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Testing a multi-scale scenario approach for smallholder tree plantations in Indonesia and Vietnam

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ABSTRACT

Smallholder tree plantations are seen as promising routes to alleviating poverty and increasing forest area among the countries in Southeast Asia. However, implementation has been disappointing, which led scientists at the Center for International Forestry Research (CIFOR) to consider a scenario exercise as a way to mitigate the risk of unwanted outcomes. The study had a characteristic that it shares with many other studies: close interaction of larger-scale processes and trends (global markets, national policy) with smaller-scale systems (regional and local policy, farmer livelihoods). The authors therefore felt than an explicitly multi-scale approach was called for. To keep close to the well-known practice, we made a modest extension to a conventional scenario logic approach, and introduced a nested, and multi-scale scenario logic. While modest, we believe that the modification is useful, and the method could be used in other studies, in particular climate adaptation studies. We applied the method during two scenario workshops held to explore the use of smallholder tree plantations in efforts to improve rural livelihoods; each workshop considered two different localities. While the scenario frameworks resulting from the workshops were similar between the localities, we believe that the nested scenario framework served to structure the process and revealed meaningful contextual differences. From these experiences, we discuss and critique the method.

1. Introduction

Indonesia and Vietnam are prominent among the countries in Asia that have chosen industrial tree plantations as a route to development and poverty alleviation. The choice is driven by several considerations: national targets for forest rehabilitation; the need to generate employment and increase community access to forest resources; and rising demand for industrial timber, both domestic and international. In Indonesia, the government plans to establish 9 million hectares (ha) of new timber plantations by 2016. This is in addition to the 5 million ha target of timber plantations to be reached in 2009, where it was reported that 4.3 million ha have been established. Of the 9 million ha, about 5.4 million ha would be allocated to communities, with the remainder allocated to large scale corporate actors. It is expected that some 360,000 rural households will be directly involved in developing plots of 15 ha each, with several hundred thousand more providing wage labor for forestry companies [1,2]. In Vietnam, the "Five Million Hectare Reforestation Program" (5MHRP), initiated in 1998, aims to increase the nation's forest cover to 43 percent by 2010 (which was successfully achieved), as well as increase the role of forests in the national economy and provide livelihood opportunities for smallholders [3]. Large numbers of farmers are now engaged in tree-planting schemes [4]. In both countries, the governments

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are promoting smallholder plantation development as a strategy for alleviating rural poverty. They are providing farmers with access to state-controlled forestland, discounted credit, technical extension, and subsidized inputs (such as seedlings and fertilizer) [1,3]. If well implemented, such programs could provide income opportunities for large numbers of rural households, while also increasing (or restoring) the productivity of degraded lands and developing sustainable raw material supplies for wood processing industries.

1.1. Drivers at multiple spatial scales

However, timber plantations are also facing different forces that operate at different levels, which could influence the success of these programs. In Indonesia, timber plantations are in the midst of the climate change debates about their contribution in carbon emissions [5]. In addition, the smallholder timber plantation (Hutan Tanaman Rakyat — HTR) program is facing difficulties in achieving its targets due to market and policy conditions [1]. Similarly, Vietnam's 5MHRP has also been facing significant challenges, both in policy formulation and implementation phases [3,6,7].

The smallholder forest sector is driven by highly uncertain forces with potentially significant impacts—such as international timber prices, global timber demand, and climate change—that will shape the future of timber plantations. When future possibilities are influenced by large but highly uncertain driving forces, a scenario approach is an appropriate tool. As with any scenario exercise, it is important to delineate the boundaries of the system. However, in this case there are multiple systems and multiple boundaries. Specifically, farmers make local decisions, typically on small farms; local and regional government planning bodies are interested in how their local policies may influence farmers; and national governments are considering policies that must be relevant across the country. Meanwhile, as noted above, actors at each of these spatial scales are operating under the influence of global markets and within global policy frameworks.

Such a multi-level decision space is not unusual. Social, technological and ecological systems are driven by forces that originate and operate at diverse spatial scales [8,9]. Moreover, in some situations, the fact that the driving forces operate at different scales affects technology adoption or decision-making; such situations call for an explicitly multi-scale method [10,11]. The question of how to link scenarios across scales (spatial and temporal) has emerged as an explicit topic in the literature on global environmental assessments, including climate change assessments. Such studies require linked analyses at radically different scales—from global to landscape, and from a century to a day. In response to this challenge, the authors see a need for foresight techniques that explicitly take into account drivers at different scales. A further, specific, motivation for this approach is that the study of which the scenario activities were a part included two locations in each country; the areas shared a national policy context, but were quite different in other respects.

In the study described in this paper the authors piloted a nested scenario logic to explicitly capture driving forces at different spatial scales. Multi-scale assessments have been a topic of concern, interest, and discussion since they were brought into focus by the Millennium Ecosystem Assessment [12]. The assessment required analyses that linked global processes to landscape (or smaller) scale ecosystem processes, which then fed back upon the global system. The problem is also acute with human systems, in particular the relationship between global drivers of climate change and adaptive responses to climate change [13,14]. Some of the researchers involved in these studies engaged in a "dialog" on multiscale scenarios, the results of which are summarized in a paper published in *Ecology and Society* [10]. The authors of the present paper share many of the concerns and conclusions of the authors of [10], but our method falls outside the range of options that they envision. Specifically, we propose that a scenario framework be constructed at several scales in one exercise, rather than leaving them to different exercises; thus, while the spirit of our approach is closest to the "loosely coupled" approach of Biggs et al. [10] in that it allows great flexibility in the way that drivers at different scales are represented, it also has some of the flavor of a "tightly-coupled" approach, in that it results in a single, coherent framework. Zurek and Henrichs proposed a classification of different approaches to scenario development at multiple geographic scales [11]. The method described in the present paper best fits Zurek and Henrichs' category of being "complementary" across scales, in that the scenario logics at different scales can be quite different from one another, while providing a unified picture. We note that although we use the term "coherence" throughout this paper, our method does not fit into Zurek and Henrichs' category of "coherence across scales", because we do not require that scenario logics be the same at different scales and so, for example, a global "breakdown" scenario would not require a local breakdown scenario.

