MODEL FOR COLLABORATIVE PLANNING OF COMMUNITY-MANAGED RESOURCES BASED ON QUALITATIVE SOFT SYSTEMS APPROACH

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Received October 2002

PURNOMO, H., MENDOZA, G. A. & PRABHU, R. 2004. Model for collaborative planning of community-managed resources based on qualitative soft systems approach. A qualitative soft systems model is proposed in this paper to address the inherent complexity of community-based resource management. The model follows the principles of participatory management where local stakeholders are fully engaged in different phases and stages of planning and decision-making. The process starts with an open exploration of views and perspectives from all participants. Collaborative or participative modelling follows where the multiple views, perspectives and concerns are systematically organised and structured into a qualitative model describing the interrelationships, interactions, and causality relationships of the different management components, particularly the relevant indicators. The modelling process allows direct participation and involvement of all stakeholders. Hence, the resultant model is a product of the collective knowledge, expertise, and experience of the stakeholders. The model and the modelling process offer an excellent environment for learning on the part of the stakeholders as they formulate the relevant components, indicators and their dynamic interactions. The proposed approach is demonstrated using a case study involving forest communities within the Pasir District located at Kalimantan, Indonesia.

Key words: System dynamics – scenario analysis – soft methodologies – participatory action research

PURNOMO, H., MENDOZA, G. A. & PRABHU, R. 2004. Model perancangan usaha sama untuk sumber yang diuruskan oleh komuniti berdasarkan pendekatan sistem perisian kualitatif. Satu model sistem perisian kualitatif dicadangkan dalam kertas

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kerja ini bagi menangani kerumitan pengurusan sumber berasaskan komuniti. Model ini berlandaskan prinsip pengurusan penyertaan. Dengan cara ini pemegang tanah terlibat sepenuhnya dalam setiap fasa serta peringkat perancangan dan membuat keputusan. Proses ini bermula dengan tinjauan terbuka tentang pendapat dan sudut pandangan semua peserta. Model usaha sama atau penyertaan disediakan setelah pelbagai pendapat, sudut pandangan dan kepentingan disusun dan distruktur secara sistematik menjadi model kualitatif yang menerangkan saling perhubungan, interaksi dan hubungan sebab akibat komponen pengurusan yang berlainan, terutamanya penunjuk yang berkenaan. Proses membuat model ini membolehkan penyertaan dan penglibatan langsung semua pemegang tanah. Justeru, model yang dihasilkan merupakan hasil kolektif pengetahuan, kepakaran dan pengalaman pemegang harta. Model serta proses membuat model ini menawarkan persekitaran yang sangat baik untuk pemegang harta menimba ilmu kerana mereka berpeluang mendapat pengalaman merumuskan komponen, penunjuk dan interaksi dinamik yang berkenaan. Pendekatan yang dicadangkan ini ditunjukkan secara kajian kes yang melibatkan komuniti hutan dalam daerah Pasir, Kalimantan, Indonesia.

Introduction

Controversies over forest management practices often arise because of differences in views and perspectives of stakeholders about what is considered sound management strategy, consistent with stakeholders' goals and objectives. For instance, Kearney *et al.* (1999), in his study of the forests in Pacific Northwest, observed the existence of a wide range of concerns including issues related to the focus, setting, and process of management. Due to the underlying multiple perspectives, participatory planning and group decision making have become increasingly more important in natural resource management.

The effectiveness of collaborative planning and decision making depend on good communication and understanding among stakeholders. However, too often many impediments to the smooth functioning of the communication process exist. For instance, one such impediment is the simple fact that stakeholders often hold different views and perspectives and may also interpret situations differently. This plurality of perspectives, coupled with people's strong positions about the legitimacy of their own views, can result in divergent problem definitions, or worst, misunderstanding and polarisation among stakeholders.

Many of these problems are manifested in the current debate about sustainable forest management in many parts of the world, including Indonesia. Part of the debate derives from divergent perspectives on appropriate forest management practise. Therefore, it is important to explore how different stakeholders understand or conceptualise appropriate forest management. Local communities who have lived in or around forests for a long time often have useful forest management knowledge based on their long-term, local experience. Recognition of the value of local stakeholders' knowledge, particularly that of local communities, and its use are key steps towards enhancing communication and cooperation between local stakeholders and other forest managers, and for empowering local people.

To help address plurality of perspectives from multiple stakeholders, a number of planning tools have been proposed. These tools can generally be categorised into two classes, namely, hard systems approach, and soft systems approach. As their names imply, both approaches adopt a holistic or system-oriented view of resource management. Clayton & Radcliffe (1996) defined a hard systems approach as a method that starts with a basic acceptance of a well-defined objective and problem specification. This approach is deeply rooted in the traditional 'scientific management' concept, which essentially assumes that the problem addressed can be sufficiently understood and the interrelationships among the system elements can be sufficiently modelled. In contrast, Checkland (1989) defined soft systems methodology (SSM) as a learning system designed for complex human-dominated systems. In other words, SSM is fundamentally designed as a tool to understand the system and not to solve a 'problem' as is the case of formal hard system-based approach (Rosenhead 1989). SSM takes the view that a formal model is only one out of potentially many perspectives of the problem.

To increase the usefulness of any participatory approach at the local level, knowledge from local stakeholders should be taken into account. Invariably, local stakeholders are most familiar with problems and issues surrounding the management of the resources that can affect, or are impacted by, them. On the other hand, Ostrom *et al.* (1993) stated that it is also misleading to suggest that existing indigenous knowledge is sufficient to pursue resource management and development. Conversely, reliance solely on scientific knowledge is likely to produce technically sound management strategies that at best may not be adopted or languish unutilised, or at worst consume more resources than they produce. Combining knowledge from local stakeholders about local circumstances with scientific management tools could be very beneficial in developing knowledge bases and management strategies that are more efficient and, consequently, lead to sustainable management of resources.

In addition to SSM, or more generally called problem structuring approaches, other participatory approaches for community development have been proposed, most notably, the participatory action research (PAR) (Chambers & Guijt 1995). Selener (1997) defined participatory research as a process through which members of a community identify a problem, collect and analyse information, and act upon the problem in order to find solutions suitable and adoptable to their unique situation and circumstances. As the name implies, PAR is collaborative and action research of the group is achieved through critically examined action or perspective of individual members. The linking of the terms 'action' and 'research' highlights the essential feature and underlying theory of the approach.

The purpose of this paper is to develop a qualitative soft system dynamics model and demonstrate its application using a case study involving a community-managed forest. The case study illustrates the different phases of qualitative modelling following the principles of soft system methods, which combines the features of PAR (Selener 1997) and qualitative systems dynamics (Wolstenholme 1999).

Materials and methods

A qualitative soft systems model

As can be seen from the above definitions, PAR and systems analysis, particularly the soft systems approach, share many of the characteristics that are best suited for participatory resource management. First, is the recognition and accommodation of multiple perspectives from the voices and opinions expressed by different stakeholders. An ideal participatory process requires not only that the views from stakeholders are sufficiently heard, but that they are also adequately incorporated at a deeper level beyond simply hearing them. Too often, participatory processes simply consist of hearing the concerns of local communities with no or little effort given to the communities for a stronger voice in the final decisions made. In addition to the rich generation of ideas, concepts, perspectives, issues and concerns made possible through open exploration of values, both PAR and soft systems approaches also give pre-eminence to facilitation. They both pay sufficient attention to the elements of a facilitated process, namely, the facilitator, analysts, intended user, and the decision maker(s). In both approaches, facilitation is pivotal not only in the initial stages of value exploration, but also in the decision exploration so that not only are stakeholders' perspectives and worldviews considered, but that each stakeholder is comfortable and given the chance to voice opinions or ideas at any time.

In view of the close affinity between PAR and the soft systems approach, it makes sense to integrate them. Combining qualitative system dynamics and PAR can theoretically facilitate integrating various disciplines and can take advantage of the strengths and capabilities of each method. On one hand, PAR enables an open environment that allows the consideration of plurality of perspectives from various stakeholders. Qualitative system dynamics, on the other hand, offers a framework within which these multiple perspectives can be simultaneously examined in a systematic and systemic manner.

