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# Model of multi-stakeholder forest management: a system study of Protected Forest Management Unit in Solok, Indonesia

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**Abstract.** Multi-stakeholders forest management can be influenced by many factors and will be difficult because of different process expectations. This paper discusses the integration of soft systems methodology (SSM) within a multi-stakeholder approach in research to support sustainable and equitable forest management of the Protected Forest Management Unit (PFMU) in Solok, Indonesia. The management of PFMU in Solok is complicated by the legitimacy of forest right, institutional culture, political interest, uncertainty the nature of relationships among stakeholders, illegal logging, and the topography is varied, existing watersheds and limitations of forest inventory data. The situation is not only characterized by its complex ecosystem but, more importantly, by the complexity of the social and political system around it. In this work, SSM contributed to expressing the problem situations of PFMU. A model was developed by formulating the root definitions and building the conceptual model of the relevant component of forest management. The model was used to stimulate debate about desirable and feasible change, as well as to explore the future scenarios. Finally, multi-stakeholders approach by implementing the SSM principle helps to harmonize the stakeholder interest and to formulate the scenario of forest management. This approach was also found to be a positive way to explore a collaborative action plans for sustainable and equitable forest management.

## 1. Introduction

Forest management cannot be separated from human interaction or different stakeholders with various interests in the forest ([1];[2]). The paradigm of forest management that is currently emerging is to increase relevant stakeholder participation. Many studies showed that the important thing is to include various stakeholders in forest management ([3]; [4]; [5];[6]), particularly those who are less powerful ([7]).

Participation is defined as a voluntary process where people, individually or through organized groups, can exchange information, express opinions and articulate interests, and have the potential to take an active role in making decisions that affect them ([8]; [9]). The participation of relevant stakeholders may give the legitimacy against the decisions that have been assigned. Participation can also be viewed as an end in itself or to local community empowerment objectives ([10]). However, the participatory process is influenced by many factors, such as participation in decision-making,



participation in economic benefits and forest conservation ([11]). The potential contradictions are further complicated by different expectations on the participation process and conflict of interest among stakeholders ([12]; [13]).

Based on the description above, a forest is not only characterized by its complex ecosystem, but also by the complexity of the social and political system around it. Complexity can be realized in various forms, such as interdependence, criticality, self-organization, uncertainties and difficulties to analyze the components and attributes system ([14]; [15]; [16]). However, the complexity of natural resource problems is beyond the cognitive capacity of most humans to fully understand and manage ([17]). Therefore, appropriate approaches to understanding this complexity is required.

One of the approaches that may be used is a multi-stakeholder approach based on systems thinking. Multi-stakeholder approaches integrate land users, technicians, governmental and non-governmental officials, and decision makers at locally, nationally, and even globally levels that motivated by social learning and empowerment goals ([5]; [18]; [19]). The Soft Systems Methodology (SSM) from Peter Checkland is a qualitative technique that can be used for applying the systems thinking in non-systematic situations. SSM is a learning system for dealing with messy or ill-structured problematic situations involving human activity that action-oriented in the real world, and where these actions seem sensible to those concerned ([20]; [21]).

The research reported in this paper aims to build a qualitative model to help harmonize the stakeholder's interest and to formulate the scenario of forest management at Protected Forest Management Unit (PFMU) in Solok, Indonesia. This PFMU was established by Ministerial Decree of Forestry number SK.42/Menhut-II/2012 and is located in the Solok district of West Sumatera. The province is the land of Minangkabau. The PFMU areas overlap with 33 nagari territory. Nagari is the lowest-level political unit of the Minangkabau ethnic group who practices the matrilineal kinship system. Based on adat (customary) law, Nagari has own territory with clear boundaries and communal land (tanah ulayat nagari). Nagari communal land is covered by forest, or cultivated for agriculture, or consists of degraded land. The people who are living in and around the forest, especially the poor have a high dependency on the forest resources for their livelihoods. This situation can create conflict among nagari people with PFMU relating to resource access; economic, ecological and social function of the forest.