Our proposed methodology therefore fits within the (currently wide) range of existing approaches. It has two important conceptual characteristics: first, a coherent multi-scale scenario logic is constructed during a single exercise, rather than being transferred from a different exercise; second, the way that the nested scenario logics at different scales cohere is a matter for discussion among those who create the scenario logic. It also has an important procedural characteristic, in that it is a relatively modest departure from popular methods, and is therefore easily adapted to existing practice. While foresight methodologies in general and scenarios in particular have a long history of development, the specific problem posed by multi-scale scenarios is relatively new and active. We believe that new methods should be welcome, and the method we present in this paper in such studies could lead to greater cross-scale consistency. We discuss our method and present some critical reflections based on our experiences.

1.2. Description of the study

We applied our method in a pair of scenario workshops that explored the use of smallholder tree plantations as a way to improve rural livelihoods by diversifying farmer incomes. The workshops formed part of a larger project initiated by the Center for International Forestry Research (CIFOR) to address the increase in industrial tree plantations in Southeast Asia, propelled largely by a growing demand for timber and timber products in China [15]. The project focuses on Indonesia and Vietnam. While each of these countries is making ambitious efforts to improve rural livelihoods through smallholder tree

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Fig. 1. Driving forces and critical uncertainties identified during the Vietnam workshop (dark circles: Binh Dinh; light circles: Phu Tho). Notes: FSC = Forest Stewardship Council, a non-governmental organization that has developed a certification scheme; this refers to certification under FSC.

plantations, such efforts generally have a problematic history. We explore the usefulness of scenario methods as a way to anticipate, and potentially address, the problems that have plagued smallholder tree plantations in the past.

The project held two scenario workshops, one in Bogor, Indonesia, in November 2009 and one in Viet Tri, Vietnam, in May 2010. Each workshop was attended by government representatives, academics and experts from two different parts of each study country: Riau and South Kalimantan Provinces in Indonesia, and Binh Dinh and Phu Tho Provinces in Vietnam. As discussed above, the regions within each country are sufficiently different that, at the workshop planning stage, it was not clear whether the same global and national driving forces would play out in the same way, or even have influence, in both regions. Moreover, differences might be expected between local driving forces and related policies. Therefore, in a bid to achieve some degree of consistency between the scenarios developed for each region, we elected to develop a multi-scale approach.

2. Methods

As discussed in the introduction, the authors felt compelled by the nature of the study to try a new method, but as the scenario activity was a practical, and not an experimental, exercise, we did not want to stray very far from well-known scenario methods. We therefore began with an intuitive logics methodology/approach [9], which we adapted to a multi-scale setting.

The process that we followed during the workshop was for the most part standard, so we offer only a brief sketch of the process. In the workshop, participants elaborated upon scenarios that were created based on the framework. They then applied these scenarios in a "wind-tunnel" test of proposed policies, during which the participants imagine possible outcomes for each scenario [16]. We asked the participants to think through the implications of introducing specific policies. While we recognize the challenges of making "no policy" narratives (or rather, narratives that are full of policies, but exclude the policies of interest), our goal was not fine-tuning policies but rather to think through and anticipate potential unpleasant surprises from the interaction of policies and trends at different scales; we believe that the exercise was suitable for this purpose.

As with most intuitive logic approaches that follow the method pioneered by Wack [17] and popularized by Schwartz [18], we asked the participants to identify driving forces and classify them along "impact" and "uncertainty" axes [19]. Driving forces classified as both high impact and high uncertainty were selected as the "critical uncertainties" that define the scenario framework. An example of driving forces classified by impact and uncertainty, constructed using the Driving Force program,[2] is shown in Fig. 1. The items in the figure are taken from the original, combined list of driving forces made by the participants of the two provinces in Vietnam. The figure has some duplicates and inconsistencies because the two groups' lists overlapped and because they perceived the uncertainty and influence of some items differently. We note that it is precisely the anticipation of such inconsistencies that led us to develop the method that we describe in this paper.

Following a recommended practice (e.g., [18] and [20]), we allowed the participants to choose several critical uncertainties. We invited them to identify, for each critical uncertainty, between two and four possible values. The participants then chose plausible and compelling combinations of values for each critical uncertainty. In each workshop, the participants built a scenario framework by deciding, in an

[2] DrivingForce is an open-source software available from http://scentools.sourceforge.net/.

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Table 1
Nested critical uncertainties (hypothetical example).

Scale	Critical uncertainties			
Global	Climate regime			
	Energy prices			
	Food prices			
National	Country 1		Country 2	
	Regional cohesion		Economic orientation	
	Policy stability		Democratization	
Landscape	Landscape 1a	Landscape 1b	Landscape 2a	Landscape 2b
	Land tenure reform	National political structure	Political representation	Strength of traditional systems
	Market access	Urbanization	Community identity	Social cohesion

open discussion, which combinations are both plausible and compelling.

2.1. Nested scenario framework

The main feature distinguishing the approach described in this paper from other intuitive logic approaches is its use of a nested scenario framework that enables a multi-scale analysis. The participants build the nested scenario framework from a nested set of critical uncertainties. A hypothetical example, which we constructed when designing the method, is illustrated in Table 1. As depicted in the figure, different critical uncertainties are active at each scale (global, national, and landscape); when a scale is relevant to more than one location (e.g., the two countries and four landscapes shown in the figure), the critical uncertainties can differ between locations. A nested structure such as that shown in Table 1 respects the uniqueness of individual national and local situations, while allowing for consistency when moving from smaller to larger scales. At the global level, all landscapes share the same set of critical uncertainties, while at smaller scales the set of critical uncertainties becomes increasingly specific to the landscape.