Soft qualitative modelling in this study involves the specification of the interactions and influences between and among elements of a system. In the context of the case study, collaborative modelling consisted of the stakeholders or participants specifying the relationships among the system elements using nodes and arrow diagrams. The direction of the arrows represents the direction of the influence or causality. In addition to specifying the causality, the nature of the causality, i.e. positive or negative, was also specified. The result of this modelling effort is a set of influence diagrams depicting the causalities (i.e. causal loop diagrams) and feedback loops, either positive or negative. A positive loop means that if the cause increases, the effect increases above what it would otherwise have been, and if the cause decreases, the effect decreases below what it would otherwise have been. A negative loop means that if the cause increases, the effect decreases above what it would otherwise have been, and if the cause decreases, the effect increases below what it would otherwise have been. These relationships are identified and specified using feedback loops and causal loop

diagrams (Sterman 2000) denoted by nodes and arrows such as those shown in Figure 3. Details about the model itself, the modelling process, and subsequent analyses are contained in the results and discussion.

The case study

The site used in this case study is situated at the Lumut mountain area located in East Kalimantan, Indonesia. The area is about 35 000 ha that was decreed by the government of Indonesia in 1993. Prior to its establishment as a protected forest, the area was leased to a timber company under a concession agreement that allowed the company to log commercial timber species. The timber company logged the forest for 23 years until it was set aside as a protection forest in 1993. The forest is a protected area and set aside for water and soil conservation as well as for biodiversity. The dominant species in the forest include *Aglaia* sp., *Aglaia tomentosa, Artocarpus elasticus, Madhuca sericea,* and *Shorea leprosula.* The forest has a current growing stock of approximately 312 m^3 ha^{-1}. A major river called Kasungai runs through the forest.

There are three villages inside the forest area, namely, Kasungai, Rantau Layung and Rantau Buta. Rantau Layung is located at the upper Kasungai River while Rantau Buta is situated downstream. Due to their proximity to the forest, Rantau Buta and Rantau Layung were the forest communities selected for the case study. As is often the case, the former concession area was allocated to the timber company under a concession agreement with little or no consultation with local communities. Figure 1 shows the location of the Pasir District where the forest communities are situated. The approximate boundaries and locations of the two forest communities and their juxtapositions relative to the timber concession are shown in Figure 2.

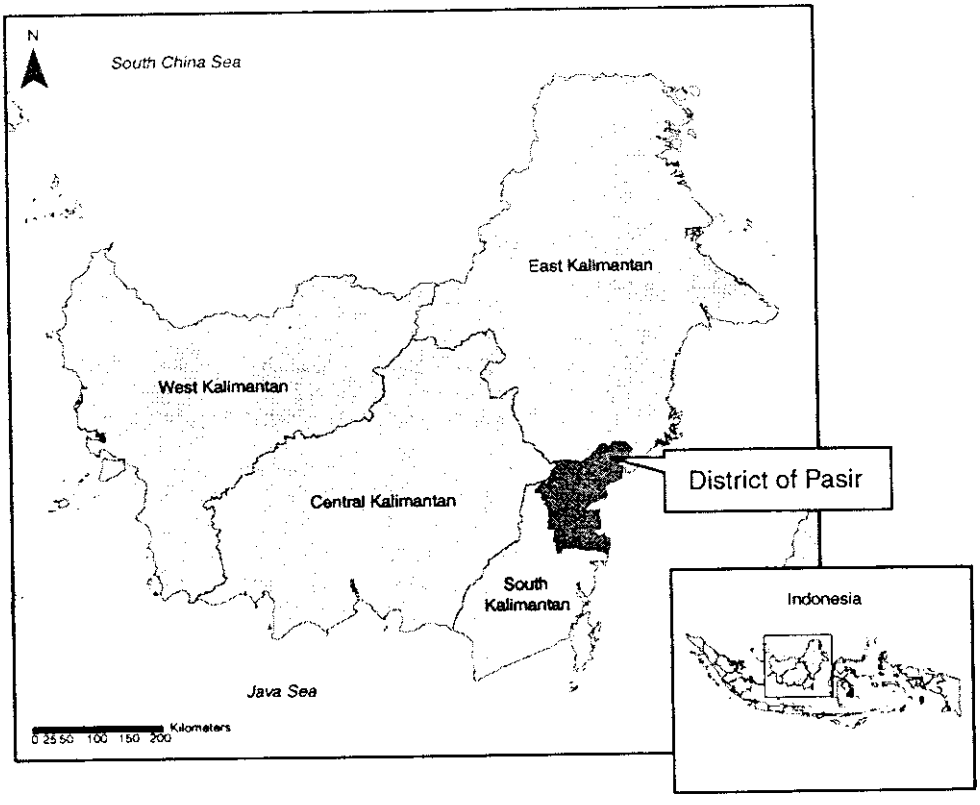


Figure 1. District of Pasir, East Kalimantan

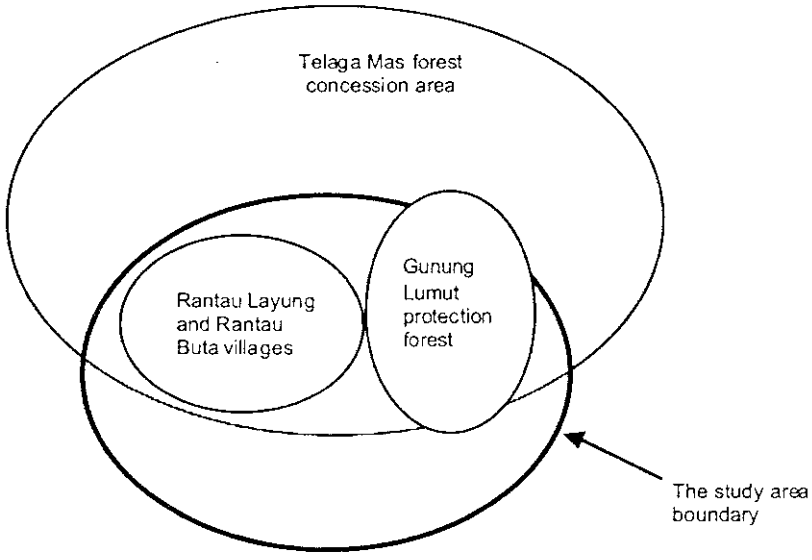


Figure 2 An abstract view of the study area

In Rantau Layung, there are 52 families whereas only 20 families reside in Rantau Buta. Livelihoods in both villages are mostly dependent on rattan, coffee and timber products. Other products include honey bee, latex, candle nuts, and fruit trees (durian, rambutan, mangoes). Total communal forest area in Rantau Layung is about 18 900 ha whereas the boundary of the community forest in Rantau Buta has not yet been identified. The amount of protection forest within Rantau Layung is approximately 500 hectares. The actual protection forest within Rantau Buta village has been estimated at approximately 16 000 ha. Only 40 ha of the forest in Rantau Buta have been cultivated for agricultural purposes while in Rantau Layung, about 100 ha have been cultivated. Most of the villagers are farmers who practise shifting cultivation following a system locally known as *gilir balik* where they plant rice only twice in the same area within a year, then they move to the nearest area in order to open a new field the following year with permission from the village chief. After five to eight years they return to their first paddy field. Each family has approximately 1.5 to 2 ha to conduct shifting cultivation, including planting of their fruit trees and other medicinal plants.

One of the objectives of the case study is to develop a common management vision for the Lumut Mountain Reserve. As stated above, the villagers within the two communities collect and plant rattan, cut timber, and practice different forms of shifting cultivation. It is not uncommon for them to wander beyond the boundaries of their forest communities. Consequently, there has been some conflict between the local communities and the timber company, including occasional discord with governmental programs and organisations. In general, conflicts arise because of issues related to forest resource access, logging benefits and costs, including ecological and social services provided by the forest.

In view of the above, the research was initiated in part to seek better ways of resolving these conflicts through facilitation aimed at searching for shared visions and perceptions from the stakeholders. To achieve this search for a common goal,

a collaborative model was developed and adopted as a tool for participatory planning and decision making. As pointed out earlier, this collaborative model integrates the principles of PAR and the soft systems approach. In so doing, the model adopts the open-ended, free and divergent thinking characteristics of PAR in order to create a rich picture of the issues representing many of the multiple views and perspectives of the stakeholders. These perceptions were structured so that their interactions and relationships can be holistically examined both individually and collectively. The model was then used as a tool to learn about the dynamics of the ecological and social sub-systems within and outside the community forest areas.

The study was conducted in three phases. Phase 1 involved an initial field visit with the communities followed by interactive consultations with the villagers. Phase 2 involved a group- or collaborative-modelling exercise followed by the development of strategies and future scenarios conducted two months after phase 1. Finally, these strategies and future scenarios were observed, monitored and evaluated in phase 3. The visits in phase 1 were aimed at observing the biophysical conditions of the forests as well as paying close attention to the problems and issues revealed by the villagers, formal head of village and customary leaders. Some benchmark socio-economic and physical field data were also collected in phase 1.

