial spatial planning documents under consideration that realistically could be implemented in the imminent future. It was still, however, relatively optimistic, as it contained more forest than in 2008.
- Because the scenarios were based on existing planning documents, they could be developed within a short time frame and with limited capacity. There were few workshop costs and there was no need to hire a scenarios facilitation expert, albeit a consultant was hired to translate land-use plans into land-cover maps.
- Stakeholder input went into the scenarios, although it was mostly gathered second-hand through ForTRUST, the coalition of NGOs and government ministries that developed the Sumatra Vision.

Challenges and areas for future improvement

- The scenarios were based on the spatial plans as they were originally laid out, assuming that the land-use and land management practices would be fully implemented and enforced.
- The scenarios were based on land-use zoning designations, so they did not reflect the actual state of the landscape, just the legal land uses. The Sumatra Vision scenario was based on conservation planning, without consideration of all political constraints. This was due to insufficient time to solicit local expertise to check whether the land-cover scenarios reflected local realities.
- Neither scenario accounts for exogenous drivers of land-use change, such as climate change or international prices, or endogenous drivers of change that are likely within the control of district and provincial governments, such as internal migration and road construction. This static setting for scenarios is likely to be unrealistic, given the large number of external factors affecting land-use decisions in Sumatra. This means that policy recommendations do not account for unanticipated events or drivers of change that may occur in the future.
- The scenarios did not reflect deforestation risk and opportunity cost. The scenarios could be complemented with more sophisticated modeling of threats and drivers to make them more informative to policy applications such as REDD. This would help, for example, to verify that a potential REDD project truly fits the "additionality" criterion (i.e., there must be some risk of deforestation or forest degradation that the project avoids).
- Some of the zoning designation categories within the scenarios include multiple land uses, which creates uncertainty when converted into one land cover.

SNAPSHOT | Sumatra

POLICY CONTEXT

Policy level
Local (district and province)

Policy questions
- advocate spatial plan
- scope policy design
- identify which policies could be implemented, and where

Ecosystem services included
Carbon storage and sequestration, biodiversity, sediment retention, nutrient retention, water yield

SCENARIO PRODUCT AND PROCESS

Scenario format
Land-use zoning designations

Number of scenarios
2

Time frame for scenarios
Study undertaken in 2010; land-use designations for Sumatra Vision in 2020; government spatial plans for 2015

Time frame for ES assessments
Carbon assessment was based on extrapolating scenarios for next 50 years

Spatial extent of scenarios
Six watersheds covering portions of Riau, Jambi and West Sumatra

Spatial extent of policy recommendations
Priority districts that overlap with the six watersheds

Stakeholder participation in scenarios
Low

Consideration of exogenous drivers
None

Consideration of endogenous drivers
Limited

Capacity and time required
Low

Case Study References

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Roosita, H., H. Waluyo, et al. (2010). Roadmap towards ecosystem conservation of Sumatra: Sumatran Vision 2020, Internal Affairs Department, Public Works Department, Forestry Department, Ministry of Environment, National Development and Planning Board, Coordinating Ministry of Economy Sector, Forum Tata Ruang Sumatera (ForTRUST).

THIS CASE STUDY WAS DEVELOPED THROUGH THE NATURAL CAPITAL PROJECT, WHICH IS A PARTNERSHIP AMONG

Developing Scenarios to Assess Ecosystem Service Tradeoffs: Guidance and Case Studies for InVEST Users is a resource for practitioners who want to assess the provision of ecosystem services under alternative future scenarios. The guide draws on case experiences where InVEST was used to compare ecosystem service tradeoffs under different scenarios. It can help InVEST users choose appropriate types of scenarios and methods, engage stakeholders, and create scenario maps. The guide highlights key issues and questions for reflection, along with tools, case studies, references and resources for those who want to learn more.

InVEST is a suite of ecosystem service models, developed by the Natural Capital Project, for mapping, quantifying and valuing ecosystem services under different scenarios. InVEST helps decision makers incorporate ecosystem services into policy and planning at different scales in terrestrial, freshwater and marine environments.

Further materials are available on the scenarios page at naturalcapitalproject.org