Scenarios can be elaborated at any of the three scales in Table 1. The steps taken in our method to move from a set of critical uncertainties to a set of scenarios are similar to those of other intuitive logic approaches: assign values for each critical uncertainty; select combinations of those values to create a scenario framework; and elaborate on the framework through narratives.

In the multi-scale approach presented in this paper, the scenarios elaborated at larger scales provide a frame for scenarios elaborated at smaller scales. However, not all of the larger-scale critical uncertainties are relevant at smaller scales or in a particular landscape, and so our approach does not fit the category of methods that impose "consistency across scales", rather falling into the category of being "complementary across scales" [11]. The example in Table 2 illustrates this through a modification of Table 1. As shown in the table, in hypothetical "Landscape 1b", global energy and food prices have a significant impact, but the climate regime does not, and policy stability is more important than regional cohesion. Thus, a scenario elaborated at the level of Landscape 1b could be consistent with more than one global or national scenario. This approach to constructing a multi-scale scenario framework, which differs from other approaches (e.g., [10]), is a distinguishing feature of the method presented in this paper.

2.2. Exploring the narratives with causal diagrams

Each workshop ran for four days. The workshop outputs included a vision of the future; a list of driving forces; a classification of driving forces by uncertainty and influence; a list of critical uncertainties and their values; a scenario framework; and some draft narratives. This material was rich but raw, and required further work before it could be presented in a report. As the workshop organizers, we then undertook to rework the raw material, including a critical review of the narratives.

To critically assess the narratives, and to check their reliability, we followed a two-step process. First, we sought within the narratives the implicit causal models that the participants had in mind as they wrote the narratives, expressing them as causal diagrams (Figs. 2–4). The diagrams illustrate how different factors link causally to effects in the participants' narratives. They reflect the facilitators' interpretation of the causal statements in the participants' narratives: for example, in Indonesia, one of the groups' narratives

Table 2
Selected critical uncertainties for a particular landscape (hypothetical example).

Scale	Critical uncertainties			
Global	~~Climate regime~~			
	Energy prices			
	Food prices			
National	Country 1		Country 2	
	~~Regional cohesion~~		Economic orientation	
	Policy stability		Democratization	
Landscape	Landscape 1a	Landscape 1b	Landscape 2a	Landscape 2b
	Land tenure reform	National political structure	Political representation	Strength of traditional systems
	Market access	Urbanization	Community identity	Social cohesion

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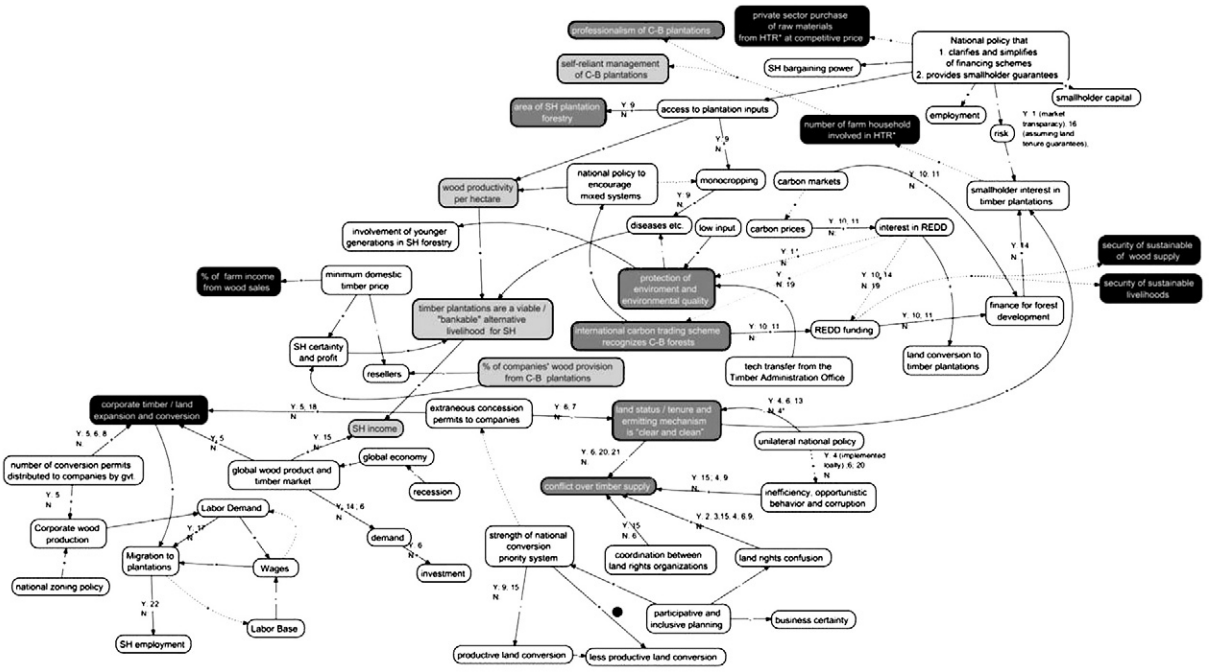

Fig. 2. Causal Diagram for Indonesia. Notes: (* HTR = Hutan Tanaman Rakyat: Smallholders/community timber plantation). Sources of diagram for Indonesia: [21], [5], [22], [23], [24], [25], [26], [24], [27], [28], [29], [30], [31], [32], [33], [34], [35], [36], [37], [33], [38], [39].

expressed the story, "As the global recession eases, timber markets start to recover; sustained moderate growth in demand for timber and timber products encourages investors."[3]This story contains causal elements linking the global economy to the market to timber and the resulting level of investment. We then captured such causal statements in diagrams. This particular causal sequence is illustrated in Fig. 2 through the linked nodes "recession", "global economy", "global wood product and timber market", "demand", and "investment". The arrows linking the nodes have a sign that reflects the direction of influence; thus, the arrow between "recession" and "global economy" is labeled with a negative sign "—", because the occurrence of a recession has a dampening effect on the global economy. The arrow between the global economy and global wood product and timber markets is labeled with a positive sign "+", because an expansion of the global economy is expected to drive an increase in wood and timber demand.