The collaborative modelling workshop in phase 2 was attended by representatives from different institutions as shown in Table 1. The purpose of this phase was to engage the villagers in a modelling exercise where the villagers' seemingly disparate views and perspectives can be brought together in a systematic and holistic manner. It is crucial and strategically significant in any community-based resource management that local communities realise the interconnections of their actions driven by their own views, interests, and perspectives about the forest. Participatory modelling is one of the most effective ways to instruct and demonstrate the principles of holistic resource management. In the case study, collaborative modelling was conducted in a workshop setting following the stages and timetable shown in Table 2. The participants developed the schedule themselves and also adjusted the timetable during the workshop so that sufficient time was allotted for each activity.

Researchers from the Center for International Forestry Research (CIFOR) and a local non-governmental organisation (NGO) called Yayayan Padi Indonesia (YPI) facilitated the collaborative modelling process. YPI has worked in the two villages since 1997; hence, they are familiar with and have intimate knowledge about the local communities. The national language called Bahasa Indonesia was used in the modelling process although sometimes it was mixed with the local dialect.

Observing and evaluating strategies and scenarios in phase 3 took place in the field for a period of six months starting a month after the collaborative modelling phase. Like phase 2, the third phase was also conducted in a participatory manner, drawing from the knowledge and experience of the stakeholders. In addition to the development of strategies and scenario assessments, the third phase was also aimed at examining subsequent actions taken by stakeholders, especially their

overall commitment. It was observed that the stakeholders manifested a strong sense of ownership to the models developed and also remained committed to the strategies they collectively developed. It was clear that the participatory or collaborative modelling and planning processes were an effective means to draw the involvement of the stakeholders.

Table 1 The modelling workshop participants

Participant	Forest related roles of institution	Number of people attended
Customary leaders	Oversee traditional laws and rules	2
Village leader	Handling formal laws and rules	1
District Parliament representative	People representation in public policy making	1
Forestry District Unit leaders	Executing forest policy	2
Pasir Development Planning Agency representative	Integrating and creating policy and planning	1
Pasir Environmental Control Agency representative	Controlling impacts	1
Pasir Office of National Land Agency leader	Administrating land rights	1
Pasir Government Bureau of Economics leader	Economic planning and evaluation	1
Pasir Government Bureau of Laws leader	Administrating regulations	1
Telaga Mas forest concession representative	Utilising/logging forest	1
Yayasan Padi Indonesia (a local NGO) representatives	Empowering local communities	3
CIFOR researchers	Research	3
Total number of people		18

Table 2 The modelling workshop activity and timetable

Activity	Day
Identification and categorisation of the components of forest management	1
Participatory modelling	2
Discussion and analysis of performance indicators	2
Exploring strategies and future scenarios	3
Roles of participants to achieve the selected scenario(s)	3

Results and discussion

The results of the case study are presented in the five sections below coinciding with the four major activities at the workshop. The first section briefly describes the identification and categorisation of the forest management component. The second section presents the results of participatory modelling process, particularly the interactions and interrelationships of the components. The third section

examines the projected performance of the indicators between the 1990–2010 time horizons. The fourth section provides exploratory analyses of scenarios and their projected impacts on the indicators. Finally, the fifth section provides a brief discussion of the impacts and influences of the modelling study, particularly in terms of the expected changes and proposed plans resulting from the analyses.

As pointed out earlier, the collaborative modelling process is a combination of PAR and the qualitative system dynamics. Hence, in conducting the different phases of the collaborative modelling process, PAR principles and qualitative systems methods were adopted as described below.

Identification and categorisation of forest management components

The participatory process began with an open exploration of visions, perspectives, goals and concerns of the stakeholders. As stated earlier, this is an open process aimed primarily at capturing the multiple views of the stakeholders. In the case study, this initial phase was intended to draw out from the stakeholders what they considered to be the major forest management components and ultimately to generate significant indicators of these components.

The participants decided to divide the forest management components into three general categories: (1) social and economy, (2) forest utilisation environment, and (3) rules and laws. Then, following the participatory principles of PAR, the participants were enjoined to share their opinions, either verbally or through index cards. To ensure better participation from, and more active involvement by, the stakeholder participants, the entire process was carefully administered by a team of facilitator who also assisted in the grouping of those components into three main categories. The result of this process is given in Appendix 1.

As expected, Appendix 1 shows a rich collection of views, perspectives, and objectives identified by the stakeholders. Some of them are actionable items; others are simply statements of concerns or issues. In facilitating this initial phase, careful consideration was given to all opinions shared. Accommodation was given importance more than clarity of ideas or visions and how they coalesced with the opinions of others. It was important that creativity and open dialogue were not prematurely stifled at this stage (Keeney 1992).

Inter-component interaction and relationships

In this phase, the participants were divided into three groups following the three components, i.e. social and economy, forest utilisation and environment, and rules and laws. The groups discussed each of the elements under each component and also 'unpacked' them into more detailed and tangible subelements. The process was guided by qualitative or soft systems principles such as cognitive mapping (Eden & Ackerman 1998) and the use of influence diagrams to denote the relationships between and among the forest management components in general, and their subelements in particular. Consistent with PAR, the group also presented their findings to all participants in a group discussion. Following the

identification of subelements within each component, the group discussion focused on the overall relationship of component categories, and the subelements under each component.

Collaborative modelling was initiated in phase 2. At this stage the stakeholders were asked to examine more closely the subcomponents they generated in phase 1. As part of the process, the stakeholders or modelling participants were also asked to review the subelements in phase 1, group them where appropriate and also think about significant indicators under each of the three general components. While no specific number of indicators were specified, it was necessary to identify 'central indicators' which could be subsequently used as a strategic focus in generating alternative scenarios to be identified in the third phase.

During the modelling process, the facilitators generally assumed passive roles by providing an informal and comfortable environment for the stakeholders to interact, share opinions, and express their perceptions with regards to the management of their forest communities. This was important in order to avoid or minimise any disciplinary and confirmation bias on the part of the researchers and the facilitators.

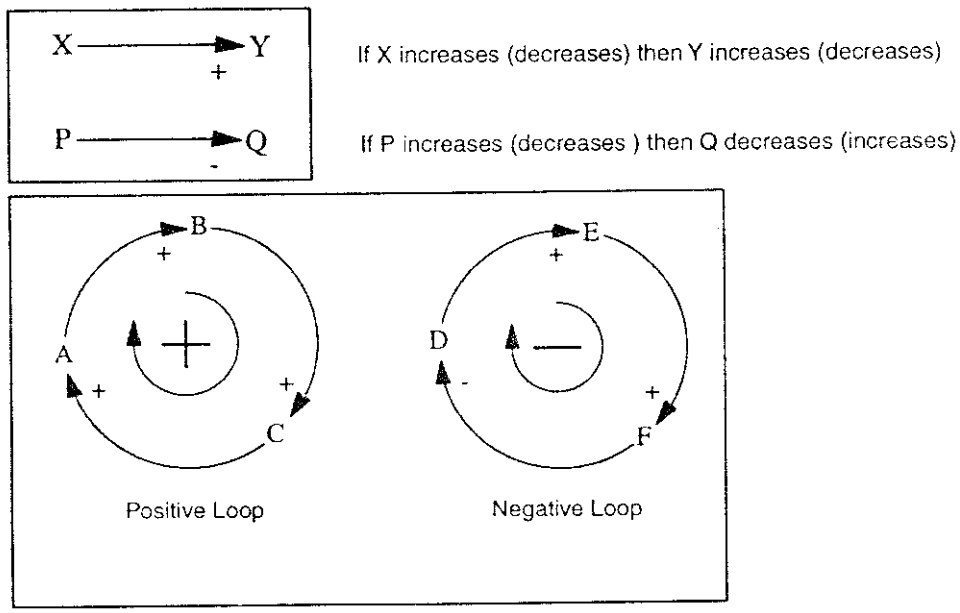


Figure 3 Components of causal loop diagram (CLD)

The results of the discussions are shown in Figure 4 for laws and rules, Figure 5 for forest utilisation and environment, and Figure 6 for social and economy. A bold circle indicates that the component is perceived as a key component of the model. For illustrative purposes, the intercomponent interactions pertaining to the forest laws and rules component shown in Figure 4 is described below. Moreover, the key indicators of the other two components are also briefly described.