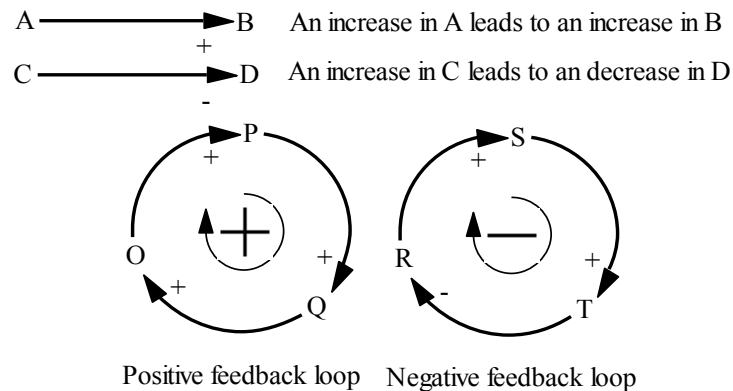
## 2. Methodology

The study area located at the PFMU of Solok, West Sumatera. PFMU of Solok was chosen because it has the potential of conflicts caused by customary land claims in the forest area. The Nagari sample unit is Nagari Sungai Abu and Sariak Alahan Tigo. The Nagari has been selected purposively with consideration of the initial observation based on the dependence level on the forest. This study was conducted from February to May 2015.

The stakeholders were selected based on several objective criteria suggested by [22] and were also nominated by others. The framework of the collection data and analysis adopted the Soft Systems Methodology (SSM) principles. The first phase, which is expressing problem situations, was facilitated through the Stakeholder Delphi technique and focus group discussion. The Stakeholder Delphi can facilitate the interactive participation of hierarchical and antagonistic stakeholder groups, good for giving equal attention to minority viewpoints, or particularly appropriate when decision-making is required in a political or emotional environment ([23]). The stakeholders did not actually meet physically and making it easier to involve those who had limited time or from different geographic locations. This phase is aimed to explore the stakeholder perspective on the current forest management.

The second phase is to formulate the Root Definitions. The modeling process commenced with formulating the root definition of the system. Formulating root definitions based on the stakeholders perspective of the problem situation. CATWOE analysis helps in proper formulation of root definitions ([20]). CATWOE is mnemonic from Customers, Actors, Transformation process, Weltanschauung (Worldview), Owner, and Environmental constraint.

The third phase carried out an investigation into the relationship of forest management components at PFMU of Solok. The stakeholders suggested identifying the relevant component of forest management. In this process, letting the stakeholders express their perceptions to understand the interrelationships between components of forest management. Inter-relationship between these components is described using causal loop diagrams ([24]). Causal loop diagram consists of variables connected with the arrows that indicate a causal relationship between the variables (see figure 1). Each causality loop consists of a positive (+) and negative loop (-).



**Figure 1.** A causal loop diagram

The fourth phase is the development of management scenarios. Checkland in [20] stated that comparison in SSM can be done in various ways, such as using models as a source of questions to respond the problem situations, informal discussions, and developing scenarios based on models. The technique used in this paper is the development of scenarios. Scenario development is intended as one step to make changes through policy choices regarding management rights to forest resources. Scenarios are developed based on key forest management components identified by stakeholders. So that there are alternatives that can be used to carry out management of KPHL Solok.

### 3. Results and Discussions

#### 3.1. Results

Based on the information from stakeholders, PFMU of Solok is classified into the second typology because it has been established and has potential resources. [25] said that the FMU with the second typology has been executing a forest management activity such as formulate a forest planning system, utilization, rehabilitation, forest protection and community empowerment. But, the implementation has not been optimal at PFMU of Solok, even there is a potential conflict. This situation is caused by several factors; some of stakeholders do not know that PFMU has been established, the local government orientation is not only to manage the forest effectively but to absorb the budget from central government, the forest area boundary has not been completely legitimized by *nagari* people, and the community of *nagari* have a desire to manage the forest on their territory. This is the stakeholders in the management of PFMU Solok (see table 1).