In the second step, we examined the available literature for evidence that either supported or disputed the claimed causal links. We did this by listing beside each link those sources that supported (marked by a "Y" for yes) or disputed (marked by an "N" for no) the claims of the participants.

2.2.1. Indonesia

The causal diagram for Indonesia combined the visions and all elements of the scenarios, as shown in Fig. 3. The nodes that are black with white text are from the vision for Riau and those that are dark gray with white text are from the vision for Kalimantan. The common parts of their visions are light gray with black text. General nodes taken from the scenario are white with black text.

Of the 28 causal links that were examined, 24 were shown to be factual and undisputed. Of the four that did have evidence of dispute, three also had supporting references. Only one of the 28 links was shown to be factually disputed: the link between interest in Reducing Emissions from Deforestation and Forest Degradation (REDD) and the international carbon trading scheme recognizes community based forests. Because there is no method yet found to accurately monitor or measure forestry carbon credits from smallholder plantations, interest in REDD would not lead to funding. However, it is not impossible for this to be funded, if the United Nations Framework Convention on Climate Change (UNFCCC) were pushed to finalize the global architecture of REDD and the national government finalizes the national and subnational architectures. The participants' causal statement was therefore not unreasonable, but is not likely to come to pass without substantial improvements in monitoring.

2.2.2. Vietnam

The causal diagrams for Vietnam combined visions and all elements of the scenarios, but kept the two provinces separate, as shown in Figs. 3 and 4. The nodes that are gray with black text are from the vision and objectives. General nodes from the scenario are white with black text. Dotted links between nodes represent author-identified causal links.

Phu Tho's diagram has an additional type of node. Since the Phu Tho, Vietnam scenario and vision were not as fully

[3] The raw output from the workshop was less clearly worded and dispersed among several outputs. The workshop facilitators drew on several outputs—vision statements, narrative elements in bullet point form, and driving forces—to produce this summary statement.

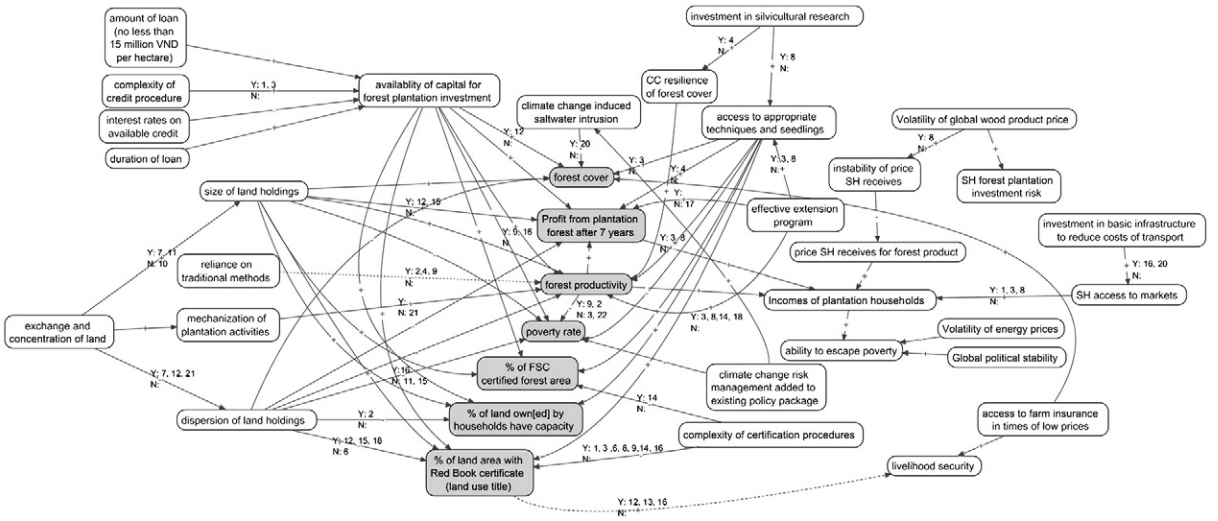

Fig. 3. Causal diagram for Binh Dinh.

developed as those of Binh Dinh's, the authors opted to include some of the relevant causal statements provided by workshop participants during a problem tree exercise that was part of the workshop but is not described in this paper. These nodes are black with white text.

The fleshed out Binh Dinh scenario makes its causal diagram generally more complicated. The additional lines in this diagram, compared to that of Phu Tho's are due to the fact that the scenario narrative included statements like the following:

"The major causes for not reaching the objectives are a lack of capital for investment into forest plantation (e.g. supported capital is small, households have difficulties in approaching capital sources and the procedures for borrowing capital are complicated), people lack appropriate techniques and seedlings, the selling price is unstable, there is a lack of land, and the land is dispersed."

Since the causal statements were linked to "the objectives" and not a specific one, the authors have included causal links from each statement in the above example, to all objectives.