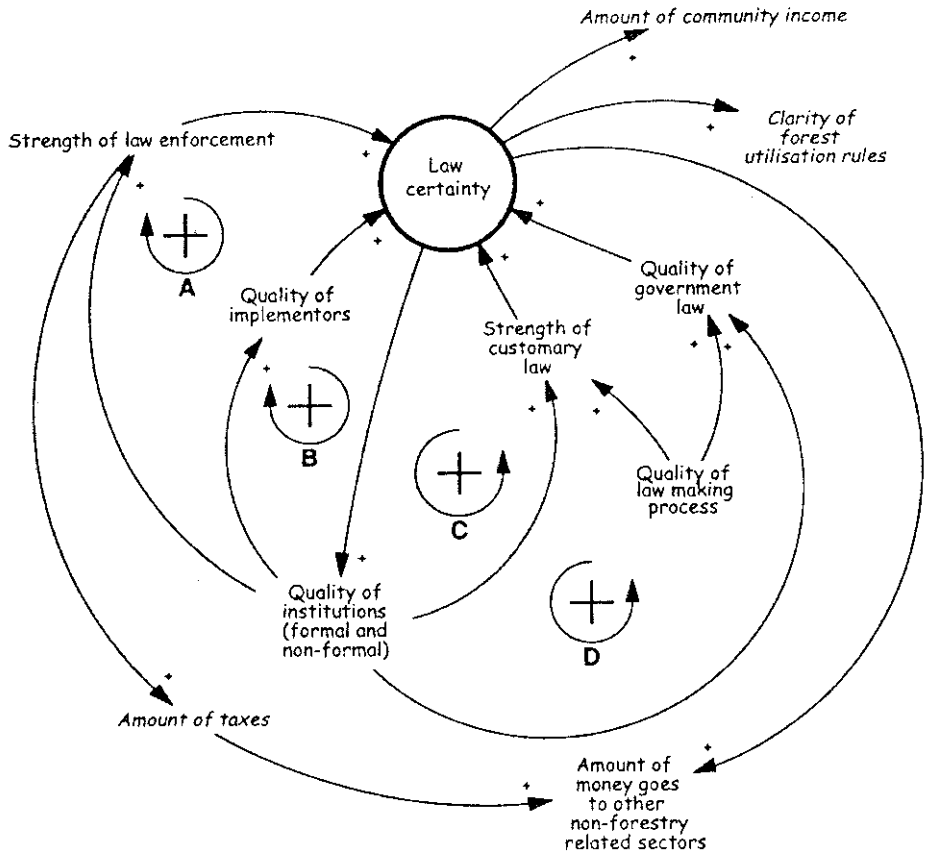


Figure 4 Inter-component relationship of forest laws and rules general category

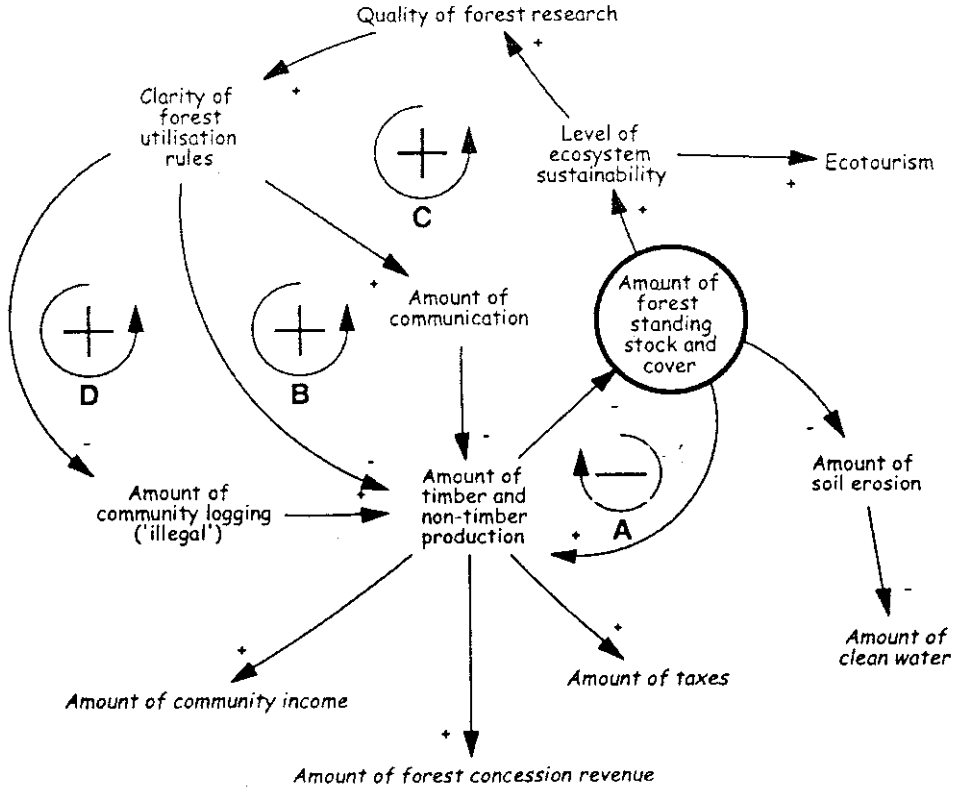


Figure 5 Inter-component relationship of forest utilisation and environment general category

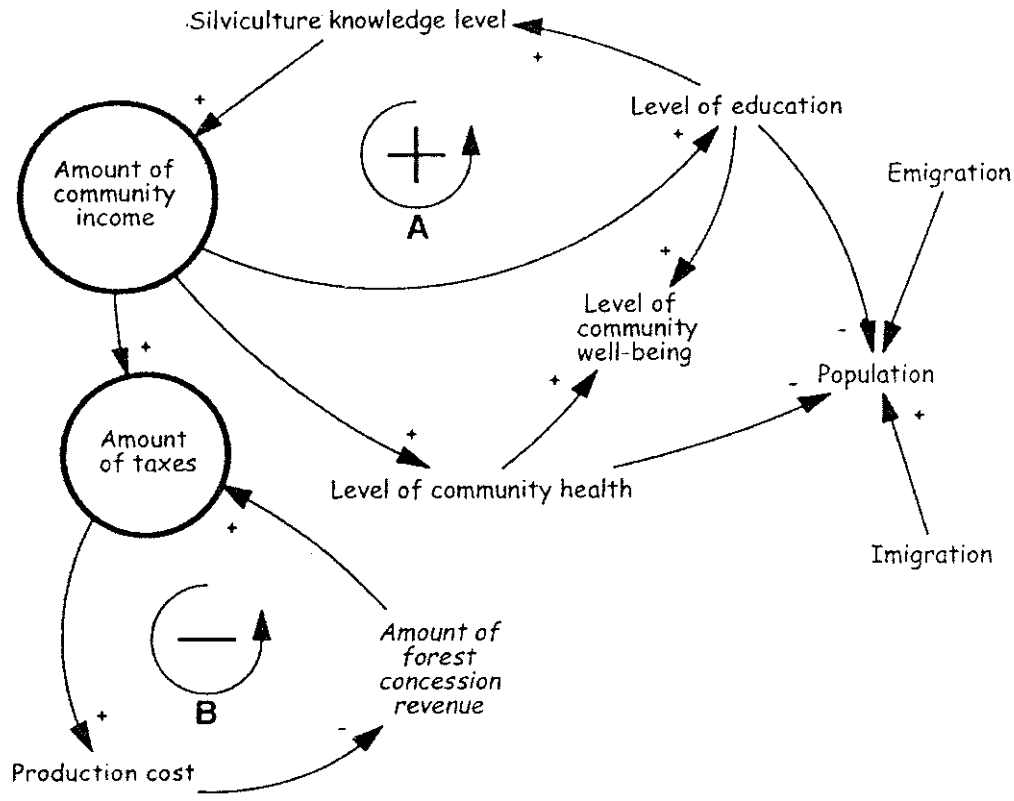


Figure 6 Inter-component relationship of social and economic general category

The participants perceived that 'law certainty' is the key indicator of forest laws and rules subcomponent. The 'law certainty' influences 'clarity of forest utilisation rules', 'community income' and the 'amount of money taken from forest taxes goes to other non-forestry related sectors'. 'Quality of institutions' and law-making process need to be improved in order to improve 'law certainty'. Furthermore, they perceived that the improvement of 'law certainty' could improve the 'quality of institutions'. This feedback is represented by the line drawn from 'law certainty' to'quality of institutions'. There are four feedback loops identified in the causal loop diagram (CLD). A positive loop A, from'quality of institutions' goes to 'strength of law enforcement', and then goes to 'law certainty', and finally back to 'quality of institutions'. This loop implies that if one could improve'quality of institutions', then after a certain time lag, the'quality of institutions' itself will be improved significantly as a result of the cumulative positive impacts from the other elements within the positive loop A or C. The CLD diagrams depict the interconnectedness of the elements within the forest laws and rules component.

