DECISIONS MAKING PROCESS IN ORGANIC STIMULANT INNOVATION ADOPTIONS USING STAKEHOLDERS ANALYSIS
(*Proses Pengambilan Keputusan dalam Adopsi Inovasi Stimulan Organik Melalui Analisis Peran Pemangku Kepentingan*)

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ABSTRACT

Wood vinegar-based stimulant is potential to be developed in Perhutani, therefore, the process of adoption is indispersable to be analyzed. This study aims at identifying the involved stakeholders and analysing the relationships among stakeholders in the policy of adopting stimulant innovation in Perhutani areas. Respondents are selected using a snowball sampling method. Stakeholder analysis is performed by using Interpretative Structural Modeling (ISM) while stakeholder relations analysis is carried out by classifying the relation into five categories: interaction, continuity, synergy, strength, and the presence or absence of conflicts. The results shows that the stakeholders involved in the stimulants innovation adoption policy are mostly in Quadrant IV or performs that Perhutani officials have legal authority in decision-making process. The pine tappers in Quadrant I implies that they have limited influence to stimulants innovation adoption policy but they have enormous interest in the management of pine forests. Academicians, researchers, forest rangers, forestry services officials and Ministry of Environment and Forestry officials are in Quadrant II. They play important role as intermediaries or facilitators and have considerable influence on decision-making process. Interaction, synergy and relationship continuity among stakeholders are well-established, except among researchers and academicians. Meanwhile, they could colaborate research with Perhutani.

Keywords: Interpretative Structural Modelling (ISM); policy; stakeholders; stimulant.

ABSTRAK

Adopsi stimulan berbahan dasar cuka kayu berpotensi untuk dikembangkan di Perhutani, oleh karena itu proses pengadopsian inovasi stimulan cuka kayu tersebut perlu dikaji. Penelitian ini bertujuan untuk mengidentifikasi pemangku kepentingan yang terlibat dan menganalisis hubungan antar pemangku kepentingan dalam pengambilan keputusan adopsi penggunaan stimulan di wilayah Perhutani. Responden dipilih dengan menggunakan metode snowball sampling. *Analisis pemangku kepentingan menggunakan* Interpretative Structural Modelling (ISM) *sedangkan analisis hubungan antar pemangku kepentingan dilakukan dengan mengklasifikasikan hubungan tersebut dalam lima kategori, yaitu interaksi, kontinuitas, sinergitas, kekuatan, dan ada tidaknya konflik. Hasil penelitian menunjukkan bahwa pemangku kepentingan yang terlibat dalam kebijakan adopsi penggunaan stimulan sebagian besar berada pada Kuadran IV (*Independent*) yaitu pejabat Perhutani yang memiliki kewenangan hukum dalam proses pengambilan keputusan. Penyadap pinus berada pada Kuadran I (*Autonomous*), artinya bahwa mereka memiliki pengaruh terbatas terhadap kebijakan adopsi inovasi stimulan tetapi memiliki minat yang sangat besar dalam pengelolaan hutan pinus. Akademisi, peneliti, Polisi Hutan, Dinas Kehutanan, dan KLHK berada pada Kuadran II (*Dependent). Mereka memainkan peran penting sebagai perantara atau fasilitator dan memiliki pengaruh besar dalam proses pengambilan keputusan. Hubungan interaksi, sinergitas, dan kontinuitas antar pemangku kepentingan telah terjalin dengan baik kecuali pihak akademisi dan peneliti. Akademisi dan peneliti bisa terlibat melalui kerjasama riset dengan Perhutani.*

Kata kunci: Interpretative Structural Modelling (ISM); *kebijakan*; *pemangku kepentingan*; *stimulan*.

I. INTRODUCTION

The increase of pine sap production is carried out by applying stimulants. Various studies on pine tapping stimulation have been developed, such as an-organic stimulants based on strong acids (H_2SO_4) and other strong acids. Almost all of Perhutani areas use an-organic stimulants in pine tapping with different compositions depending on the height of the place. The effect of using an-organic stimulants can disrupt the health of trees and their tappers and would cause environmental pollution (Sainoi & Sdoodee, 2012).