As with Indonesia, in most cases participants' statements were either partially or fully supported. In both Binh Dinh and Pho Tho provinces, two causal connections were unsupported. In Binh Dinh, the claims that mechanization increases forest productivity and that effective extension programs increase profits could not be supported from the available literature; nevertheless, the participants' claims are not unreasonable, and the conclusions from the literature might be debated. The main lesson to draw from the literature is that these beneficial results cannot be assumed, but might be achieved with careful implementation. In Phu Tho, the claims that existing government policies increase both smallholder income from forestry and employment options could not be supported from the literature. This is potentially important for the scenarios, because it may explain the relatively optimistic scenario expectations of the participants from Phu Tho.

3. Critical reflections

With the nested scenario logic, we were trying out a new process, although it drew heavily on past workshops we had either led or been involved in. Based on this experience, some parts of the process will be modified or abandoned for future workshops; we discuss such modifications in Section 4. In this section, we focus on the results of the process, paying particular attention to the results from the nested scenario framework for the multi-scale scenario analysis.

3.1. Nested scenarios

In both the Indonesia and Vietnam workshops, the participants were asked to classify driving forces according to the scale at which they operate. As explained in Section 2, we anticipated that, as the most relevant driving forces for the two provinces at each workshop would differ, a nested scenario framework, as illustrated in Table 1, would be useful and appropriate. In both workshops, representatives from the two provinces selected a common scenario framework at the global/national level, but revealing differences emerged at the provincial scale. In Indonesia, provincial-level policies played an important role. By contrast, in Vietnam where provincial policies are essentially set at the national level, differences in the provincial-scale scenarios were determined more by distance from the capital, climate, landscape, and culture than by local policies.

Each workshop had some undesirable outcomes, which should be avoided in future workshops. First, in the Indonesia workshop, the group from South Kalimantan Province developed a considerably more elaborate scenario framework than did the Riau group. We decided that such differences, while unavoidable to some extent, could be reduced by providing more explicit instructions. Hence, in the Vietnam workshop, we provided specific guidelines on narrative writing, which did appear to help reduce (although not to eliminate) differences

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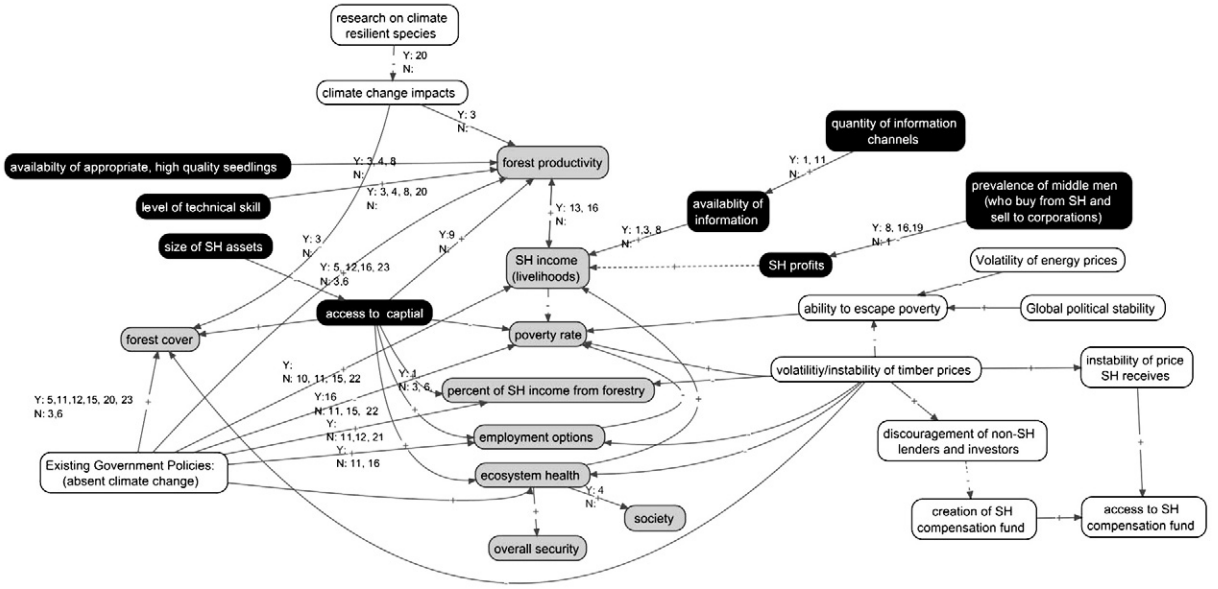

Fig. 4. Causal diagram for Phu Tho. Notes: CC: climate change; FSC: Forest Stewardship Council; SH: smallholders; VND: Vietnamese Dong. Sources of the diagrams 4 and 5: [21], [40], [41], [42], [43], [7], [44], [27], [45], [46], [47], [48], [32], [49], [50], [51], [52], [53], [54], [29], [6], [55], [56].

between the scenarios generated by each group. Second, the trajectory of scenario development in the Vietnam workshop suggested that a shared scenario framework for both provinces could be useful; that is, we elected to abandon our nested structure during the course of the workshop. While we encouraged the creation of a common framework, we now believe that real differences could have been identified if the two provinces had created separate scenario frameworks; we discuss this point further in Section 4.

The scenario framework at the global/national and regional scales for South Kalimantan is shown in Table 3. The framework was developed using the nested scenario method described in this paper by participants in the Indonesian workshop in Bogor. The scenarios at the two scales are related but, as shown, even where topics overlap, trends at different scales can move in different directions. For example, a high level of risk from monocropping systems at the national level could be consistent with a high local capacity to minimize that risk. At both global/national and regional levels, the scenarios aim to delimit extreme possibilities, whether an enabling, high-capacity environment with strong economic incentives for timber, or a challenging, low-capacity environment with weak economic incentives. Such a structure can create an unhelpful "good/bad" dichotomy for a normative scenario exercise, but it can be useful for identifying no-regrets or low-regret options in a "wind tunnel" policy evaluation exercise.