**Table 1.** Stakeholders on the management of PFMU Solok

Stakeholders	Basis for inclusion
Ministry of Environment and Forest	Legal rights; knowledge of forest
PFMU of Solok	Legal rights; knowledge of forest
Forestry Provincial Unit (FPU)	Legal rights; knowledge of forest
BPDAS Batang Hari	Legal rights; knowledge of forest
BPDAS Agam Kuantan	Legal rights; knowledge of forest
BPDAS Indragiri Rokan	Legal rights; knowledge of forest
BPKH Wilayah 1 Medan	Legal rights; knowledge of forest
District Parliament	Legal rights
Forestry District Unit (FDU)	Legal rights; knowledge of forest
Development Planning Agency (DPA), Solok	Legal rights
Office of Law Section, Solok	Legal rights
Community Development Agency (CDA), Solok	Legal rights
Environmental Control Agency, Solok	Legal rights
Academics of Andalas University	Knowledge of forest
Village leader	Proximity; dependency; traditional rights; knowledge of forest; cultural links
Board of the Nagari clan	Proximity; dependency; traditional rights; knowledge of forest; cultural links
Leader ( <i>Kerapatan Adat Nagari</i> / KAN)	Proximity; dependency; traditional rights; knowledge of forest; cultural links
Nagari parliament ( <i>Badan Musyawarah Nagari</i> / BMN)	Proximity; dependency; traditional rights; knowledge of forest; cultural links
Forest Management Agency of Nagari ( <i>Lembaga Pengelolaan Hutan Nagari</i> / LPHN)	Proximity; dependency; traditional rights; knowledge of forest; cultural links
Illegal Logger	Dependency; proximity
NGO KKI-Warsi	Spirit of forestry; knowledge of forest
Private sector	Dependency; legal rights

The stakeholders involved in the management of Solok KPHL have the same view in interpreting the problem system of this area. To achieve the same goal, namely a prosperous community and sustainable forest, the stakeholders suggested that it was necessary to involve all interested parties in managing the KPHL of Solok. However, this process has *environmental constraints*. These obstacles include legal certainty of forest areas, different understandings of the roles of each stakeholder, low commitment, the high cost of collaboration, sectoral ego tendencies, non-mutually supporting regulations, and political will.

Customers on the root definition of the system in Solok KPHL management are all stakeholders that involved. In other words, all parties involved either those position as regulators, operators, users, and the public are customers. All stakeholders are customers because those who will benefit and will be harmed by running or not running the management of KPHL Solok. This is the result of CATWOE analysis of the problem situation in the forest management system at PFMU of Solok (table 2).

**Table 2.** CATWOE characteristics of forest management system at PFMU Solok

C	Customer	All the stakeholders involved in the management of Solok KPHL
A	Actor	PFMU, Forestry Unit, BPDAS, LPHN and NGO KKI Warsi
T	Transformation	The forest are utilized for increase of household and government incomes as well as conserving the forest by considering the stakeholders interests
W	Weltanschauung	Sustainable and equitable forest management can be achieved by harmonizing the stakeholders interests
O	Owner	MoEF, Forestry District Unit, PFMU of Solok and LPHN
E	Environmental constraints	Legal certainty of forest area, stakeholders commitment, understanding stakeholders interest each other, tendency of sectors ego, lack of budget, political will and the overlapping regulations

The stakeholder's perceived that law certainty, community income, amount of taxes, and condition of forest stand as a key component within forest management (see figure 2). There are five positive loops on the law certainty that involves the political will and capacity of the institution (see figure 3). Political will influences each other with legal certainty. Political will is also a positive effect on the quality of the lawmaking process, the amount of budget and capacity of the institution. The capacity of institutions and law certainty are also interrelated. Components that are affected by the institutional capacity is the clarity of the regulation, the strength of customary law, strength of law enforcement and the quality of implementers. Additionally, clarity of government law and strength of customary law is also influenced by the quality of law making process.

The condition of forest stand with a total production of forest products has a negative loop (see figure 2). The stakeholders identified that the number of forest production is influenced by the clarity of forest utilization rule through the communication quality (loop F) and the accessibility and number of utilization of forest products (loop G). Meanwhile, the clarity of clarity of forest utilization rule is affected by the law certainty and the quality of forestry research (loop H).