The application of friendly environmental stimulant, such as wood vinegar, is essential to support sustainable pine forest management in sap production. Wood vinegar is produced from a carbonized and condensed lignocellulosic waste material. The main component of wood vinegar is acetic acid (CH_3COOH) which is classified as weak acids (Darmaji, 2009; Pari & Nurhayati, 2009; Wijaya, 2010). Addition of acid substance in a pine-tapping process will reduce coagulated, thus it would increase sap production (Rodrigues, Azevedo, Sobreiro, Pelissari, & Fett-Neto, 2008; Reed *et al.*, 2009; Rodrigues, Apel, Henrique, & Neto, 2011; Sharma & Lekha, 2013). Wood vinegar based stimulant is potential to be develop since it is easy to produce, cheap and friendly environmental.

The decision making process in adopting stimulant innovation in Perhutani area considers the following factors: economic, social, environment, and technology. Economic factor relates to financial income of pine tappers and perhutani, while social factor relates to the pine tappers acceptance to the stimulant. Environmental factor relates to the safety of the stimulant adoption for tappers, pine stands and surounding environment. Lastly, the technological factor associates with the easiness of the innovative technology.

Stakeholder analysis in adopting stimulant innovation process is necessary to determine which interests are the most probable to accommodate in the program planning or in the decision making process. Recognizing the key role of stakeholders in order to implement the program is an important tool for policy-makers (Herawati, Widjayanto, Saharuddin, & Eriyatno, 2010). Stakeholders are all those who influence and or are influenced by policies, decisions, and actions within a system (Reed *et al.*, 2009). In this study, the parties are Perhutani as pine forest managers, pine tapper as workers and other parties, such as academicians and researchers. On the other hand, stakeholders have different influences and interests (Reed *et al.*, 2009). They have plurality point of view in policy interventions which would base their decisions (Ferreti, 2016). Differences of interest and influence among actors could be a source of conflicts because each actor would try hard to achieve their interests the power that to get its interests (Febriyano, 2014). Therefore, it is necessary to know the intensity of stakeholders in the decision making of adopting stimulant innovations in Perhutani by conducting stakeholder analysis from the aspects of influence, relationships, and interests.

This study aims to identify the involved stakeholders, their importance and roles and the relationships among stakeholders in the policy of adopting stimulant innovation in Perhutani area.

II. RESEARCH METHODS

Primary and secondary data was collected in Perhutani regions from August to November 2016. Primary data was collected from the involved stakeholders. Secondary data in the form of reference data is taken from Perhutani and literature studies, and they are carried out to be the supplement of the primary data.

Data and information about the stakeholders in decision-making are collected using in-depth interview methods in accordance with the objectives that have been prepared. Identification of stakeholders, the importance, and the role as well as the relationships among stakeholders are conducted using

snowball sampling method. This sampling method determines respondents based on the recommendations of the earlier stakeholders. The data and information are then processed and analyzed.

A. Identification of Stakeholders

Identification of stakeholders is performed by using Interpretative Structural Modeling (ISM) developed by Saxena, Sushil, & Vrat (1992). The steps taken on the ISM method are (Marimin, 2009) covers:

1. Identifying and registering elements. The elements in this study were stakeholders.
2. Building contextual relationships among elements.
3. Preparing Structural Self Interaction Matrix (SSIM). This matrix represents respondents perception of elements of intended relationship, with the symbol representing types of relationship between the two elements. The symbols were:
   a. V: relationship of elements Ei to Ej, not vice versa
   b. A: relationship of elements Ej to Ei, not vice versa
   c. X: interrelation between Ei and Ej, can be otherwise
   d. O: unrelated Ei and Ej
4. Compiling Reachability Matrix (RM), by converting SSIM symbol into binary matrix.
5. Clasifying elements at different levels of ISM structure. For this purpose, two devices are associated with each element Ei of the system; Reachability Set (Ri), is a set of all elements that can be reached from the element Ei, and Antecedent Set (Ai), is a set of all elements in which the element Ei can be achieved. In the first iteration, all of elements where Ri = Ri∩Ai, are level 1 elements. In subsequent iterations, the elements are identified as level elements in the previous iterations that are omitted, and the new elements are selected for the next levels using the same rules. Furthermore, all elements of the system are grouped into different levels.

6. Compiling Canonical matrix by grouping the same elements.This resultant matrix has most of triangular elements with the highest and the lowest is 0 and 1.
7. Preparing Diagraph, the graph of the elements that are related to each other and at a hierarchy level.
8. Generating ISM by moving the entire number of elements with the description of the actual elements.