When writing their narratives, the South Kalimantan participants chose not to use their full multi-scale scenario framework, and the scenario framework and narratives for Riau lacked detail. Accordingly, in the "post-processing" step, we decided to create a unified scenario framework; therefore, the final product was a common scenario framework at the global/national level, with different detailed scenario narratives and policy options at the provincial level. In this way, the outcome was similar to that from a conventional intuitive logic process, followed by a "wind-tunnel" application of the scenario framework to particular policy questions. In general, the workshop participants assumed that the identified policies would change the course of the scenarios for the better—that is, bringing them closer to the goals they identified in their visions. However, following the two workshops, we decided that a further step is warranted, in which the participants could explore any possible side effects or unintended consequences of the policies that could lead to an outcome worse than that without a policy intervention.

4. Discussion

We believe that the scenarios developed in the two workshops meet the goal of increasing awareness among stakeholders and decision-makers of potential problems that could reduce the effectiveness of policies designed to encourage smallholder tree plantations. Furthermore, they highlighted where local policies could increase the likelihood of positive outcomes despite adverse external events and conflicting national policy. While the scenario logics developed during the workshops were relatively small, with a handful of critical uncertainties, it should be possible to expand the set of critical uncertainties. The main role for the nested scenarios is to organize related sets of critical uncertainties at different locations and at different scales. A particular subset of the full set of critical uncertainties applies at a given scale (e.g., national level rather than local level) or location (e.g., Riau rather than South Kalimantan). Any technique for managing interactions between large sets of critical uncertainties (e.g., cross-impact balances [57]) can be used with the technique described in this paper.

The main innovation in our approach was the use of the nested scenario framework. Although the workshop outcomes did not match our original intentions, in that the

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scenario frameworks that resulted from the workshops did not make a sharp distinction between the provinces represented, we believe that the nested scenario framework was a useful way to structure the process. Indeed, until the final narratives were created, the scenario frameworks for Riau and South Kalimantan in Indonesia were quite distinct. We argue that this is important for at least three reasons. First, the participants in a scenario workshop construct knowledge for themselves [58], and so the process itself is important. Second, allowing the result to emerge from the process can increase "ownership" of the product among the participants, a common argument for participatory approaches. Third, we believe that in the Vietnam scenarios the provinces should have used distinct scenario frameworks. As evidence for this third point, we note the differences between the scenario narratives for Binh Dinh and Phu Tho Provinces. The participants from Binh Dinh Province argued that challenges were likely in both scenarios—even the relatively positive one—and discussed how specific policies might alleviate those problems. By contrast, the participants from Phu Tho argued that under their Scenario 1, with existing policies, all of the goals in their vision could be met; this did not apply for their Scenario 2, but the proposed policy alternatives were relatively modest. This suggests to us that the participants from Phu Tho did not identify the most important driving forces for their province. This conclusion is reinforced by the inconsistent placement of common driving forces on the plot of impact vs. uncertainty (Fig. 1). The result was that in the examination of policies by the Phu Tho group, the "wind tunnel" was set to a "moderate breeze" rather than a "strong wind", and so their policy proposals were not rigorously tested. This suggests to us that the Phu Tho group should have had a different scenario framework at the regional level—and possibly also at the national level—from that of Binh Dinh. In retrospect, we should have trusted the method that we had developed, but as it was new and we were not confident in the outcome, we decided to revert to a more conventional approach. So, while this led to a less satisfactory outcome for the workshop than we hoped, it also indirectly supported our preference for an explicitly multi-scale scenario logic.

Table 3
Global, national, and regional scenarios, as developed by workshop participants from South Kalimantan Province, Indonesia.

Global/national	Scenario N1	Scenario N2
Dominance of forest exploitation policies	More	Less
Risk of monocropping systems	High	Medium
Market demand for forest products	Decrease	Increase
Status of REDD[a]	Unclear and unfunded	Clear but unfunded
Carbon trade	Unrecognized	Recognized
Regional	*Scenario R1*	*Scenario R2*
Number of conversion permits[a]	High	Low
Capacity to minimize risk from monocropping	Incapable	Capable
Prices of forest products	Unattractive	Attractive
Local institutional capacity for REDD[b]	Inadequate	Adequate
Carbon price	Unattractive	Attractive

[a] Reducing emissions from deforestation and forest degradation: An opportunity for farmers to gain income from forest conservation policies.
[b] Conversion permits allow a company to convert land: If granted in large numbers, conflicts and inconsistencies are much more likely.

5. Conclusion

We believe that the method presented in this paper provided a useful structure for the workshops on smallholder tree plantations, and can be more widely applied in contexts where the fact that distinct driving forces act at different spatial scales affects the analysis. The nested framework allows for local differentiation within a consistent set of scenarios. It is a modest but significant variation on the standard intuitive logic approach—modest because it can be grafted almost without change onto existing intuitive logic approaches, but significant because it can accommodate participants who are active at different scales in the initial development of a multi-scale scenario exercise. It therefore contrasts with multi-scale approaches that start with a high-level scenario and then ask participants to fit themselves within it [10,11]. Our method is also applicable if a set of high-level scenarios is constructed separately from those at smaller scales; a distinguishing feature of the approach described in this paper is that scenarios at the smaller scales might adopt all or only part of the scenario framework at the larger scales, depending on local conditions.

The method described in this paper is particularly useful in situations where the participants come from localities with different characteristics, and in countries where policy-making is relatively decentralized. Therefore, it is important for workshop facilitators to become familiar with the political context of the participants' countries and regions. The method could also be applicable during local impact studies based on global drivers, such as global climate change or global economic transformation.