Amount of community income has a positive loop (loop J) with the level of education. Community incomes affected by the accumulation of knowledge is assumed to be linear with the level of their education. The amount of forest products, ecotourism potential, paddy productivity and amount of fish was also a positive influence on community income. It is revealed that the community has a high level of dependence on forests. Meanwhile, the amount of community income is also affected by the law certainty, especially in terms of their access to forest resource management. Increasing the amount of community income also plays a role in increasing the number of taxes.

The amount of taxes is defined as the local government revenue, as a result the utilization of forest products. This component has a positive loop (loop K) with the amount of private revenue. The amount of taxes is affected by the law certainty, the number of forest products, ecotourism service utilization as well as the private sector and community revenue. Meanwhile, the amount of taxes had a positive influence on the amount of government budget.

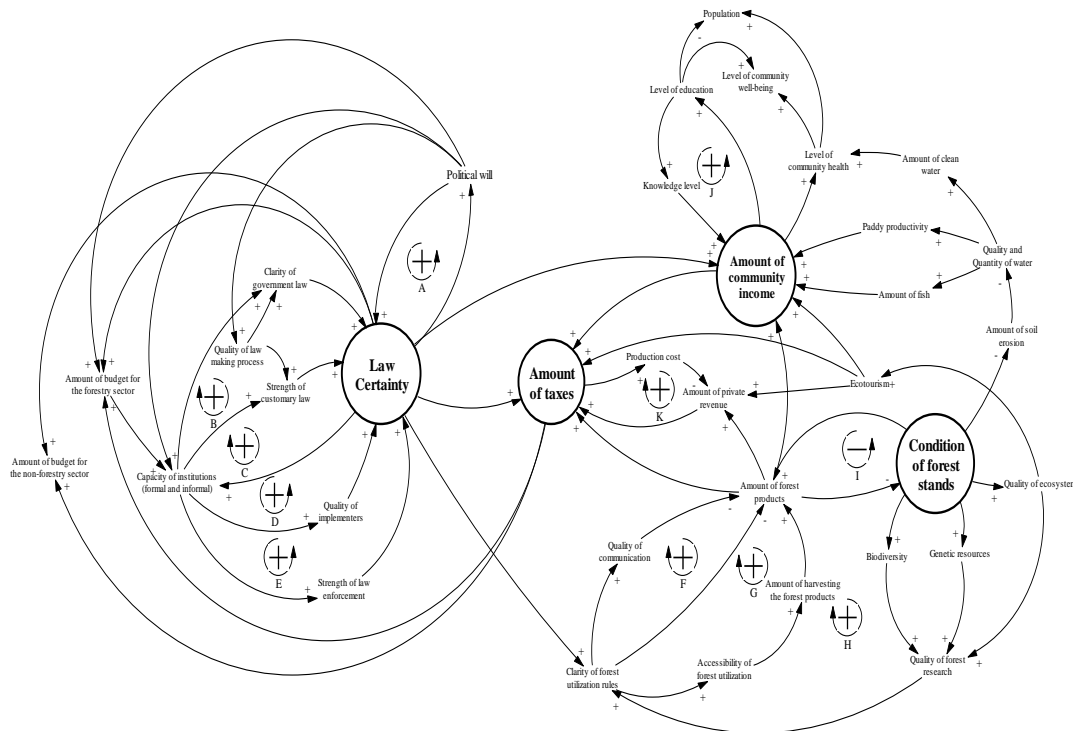


Figure 2. The complete causal loop diagram developed by stakeholders

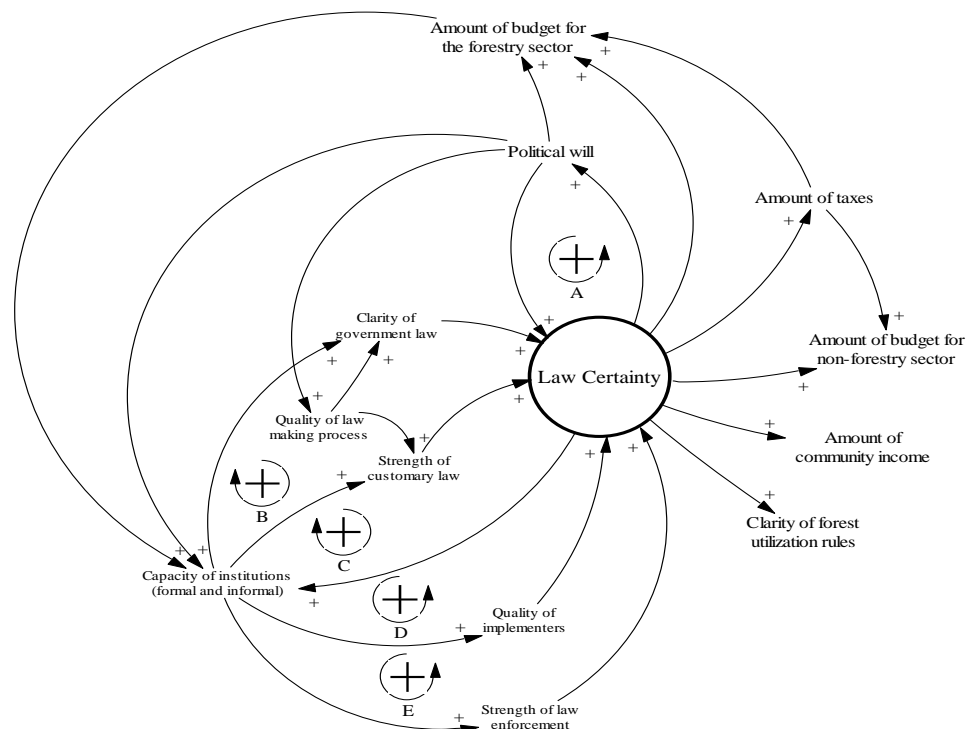


Figure 3 The interrelationships between forest laws and rules as perceived by stakeholders

In the last phase, the key component that was nominated by stakeholders is used as a basis for developing a scenario of forest management. The scenarios are developed using the intuitive logic approach which assumes that communities around the forest are an important stakeholder. This approach

relied on the interview results and interaction with the decision maker or relevant stakeholders. The resulting scenarios from the process are Status quo; Forest management by Nagari community; Cooperation between PFMU and private sector; Cooperation between PFMU and Nagari community; Collaboration between Nagari community, PFMU and relevant institutions (see table 3).

**Table 3** Comparison of forest management scenarios at PFMU of Solok

Scenario	Scenario																			
	Scenario I				Scenario II				Scenario III				Scenario IV				Scenario V			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