The 'amount of forest standing stock and cover' in Figure 5 was identified as the key indicator by the participants for the forest utilisation and environment subcomponent. There are four loops identified in the CLD. Finally, the 'amount of community income' and 'amount of taxes' in Figure 6 were selected by the participants as key indicators for the social and economy subcomponent. There were two loops identified in the CLD.

In addition to identifying the causalities or interactions among subelements within each component, the participants also specified the interconnections and interactions between and outside the components. This holistic or system-wide depiction of overall relationships is shown in Figure 7.

The diagram shown in Figure 7 only depicts the final result of the ensuing debate and dialogue that characterised the collaborative modelling process. What is not depicted is the evolution process and the rich exchange of ideas among participants as each node, arrow and feedback loop was presented, debated, justified, and considered as acceptable by the group. The process itself is perhaps just as important, if not more, as the final output shown in Figure 7. The process created an excellent platform or environment for demonstrating the merits of participatory action research in general, and participatory modelling in particular as arrows, nodes, and causalities were presented by some participants and were subsequently challenged by other participants in the group.

The process also highlighted the merits of qualitative modelling as advocated by Coyle (2000) and Wolstenholme (1999). Experience gained from the qualitative modelling exercise in this case study demonstrated the value of the influence diagrams and causal loop diagrams as means to describe and more deeply understand the scope and complexity inherent in many community-managed resources. While the dynamics of the overall system embraced by the community-based management regime examined in the case study were not comprehensively or exhaustively defined and analysed, the qualitative model still provided valuable insights to the stakeholders in many respects. It was useful in helping the stakeholders identify 'central or strategic' indicators for each forest management component. Although actual simulation of the system were not performed to fully understand its dynamic behavior, the model was insightful in helping understand the 'structure' of the different forest management components. Clearly the insights gained were generally inferential or descriptive rather than conclusive and prescriptive. However, the broad understanding of the structure of the community-based natural resource management system provided by the qualitative model was instrumental in guiding the discussion and development of strategies and future scenarios as described in the following.

Analyses of performance indicators: Year 1990–2010

As mentioned earlier, the key indicators for the three components are: 'law certainty', 'forest standing stock and cover' and 'community income' and 'taxes'. In addition, after some deliberation, two other indicators were added, namely, 'level of people awareness and participation' and 'forest concessionaire revenue'. The participants were first asked to take a historic look at what happened to the indicator from year 1990 to year 2000. After this initial assessment, the participants were then asked to make an overall assessment of the likely condition of the indicators after 10 years. At the time of the workshop, it was not possible to give quantitative values to each indicator although a graphical illustration comparing the current and future conditions of an indicator was quite instructive and informative to the participants. Hence, in evaluating the performance indicators,

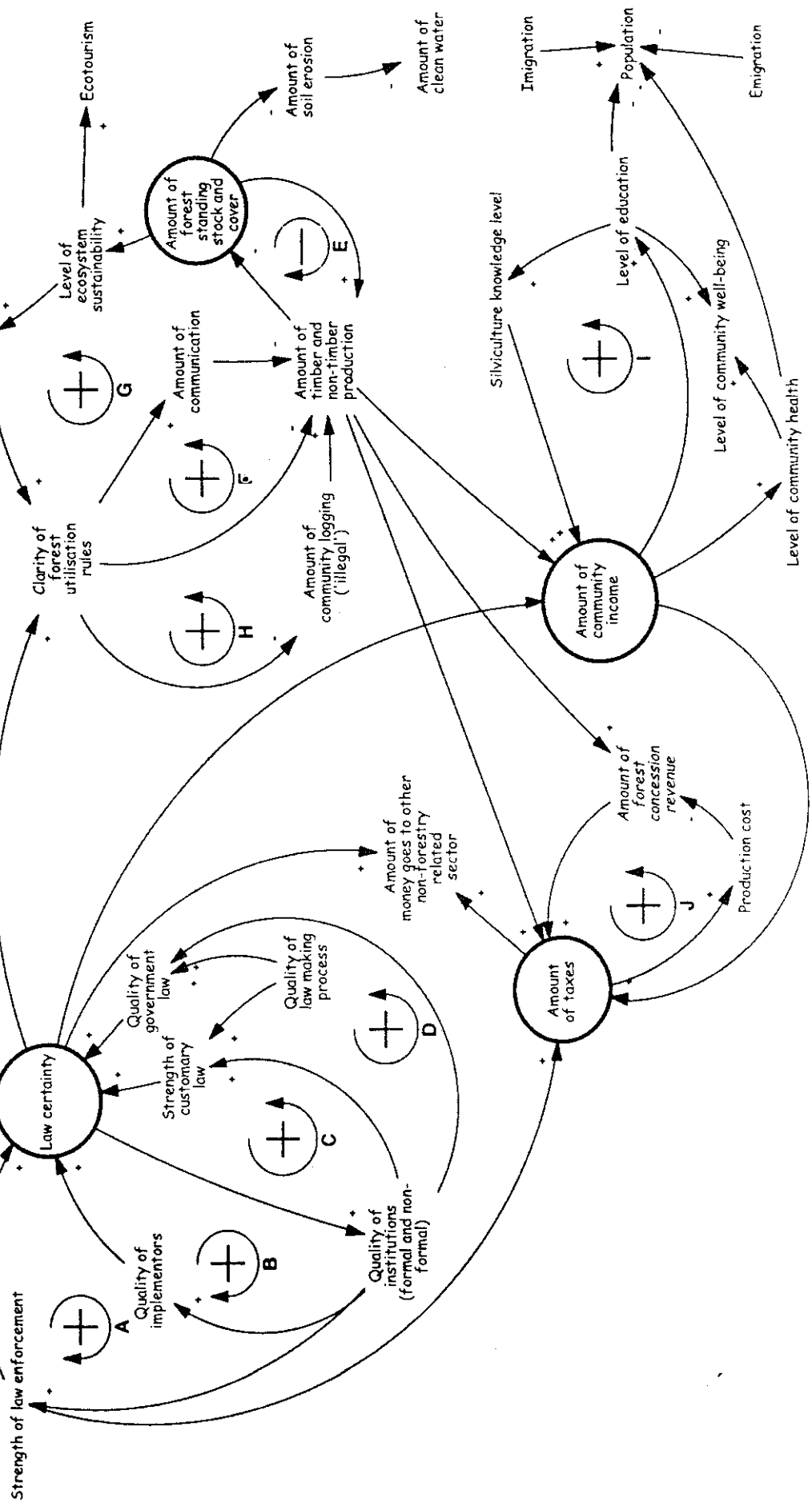
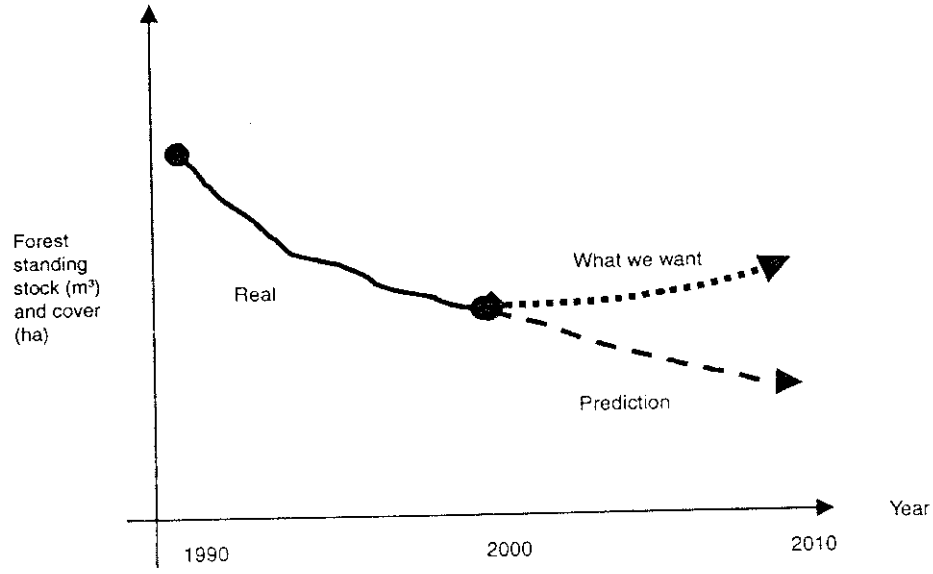
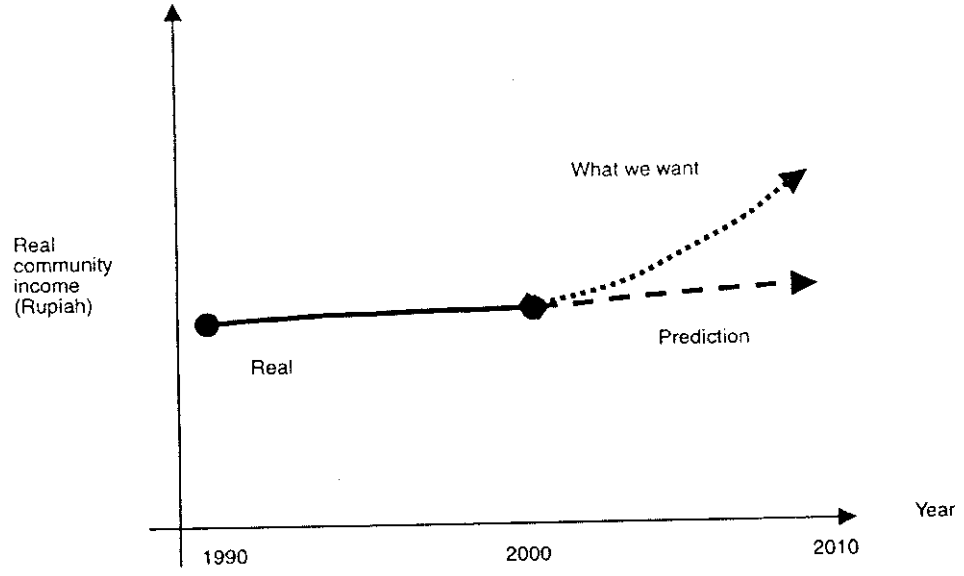