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References

[1] K. Obidzinski, A. Dermawan, Smallholder timber plantation development in Indonesia: what is preventing progress? Int. For. Rev. 12 (4) (2010) 339–348.

[2] D. Kustiawan, Program pembangunan hutan tanaman rakyat (HTR), presentation at workshop 'Jaringan Kerja Litbang Hutan Tanaman', Ministry of Forestry, Bogor, Indonesia, 2007.
[3] Ministry of Agriculture and Rural Development (MARD), Five million hectare reforestation program partnership: synthesis report, MARD, Hanoi, Vietnam, 2001.
[4] A.A. Nawir, H. Kassa, M. Sandewall, D. Dore, B.M. Campbell, B. Ohlsson, M. Bekele, Stimulating smallholder tree planting — lessons from Africa and Asia, Unasylva, 58, 2007.
[5] L. Verchot, E. Petkova, K. Obidzinski, S. Atmadja, E.L. Yuliani, A. Dermawan, D. Murdiyarso, S. Amira, Reducing forestry emissions in Indonesia, CIFOR, Bogor, Indonesia, 2010.
[6] C. Lang, Vietnam: what's happening in the pulp and paper sector? WRM Bulletin Issue 115, http://www.wrm.org.uy/bulletin/115/viewpoint.html#Vietnam February 2007.
[7] F. Clement, J.M. Amezaga, Afforestation and forestry land allocation in northern Vietnam: Analysing the gap between policy intentions and outcomes, Land Use Policy 26 (2009) 458–470.
[8] C.S. Holling, F. Berkes, C. Folke, Science, sustainability, and resource management, in: F. Berkes, C. Folke (Eds.), Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience, Cambridge University Press, Cambridge, UK, 1998.
[9] J. Norberg, J. Wilson, B. Walker, E. Ostrom, Diversity and resilience of social–ecological systems, in: J. Norberg, G. Cumming (Eds.), Complexity Theory for a Sustainable Future, Columbia University Press, New York, NY, 2008.
[10] R. Biggs, C. Raudsepp-Hearne, C. Atkinson-Palombo, E. Bohensky, E. Boyd, G. Cundill, H. Fox, S. Ingram, K. Kok, S. Spehar, M. Tengö, D. Timmer, M. Zurek, Linking futures across scales: a dialog on multiscale scenarios, Ecol. Soc. 12 (1) (2007) 17.
[11] M.B. Zurek, T. Henrichs, Linking scenarios across geographical scales in international environmental assessments, Technol. Forecast. Soc. Chang. 74 (8) (2007) 1282–1295.
[12] Millennium Ecosystem Assessment (MA), World Resources Institute (WRI), Dealing With Scale, in: Ecosystems and Human Well-Being: A Framework for Assessment, Island Press, Washington, D.C, 2003.
[13] E. Kriegler, B.C. O'Neill, S. Hallegatte, T. Kram, R.J. Lempert, R.H. Moss, T. Wilbanks, The need for and use of socio-economic scenarios for climate change analysis: a new approach based on shared socio-economic pathways, Glob. Environ. Chang. 22 (2012) 807–822.
[14] D.P. van Vuuren, K. Riahi, R. Moss, J. Edmonds, A. Thomson, N. Nakicenovic, T. Kram, F. Berkhout, R. Swart, A. Janetos, S.K. Rose, N. Arnell, A proposal for a new scenario framework to support research and assessment in different climate research communities, Glob. Environ. Chang. 22 (2012) 21–35.
[15] C. Barr, C. Cossalter, China's development of a plantation-based pulp industry: government policies, financial incentives, and investment trends, Int. For. Rev. 6 (3–4) (2004) 267–281.
[16] N. Turner, Future-proofing your organisation, CEO J. (October 2008) 1–3.
[17] P. Wack, Scenarios: shooting the rapids, Harv. Bus. Rev. (Nov–Dec 1985) 139–150.
[18] P. Schwartz, The Art of the Long View: Planning for the Future in an Uncertain World, Currency Doubleday, New York, NY, 1996.
[19] P. Bishop, A. Hines, T. Collins, The current state of scenario development: an overview of techniques, Foresight 9 (2007) 5–25.
[20] I. Grossmann, Critical and strategic factors for scenario development and discontinuity tracing, Futures 39 (2007) 878–894.
[21] D. Race, A.R. Bisjoe, R. Hakim, N. Hayati, Julmansyah, A. Kadir, I. Kurniawan, Partnerships for involving small-scale growers in commercial forestry: lessons from Australia and Indonesia, Int. For. Rev. 11 (2009) 88–97.
[22] W.D. Sunderlin, I.A.P. Resosudarmo, Rates and causes of deforestation in Indonesia: towards a resolution of the ambiguities, CIFOR, Bogor, Indonesia, 1996.
[23] Department for International Development (DFID), Crime and persuasion: tackling illegal logging, improving forest governance, DFID, London, UK, 2007.
[24] L. Potter, S. Badcock, The effects of Indonesia's decentralisation on forests and estate crops in Riau Province: case studies of the original districts of Kampar and Indragiri Hulu, CIFOR, Bogor, Indonesia, 2001.
[25] M. Colchester, Bridging the gap: challenges to community forestry networking in Indonesia, CIFOR, Bogor, Indonesia, 2002.
[26] C.M. O'Connor, Effects of central decisions on local livelihoods in Indonesia: potential synergies between the programs of transmigration and industrial forest conversion, Popul. Environ. 25 (2004) 319–333.
[27] C.H. Anyonge, J.M. Roshetko, Farm-level timber production: orienting farmers towards the market, Unasylva 54 (2003) 48–56.
[28] N. Olsen, J. Bishop, The financial costs of REDD: evidence from Brazil and Indonesia, IUCN and Rio Tinto, Gland, Switzerland, 2009.