S I	■	■	■	■	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S II	+	+	+	+	■	■	■	■	+	+	+	-	-	-	-	+	-	-	-	+
S III	+	+	+	+	-	-	-	+	■	■	■	■	-	-	-	+	-	-	-	+
S IV	+	+	+	+	+	+	+	-	+	+	+	-	■	■	■	■	-	-	-	+
S V	+	+	+	+	+	+	+	-	+	+	+	-	+	+	+	-	■	■	■	■

Note: Indicators are 1 community income; 2 law certainty; 3 condition of forest stand; 4 taxes.

'+' means higher; '-' means lower

Overall, the scenario developed does not provide a better alternative to any component of forest management. However, if you want to increase people's income, provide recognition of community rights over forests and maintain the condition of the forest stand, the application of scenario 5 is a better choice because it can accommodate the interests of all stakeholders. To optimize the forest management in PFMU of Solok through this scenario, the stakeholders need to take possible action to strengthen the key components. This is an action by stakeholders (see table 4).

**Table 4.** Possible actions and role of stakeholders

No	Proposed actions	Indicators				Stakeholders role
		1	2	3	4	
1	Allocation of PFMU area for Nagari forest	+	+	+	+	Ensure boundaries of customary lands between the Nagari; Nagari community facilitated by PFMU, FDU and WARSI for propose the establishment of Nagari forest
2	Speed up the permit process of Nagari forest	+	+	+	+	Improve the coordination of PFMU, FDU, FPU, local government and MoEF to speed up the permit process of Nagari forest
3	Improve rule-making process and formulate the forest management plan through public consultation; ensure forest area by considering the claim of Nagari community; strengthen customary (KAN) and Nagari institutions; oversee implementation of the activity and law by Nagari community, parliament and WARSI.	+	+	+	?	Nagari community and WARSI send suggestion to district government and parliament as well as request public consultation on relevant laws and rules; stakeholder dialogue facilitated by WARSI; involving of Nagari communities for formulation of PFMU management plans and considering the academics advice; Parliament member is visiting the Nagari to listen the community aspirations