Figure 7 Causal loop diagram for management of forest as perceived by its stakeholders

the participants assessed the current condition of the indicators first, then they proceeded to make some judgment about what might happen if current practices were maintained. Finally, they also made projections with respect to some desired future conditions. Moreover, they also examined and addressed the question, "If what we want is to be achieved, what things need to be changed?" Figures 8(a) and (b) show some examples of the current and future conditions of two performance indicators, namely, 'forest standing stock and cover', and 'community income'. These illustrations are not accurate projections; they are meant only to show a very crude comparative analysis and projection between status quo and projected desired future condition.



(a) Forest standing stock and cover indicator assessment and desired outcome, as perceived by the workshop participants



(b) Real community income indicator assessment and desired outcome, as perceived by the workshop participants

Figure 8 Comparative analysis of desired future and predicted condition under status quo

In addition to making comparative analysis of the current and desired future conditions of the performance indicators, the participants also wanted to prioritise the indicators in order to identify those that are considered most important. The priorities of the six important indicators identified earlier were shown in Table 3. The method described in Mendoza & Prabhu (2000) were used to estimate the relative importance of each indicator, and to establish the priorities as shown in Table 3.

Table 3 Ranking of the major indicators

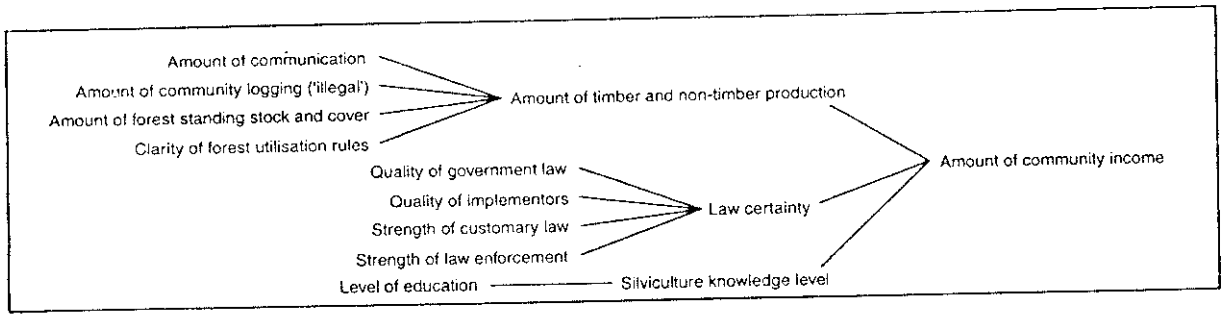
Indicator	Code	Ranking
Community income	1	1
Forest standing stock and cover	2	2
Law certainty	3	3
People awareness and participation	4	4
Taxes	5	5
Forest concessionaire revenue	6	6

Exploring strategies and scenarios

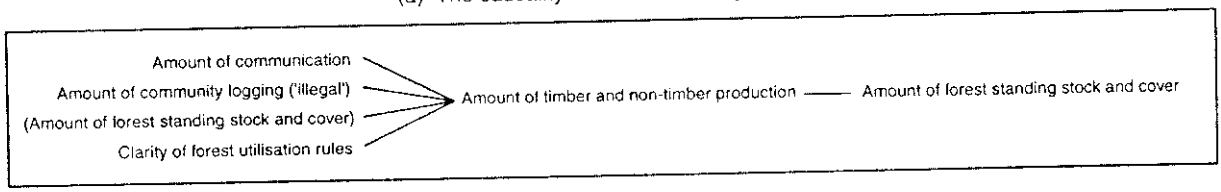
The influence diagrams shown in Figures 4 to 7 along with the prioritised set of performance indicators served as general guides in developing general strategies and scenarios. To do this, the participants transformed the causal loop diagrams into 'causality trees' (Sterman 2000). These causality tree diagrams offer useful insights particularly in terms of the cause and effect relationships ultimately leading to the significant indicators.

Exploring strategies and scenarios is a process based on general assessment of current conditions, *vis-a-vis* desired future conditions, that may be broadly defined as shown in Figure 8. Clearly, assessment must be done in the context of the causality trees shown in Figure 9. For example, consider the causality tree on community income shown in Figure 9(a). Suppose the desired future condition is 'to improve community income'. To achieve this target, there are a number of potential actions that can be taken, some of which are shown by the causality tree depicted in Figure 9(a), such as: increasing amount of communication, community logging and strength of law enforcement. However, these actions may or may not be acceptable, or agreed upon, by all stakeholders. The participants then can propose possible future scenarios, along with their respective roles, if a particular scenario is implemented as outlined in Table 4.

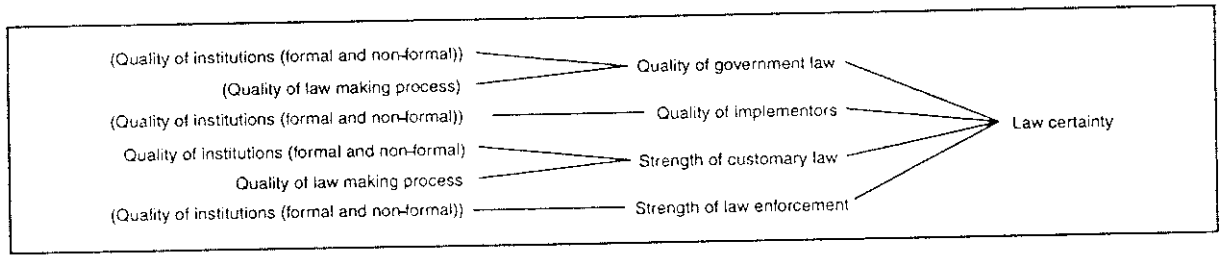
In devising strategies, it was decided to focus on at least one or a few activities that the stakeholders or participants can undertake. Along with the activities or action plans, the participants also examined the impacts of the activities on the performance indicators. Impacts were simply judged in terms of whether the activity will improve (+) or undermine (-) the indicator. In some cases, the impacts are not clear and hence the assessment was left as a question mark as shown in Table 4.