[29] J. Eliasch, Climate change: financing global forests, Earthscan, London, 2008.
[30] M. Nanang, M. Inoue, Local forest management in Indonesia: a contradiction between national forest policy and reality, Int. Rev. Environ. Strateg. 1 (1) (2000) 175–191.
[31] Greenpeace International, Indonesia's rainforests and the climate crisis, Greenpeace, http://greenpeace.hu/up_files/1286290540.pdf 2009.
[32] A. Hinrichs, D.R. Muhtaman, N. Irianto, Forest certification on community land in Indonesia, Gesellschaft für Technische Zusammenarbeit, Jakarta, Indonesia, 2008.
[33] R. Kanaan, J. Schweithelm, Growing conflict and unrest in Indonesian forests: a summary paper, ARD, Burlington, 2004.
[34] J.M. Roshetko, Agroforestry for livelihood enhancement and enterprise development, World Agroforestry Center (ICRAF) and Winrock International, Bogor, Indonesia, 2006.
[35] Humanitarian Policy and Conflict Research International, Building Human Security in Indonesia, Harvard University, Cambridge, Massachusetts, 2009.
[36] S. Dewi, B. Belcher, A. Puntodewo, Village economic opportunity, forest dependence, and rural livelihoods in East Kalimantan, Indonesia, World Dev. 33 (9) (2005) 1419–1434.
[37] G. Turner, J. Malsbury, A. Parpia, G. Turner, J. Malsbury, A. Parpia, The impact of forestry on the global carbon market, New Carbon Financ. 13 (2009).
[38] S. Suyanto, G. Applegate, R.P. Permana, N. Khususiyah, I. Kurniawan, The role of fire in changing land use and livelihoods in Riau-Sumatra, Ecol. Soc. 9 (1) (2004).
[39] L. Chidley, Forests, People and Rights, Down to Earth, International Campaign for Ecological Justice in Indonesia, Special Report, Down to Earth, Cumbria, UK, 2002.
[40] C. Saint-Macary, A. Keil, M. Zeller, F. Heidhues, P.T.M. Dung, Land titling policy and soil conservation in the northern uplands of Vietnam, Land Use Policy 27 (2010) 617–627.
[41] World Bank, Vietnam development report 2011 natural resources management, in: Joint Development Partner Report to the Vietnam Consultative Group Meeting. Hanoi, December 7–8 2010.
[42] K. Rerkasem, N. Yimyam, B. Rerkasem, Land use transformation in the mountainous mainland Southeast Asia region and the role of indigenous knowledge and skills in forest management, For. Ecol. Manag. 257 (2009) 2035–2043.
[43] B. Ohlsson, Farmers and forest land use in Lao PDR and Vietnam. Unpublished Ph.D dissertation. Swedish University of Agricultural Sciences. Umeå, 2009.
[44] M. Ravallion, D.v.d. Walle, Land in Transition: Reform and Poverty in Rural Vietnam, World Bank, Washington, D.C, 2008.
[45] N. Kemper, R. Klump, Land reform and the formalization of household credit in rural Vietnam, in: Paper Presented at the Annual Poverty Reduction, Equity and Growth Network (PREGNet) Conference, The Hague, Netherlands, September 3–4 2009.
[46] T. Sikor, T.Q. Nguyen, Why may forest devolution not benefit the rural poor? Forest entitlements in Vietnam's central highlands, World Dev. 35 (2007) 2010–2025.
[47] F. Clément, J.M. Amezaga, D. Orange, T.D. Toan, The impact of government policies on land use in Northern Vietnam: an institutional approach for understanding farmer decisions, IWMI Research Report 112, International Water Management Institute, Colombo, Sri Lanka, 2007.
[48] T. Sikor, The allocation of forestry land in Vietnam: did it cause the expansion of forests in the northwest? For. Policy Econ. 2 (2001) 1–11.
[49] M.R. Auer, Group forest certification for smallholders in Vietnam: an early test and future prospects, Hum. Ecol. 40 (2012) 5–14.
[50] J.C. Castella, S. Boissau, N.H. Thanh, P. Novosad, Impact of forestland allocation on land use in a mountainous province of Vietnam, Land Use Policy 23 (2006) 147–160.
[51] W.D. Sunderlin, T.B. Huynh, Poverty alleviation and forests in Vietnam, CIFOR, Bogor, Indonesia, 2005.
[52] B. Ohlsson, M. Sandewall, R.K. Sandewall, N.H. Phon, Government plans and farmers intentions: a study on forest land use planning in Vietnam, Ambio 34 (3) (2005) 248–255.
[53] T. Sikor, Politics of rural land registration in post-socialist societies: contested titling in villages of Northwest Vietnam, Land Use Policy 23 (2006) 617–628.
[54] M. Völker, H. Waibel, Do rural households extract more forest products in times of crisis? Evidence from the mountainous uplands of Vietnam, For. Policy Econ. 12 (2010) 407–414.
[55] D. Muller, M. Epprecht, W. Sunderlin, Where are the poor and where are the trees? Targeting of poverty reduction and forest conservation in Vietnam, CIFOR, Bogor, Indonesia, 2006.
[56] M. Moeliono, L.Q. Trung, N.A. Utomo, R. Andriani, Who benefits? Small scale tree planters and companies in Vietnam and Indonesia, in:

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[57] W. Weimer-Jehle, Cross-impact balances: a system-theoretical approach to cross-impact analysis, Technol. Forecast. Soc. Chang. 73 (2006) 334–361.
[58] T.J. Chermack, L. van der Merwe, The role of constructivist learning in scenario planning, Futures 35 (2003) 445–460.

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