No	Proposed actions	Indicators				Stakeholders role
		1	2	3	4	
4	Increase the forest products and give them an added value	+	?	-	+	PFMU, WARSI, FDU, Academics and CDA provides technical assistance on the utilization and processing of forest products; PFMU provide marketplace information for the refined products of FMAN
5	Ensure availability of the MPTS seeds to forests rehabilitation	+	?	+	?	Improve the coordination of PFMU, FDU and BPDAS to provide a budget for rehabilitation activities and seed procurement through the “ <i>Kebun Bibit Rakyat</i> ” schemes
6	Institutional strengthening of FMAN	+	+	+	?	PFMU, NGOs, FDU provide facilitation to the development of FMAN human resource and create a forum of Nagari forest at district level; create a forum of Nagari forest at provincial level facilitated by social forestry section; WARSI and PFMU provide facilitation to formulate the management plans of Nagari forest
7	Increase the budget absorption of PFMU from the district budget and the business benefit to be able operate maximally	?	+	?	-	PFMU through FDU actively to lobby the economic section in BAPPEDA and to seeking marketplace access for refined products of community
8	Improve forest protection and monitoring	?	+	+	?	PFMU and FMAN protect the forest from illegal activities carried out by persons who are not responsible

Note: Indicators are 1 community income; 2 law certainty; 3 condition of forest stand; 4 taxes.

‘+’ means enhances; ‘-’ means diminishes; ‘?’ means uncertain.

### 3.2. Discussion

The aims of multi-stakeholders approach by implementing of SSM principles are to understand the complexity of the problem situation and to harmonize the stakeholder interests. Thus, the first phase is to express the problem situations, the second phase is to formulate the root definitions, the third phase is to establish the relationship between key components of forest management using a causal loop diagram. The last phase is to formulate the forest management scenario and action plans.

This approach helps to understand and integrate different stakeholder perspective. It offers a positive way to choose performance indicators of forest management to formulating the scenario and action plans. Increasing understanding of the problem situation and interrelationship of forest management components, as well as the development of scenarios can encourage the stakeholders for collaborative action.

Forest management by *nagari* people with the assistance, mentoring by KPHL and well as other relevant institutions is a rational choice for this moment. Multi-stakeholder or collaborative forest management can be developed at PFMU of Solok, because; most of the PFMU areas are customary land, *nagari* community has a strong consciousness on their customary rights, *nagari* community have a high dependence on the forest for their livelihoods and culture, decision to be taken about managing the forest has a high controversy, the government realized its failure in managing forests, and the stakeholders want to collaborate.

Multi-stakeholder forest management can be carried out at the site level, although there is the uncertainty of forest area status. The stakeholders collaborate because it is a rational choice. The

stakeholders recognize that collaboration can threaten existing power structures. However, multi-stakeholder processes in forest management at PFMU of Solok may be implemented on the constitution level. This could happen when PFMU can act as a regulator which is an extension of the Ministry of Environment and Forests to accelerate the licensing process of Nagari Forest.

Although this approach is not a panacea to solve the problems of forest management, it is useful as a learning process and complementary to another approach for to achieving the sustainability forest management and equitable. Finally, the focus of forest management in the future must be on integrating the global benefits of the forest into local livelihoods to strengthen collaborative forest management.

#### 4. Conclusions

Multi-stakeholder approach by implementing of Soft System Methodology principle helps to harmonize stakeholder interests, to understanding the complexity of problem situation, and enhancing collective learning. The scenarios and roles defined in the process can influenced the stakeholder for collaborative action in manage forest. Developing the forest management scenarios is a positive contribution in helping to achieve the sustainable forest management and equitable equity. However, there it remains to improve the process and achieve tangible benefits.

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