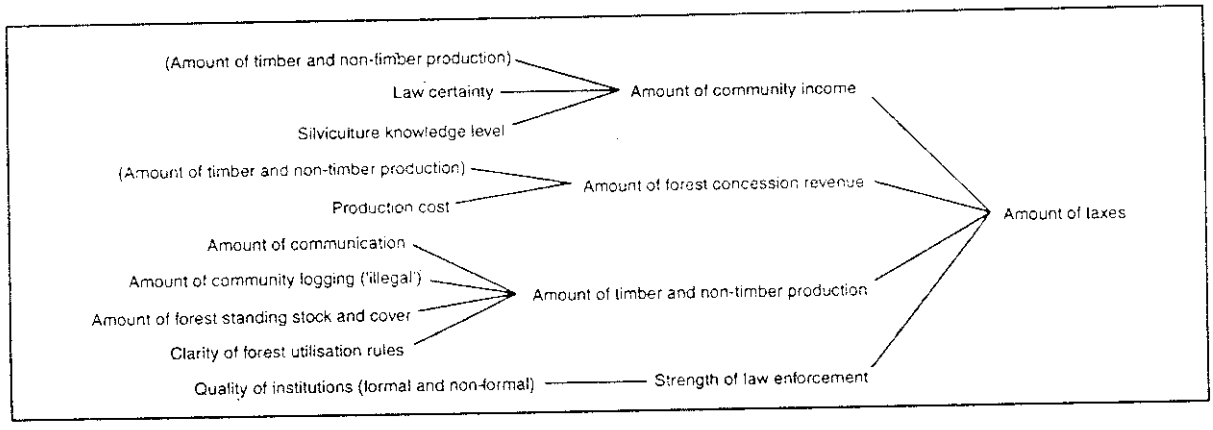
(a) The causality tree of community income



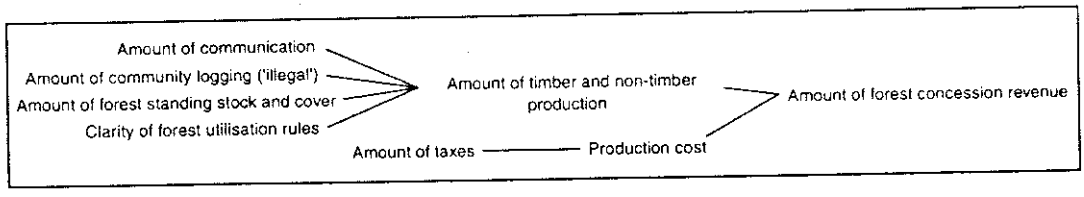
(b) The causality tree of forest standing stock



(c) The causality tree of law certainty



(d) The causality tree of taxes



(e) The causality tree of forest concessionaire revenue

Figure 9 Causality trees of major indicators

Scenario A proposes activities such as improving rule-making process, strengthening village customary institutions, and watching the law and rules implementers (Table 4). These activities are expected to improve law certainty, amount of community incomes and forest standing stock and cover as shown in

Figures 7 and 9. The improvement of community incomes may increase the amount of taxes obtained by the government from the communities. However, these activities may also lead to a decrease in the amount of taxes because of the possibility of decreasing the amount of timber and non-timber production. Moreover, examining Figure 7, the improvement of law certainty may lead to a decrease in the forest concession revenue in the short term; however the stakeholders believe this will also benefit the forest concession in the long run.

Table 4 Future scenarios

Scenario	Influenced indicator	Indicator improvement (+) /drawback (-)	Roles of Participant
A			
Improve rule-making process through public consultation	1	+	Give suggestion to the district government and parliament by sending a letter concerning public consultation for every related laws and rules.
	2	+	
	3	+	
Strengthen village and customary institutions	4	+	
	5	?	
	6	?	
Watch the law and rules implementors carried out by people, parliament and NGOs			Community-facilitation by NGOs The District Land Agency gives necessary explanation of communities' rights to land. Socialisation of laws and rules Ask Parliament member to go to the villages
B			
Establishment of plantation as a demonstration plot in the area	1	+	The concessionaire will establish the demonstration plot.
	2	+	
	3	?	
	4	+	
	5	+	
	6	?	
C			
Increase timber and non timber productions	1	+	Villagers' role not explicitly defined
	2	-	
	3	-	
	4	-	
	5	+	
	6	+	
D			
Recognise the land right claim of Raden Panji Suryanata and Panembahan Sulaeman (the past Kings of Pasir).	1	-	Villagers did not want to take any role on this scenario
	2	-	
	3	-	
	4	-	
	5	-	
	6	?	
E			
Recognised fully the rights of the concessionaire	1	-	Villagers' role unclear and hence did not take any role on this scenario
	2	-	
	3	+	
	4	-	
	5	+	
	6	+	

Note: '?' means 'not sure'

Scenario B proposes the establishment of a plantation demonstration plot in the area. The concession holder or the timber company was the primary proponent of this scenario. The proposed demonstration plot serves as a pilot plantation project in the scale of approximately 100 ha. This scenario can potentially improve the community incomes, taxes and forest plantation standing stock and cover. This activity can also enhance the awareness and participation of local people in particular because it is directly concerned with their livelihood. The participants are uncertain on how this activity influences law certainty and forest concession revenue.

Scenario C proposes to increase timber and non-timber productions. This activity will increase the amount of community incomes, taxes and forest concession revenues and it is also likely to decrease forest standing stock and cover as illustrated in Table 4 and Figure 7. This scenario, however, can reduce law certainty and the level of people participation since the enlargement of timber production is contrary to current law and can create negative impacts on the health of community.

Scenario D proposes the recognition of the land right to tribal communities who claim to be descendants of Raden Panji Suryanata and Panembahan Sulaeman (the past Kings of Pasir). It is related to the issue that the descendants of past kings have claimed ownership of the forest area within Gunung Lumut Mountain. If this claim becomes a reality then the area will belong to the descendants. The stakeholders perceived this claim would lead to negative impacts on all indicators except the concessionaire revenue.

The last scenario is to recognise fully the rights of the concessionaire or timber company. It means all community rights to the forest are invalidated. This scenario will increase the forest concession revenue, taxes and law certainty, but it will decrease the community incomes, forest standing stock and cover, and people awareness and participation. The communities expressed their disagreement with this scenario even though they may benefit from tax redistribution.

All participants compared these five scenarios to determine which one meets their desired indicators. None of the scenarios fully satisfied the target or desired future conditions of the indicators, i.e. improvement of community income, forest standing stock and cover, law certainty, people awareness and participation, taxes and maintain forest concessionaire revenue at the current level. Due to lack of information and adequate understanding of the overall dynamics shown in Figures 4 to 7, comparison of the scenarios was limited to broadly defined trade-off analyses based on the expected improvement of scenarios and negative impacts on the indicators.

Finally, the participants also prioritised the strategies and scenarios. While it is not described in this paper, the process of prioritising strategies was done systematically using the procedure described by Mendoza & Prabhu (2000). In many real world applications, strategies could be generated with relative ease; however, the more important problem is to be able to identify the most suitable or effective strategy given the concerns and objectives of the stakeholders. From the contents of Table 5, it was clear that Scenario A was the most preferred among the five other scenarios.

Table 5 Ranking of scenarios

Ranking	Scenario
1	A
2	B
3	C
4	D
5	E

The five scenarios described in Table 4 varied in terms of scope, intent, and the activity or action plan they required. Scenario A was the most comprehensive, covered a wider scope and required more activities. The other four scenarios were simpler and focused only on one activity. Clearly, one can think of other scenarios that can be analysed involving other activities and forest management components, which is typically done when using traditional planning methods that do not use qualitative modelling. Quite often, traditional planning methods formulate scenarios based mainly on intuition, past experience and history. In the case study, the participants formulated the scenarios and strategies with the aid of the qualitative model, specifically the casual diagrams and causality trees. Hence, the strategies were also evaluated not purely on intuition or experiential knowledge bereft of any analytical support. Instead, they were generated in the presence, or with the benefit, of insights that can be drawn from the diagrams. The potential advantages of qualitative models was described best by Wolstenholme (1999) as follows:

> "*Causal loop' qualitative (model) enhances linear and 'laundry list' thinking by introducing circular causality and providing a medium by which people can externalise mental models and assumptions and enrich these by sharing them. Furthermore, it facilitates inference of models of behaviour by assisting mental simulation of maps.*"

Mental simulation of the CLD did occur during the modelling process. Each participant independently examined his/her mental maps (Eden & Ackerman 1998) of the causality relationships. Following the principles of PAR, these map models were presented and debated by the participants. The modelling process, debate, and iterative presentations of causality maps eventually led to a group model CLD diagrams as shown in Figures 4 to 7 and the causality tress described in Figure 9.

Participatory modelling influences

The case study was pursued beyond the exploration of objectives, views and perspectives in phase 1, the collaborative modelling process of phase 2, and the generation and evaluation of strategies and future scenarios in phase 3. As a follow up activity, a final workshop was held to evaluate the study itself, the participants'

views about the model, the decisions they made and their respective commitments, and to look at the changes that may have occurred as a result. While it is difficult to ascertain the impact of the study, the feedback received at the final workshop highlights the desirable changes and attitudes that resulted from the participatory action research and the collaborative modelling activities conducted in the case study. Some of these changes and subsequent plans include:

(1) Plans for public consultation to study policies dealing with forest utilisation.

(2) Requiring community representation to speak at a district seminar on Forest Management in the Pasir District.

(3) Institutionalisation of Collaborative Forest Management (CFM) scheme at the village level. The CFM scheme considers communities as important shareholders and can utilise products from the forest consistent with regulations such as 'Permission of Timber Collection and Utilisation'. The shareholders, through Forest District Unit, set up a contract agreement with the existing Forest Concessionaire. The agreement advocates for mutual benefits between the concessionaire and the villagers.

(4) Requiring public hearings with the participation of elected Pasir District Parliament Members to study future management regimes in the Pasir District.

These plans and changes partly demonstrate the potential impact of the collaborative modelling and participatory action research conducted in this study. It was evident at the end of the study that the communities seemed to have gained more confidence in their ability to generate strategies, analyse potential impacts of different action plans, and gained more appreciation on the value of qualitative modelling in improving their decision-making systems.

Conclusions

This paper described a collaborative model that embodies many of the issues and problems typical of most community-managed resources. The model also exemplifies many desirable features that matches, and are consistent with, the nature and characteristics of community-managed resources. First, the model adopts a participatory approach where stakeholders are actively involved in all phases of planning and decision-making processes. Second, the model is robust, flexible, and versatile in directly accommodating multiple objectives, views, and perspectives from all stakeholders. Third, the model puts primary importance to facilitation, recognising that views and knowledge of local stakeholders are just as important as those of expert. Finally, the model's intended use is not as a 'problem-solving' tool; instead, it is designed primarily as a 'learning' and communication tool, with the community people as the primary intended users.

Traditionally, modelling has been the exclusive domain of scientists who are known to have both disciplinary expertise and computer know-how to be able to organise data, develop a structure to do analysis of the data, and finally, develop a computer-assisted model for the purpose of doing simulation analysis. While this approach might work well on narrowly defined biophysical aspects of resource management, it may not be the most appropriate tool to analyse human-dominated problems like community-based resource management. More appropriate would be a collaborative modelling system that can accommodate possibly divergent views of different stakeholders.

Collaborative modelling appears to be a convenient and powerful way for stakeholders to express their interests and perspectives in managing a forest. Experience gained from the case study suggests that the qualitative soft systems approach offers a suitable environment for a participatory modelling process. The stakeholders representing local communities and other institutions seemed to have easily grasped the concept of a model, and were fully at ease during the modelling process. Consequently, the development of influence diagrams, causal, and feedback loops was truly a participative process. All participants were fully engaged and actively involved in the formulation and specification of relevant indicators and their relationships.

The modelling process also offered opportunities for learning on the part of the stakeholders. It was apparent during the deliberation process that stakeholders became more aware of the interconnectedness and dynamic relationships of the different forest management components. Moreover, the causal loop diagrams and the causality trees seemed to engender new perspectives in terms of how the participants view the strategies and scenarios. While it is difficult to ascertain, it seemed clear that the modelling process and the model itself provided a learning experience for the participants. This is consistent with the aspects of modelling as a learning process reported by Morecroft and Sterman (1994).

Lessons learned from the case study suggest that collaborative modelling can enhance the likelihood that strategies generated using participatory methods will be adopted. This conclusion is supported by (1) the strong sense of ownership on the part of the stakeholders of the strategies generated from the model, (2) the apparent confidence shown by the participants to the model they themselves created, (3) the apparent comfort shown by the stakeholders that the strategies they developed were based on model analyses that they themselves conducted, and (4) the transparency of the qualitative soft systems approach. These features were manifested in the case study described in this paper.

As described earlier, results from a qualitative soft system method are not prescriptive and hence they do not lend themselves to explicit and well-defined recommendations. The results are generally descriptive and offer only insights, and not prescriptive solutions. The feedback loops, causal loop diagrams, and causality trees are meaningful, informative, and provide deeper understanding of the extent, scope, and nature of community-managed resources. The strategies, scenarios and plans, although generally insightful are descriptive and lack the analytical depth and rigour that quantitative analysis can provide. However,

feedback received from the participants indicated that the qualitative soft systems method offer a systematic approach with sufficient rigour that is acceptable and understandable to the targeted clientele, i.e. local communities.

Acknowledgements

This study was conducted with the involvement and active participation of the following colleagues from the Center for International Forestry Research, Yurdi Yasmi and S. Hakim. This study was partially funded by a collaborative project between the Center for International Forestry Research and the University of Illinois, Project No. MS 65-368 NRES.

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Appendix 1 The identified forest management components

Social and economy

Category	Component
Income and empowerment of local communities	Development of home based industry *(kerajinan rakyat)*
	Paradigm changing of local communities/village development
	Prosperity
	Communities' revenue
	Concessionaire revenue (Telaga Mas)
	Taxes to government
	Income per capita
	People income
	Low people income
	Forest products marketing
	Marketing
	Capital aid
Organisation and institution	Security of area managed by communities
	Organisation and institution
	Rights of customary organisation to manage
	Communities, participation for sustaining forest
	Empowerment of village customary institution
	Customary law
	Collective action
	Communication
	Unity of communities
	Communities' access rights to forest
Education	Education
	The availability of general and religion education
	Building for education
	Teachers
	Religion and technology
	Home-based industry
Health	Health
	Community health level and services
	Medical doctors and paramedics
Silviculture	Sustainability of the small plantation
	Rattan silviculture
	Biodiversity
	Livestock techniques
Accessibility and information	Transportation
	Information access
	Road transportation
Demography	Profession
	Population
	Household number

(continued)

Appendix 1 (continued)

Forest utilisation and environment

Category	Component
Timber and non timber production	Timber flow monitoring (flow out from forests)
	Timber and other forest products of communities clearly calculated
	Sub optimum of rattan utilisation
	Timber logging
	Amount of rattan flowing out has to be clear
	Rattan silviculture
	Trees produce timber and "damar"
	Furniture industry
	Timber and non-timber production
	Illegal logging
	Trees produce timber need to be sustained by the communities
	Bamboo based activities
Clean water	Forests have to be sustained to avoid flood
	Clean water need to be improved mainly by non-villagers
	Clean water of rivers has to be maintained
	Water pollution
	Clean water 'bank'
	Social forestry for clean water purposes
	Clean water of rivers
Forest utilisation rules	Rules for taking out timber have to be clear
	Rights and roles of communities in forest utilisation
	Fair forest benefit distribution
	Forest product production techniques (exploitation and re-growth)
	Forest statue according to laws
	Forest managed by communities and commercial companies
	Forest benefits sharing for communities, companies and governments
Soil erosion	Maintaining soil quality
	Logging techniques/silviculture
	Soil erosion
	Soil contamination
	Preventing erosion
	Land rehabilitation
Forest cover and stock	Forest stand structure
	High forest cover
	High forest standing stock
Ecosystem sustainability	Balance of forest ecosystem
	Protection of endangered species
	Biodiversity
	Sustainability of fauna
	Forest products continuity
	Sustainability
Eco-tourism	Utilisation of potential sites for ecotourism and adventure
	Forest tourism "empowerment"
	Establishment ecotourism environment

(continued)

Appendix 1 (continued)

Category	Component
Extension	Dissemination and socialisation of protection forest
Research	Forest research area
Laws and rules	
Customary laws	Customary laws of resource access Improvement of customary laws by communities Customary laws are respected Customary laws are recognised Community inheritance rules Customary rights Recognition of the ownership of customary organisation to forests through PERDA (local government rules) Clear forest access rights Community rights to forests
Laws certainty	Rules for quantitative benefits sharing (%) of communities and commercial company Forest utilisation permission Redefining *(penataan ulang)* forest utilisation rules
Rules making process	People participation in rule making process Transparency of rule making process Process of rule creation
Rules of forest ownership	Rules of resource ownership (forest and land) Current law status of the forests Laws certainty Rules are not overlapping Clear rules Clear and un-confusing rules Rules enforcement
Land boundary	Boundary of communities' land in their village Forest land boundary needs to be solved Certainty of village and forest boundary
Village community institution	Village institution Community institution Establishment of conflict resolution mechanism
Clear forest utilisation permission	Rules of land ownership Clear resource ownership (forest and land) Land ownership distribution Community land ownership