ISM methodology and techniques are divided into two parts: preparation of hierarchy and classification of sub-elements. Classification of sub-element refers to RM result which is fulfilled the transitivity rules to obtain the value of Driver-Power (DP) and the value of Dependence (D), in accordance with:

1. Quadrant I; weak driver-weak dependent variables (Autonomous) namely sub-element with DP value ≤ 0.5 X and D$\leq$0.5 X; where X is the number of sub-elements. These sub-elements are generally unrelated to the system and may have few relationships although they may be strong.
2. Quadrant II; weak driver-strongly dependent variables (Dependent), ie sub-element with DP value ≤ 0.5 X and D> 0.5 X. Sub-elements in this sector are bound sub-elements.
3. Quadrant III; strong driver-strongly dependent variables (Linkage) ie sub-element with DP value > 0.5 X and D > 0.5 X. Sub-elements in this sector should be examined carefully because of the relationship between the sub-element is unstable. Any actions on the sub-element will have an impact on the other sub-elements and the effect of the feedback can magnify the impact.
4. Quadrant IV; strong driver-weak dependent variables (Independent) ie sub-element with DP value > 0.5 X and D $\leq$ 0.5 X. This sub-element is the remaining part of the system and it is called independent variable.

B. Relationships Among Stakeholders

Stakeholder relations to the policy of adopting innovation stimulant in Perhutani are analyzed in order to identify relationships among various parties who have common interest. Analysis of relationships among stakeholders refers to relationship that is part of 4Rs framework analyst (Dubois, 1998). Identification of relationships among stakeholders comprises five categories, namely interaction, continuity, synergy, strength, and presence or absence of conflicts. Each category is given a weight value based on Table 1.

III. RESULTS AND DISCUSSION

A. Identification of Stakeholders

A stakeholder is a person with an interest or concern on the issues identified by certain considerations, i.e the importance and the influence they have (Harrison, Bosse, & Phillips, 2009; Frow & Payne, 2011). Based on the identification, the stakeholders involved or related to the stimulants adoption policy in Perhutani areas and their roles bases on the level of interest and influence which are presented in Table 2.

Based on Table 2, Perhutani and its staff are key factors that have legal authority in decision making of forest management. As a state-owned enterprise, Perhutani is also required

to generate profits for the company so that Perhutani must be able to achieve the targets set by the company. Therefore, Perhutani has the authority and responsibility for all planned program activities. The policy of stimulants adoption in pine tapping bases on SK No. 527/045.1/PROD/Dir datd on September 5th 2007, regarding recommendation for the use of un -organic stimulants, and SK No.220/045.9/PROSAR/Dir April 25th 2011 regarding the use of ETRAT stimulants on pine tapping. The policy on stimulant use is mentioned in a Decree issued by the Director of Perhutani in Jakarta.Based on interviews with Perhutani officials, it is known that the policy of using stimulants in pine tapping according to the decree mentioned above and the implementation will be submitted to the policies of each Unit.Therefore, the policy of stimulant used in each unit varies.

Pine tappers are parties directly affected by the adoption policy and have direct interest in the activity. They are beneficiaries of income from pine tapping business academicians, researchers, Forestry Services Officials to the Ministry of Enviroment and Forestry who have policy support roles. Researchers and academicians are responsible as scientists to contribute ideas to create new innovations and results that can be implemented. The Forestry Services Officials have roles in licensing, while the Ministry of Enviroment and Forestry has

Table 1 Description and weight of value of each relationship category
Tabel 1 Deskripsi dan bobot nilai masing-masing kategori hubungan

Score (*Skor*)	Relationship category (*Kategori hubungan*)	Relationship criteria (*Kriteria hubungan*)				
		Interaction (*Interaksi*)	Continuity (*Kontinuitas*)	Synergy (*Sinergitas*)	Strength (*Kekuatan*)	Conflict (*Konflik*)
5	Excellent	Exist	Continuous	Exist	Strong	None
4	Good	Exist	Continuous	Exist	Sufficient	None
3	Fair	Exist	Continuous	None	Weak	None
2	Poor	Exist	None	None	Weak	None
1	No connection	None	None	None	Weak	None
0	Not identified	-	-	-	-	-
-1	Potential conflict occurs	Exist	None	None	Weak	Exist
-2	Conflict often occurs	Exist	Continuous	None	Sufficient	Exist

Source (*Sumber*): Dubois (1998).

Table 2 The role of parties based on the level of interest and influence on stimulant innovation adoption policies
Tabel 2 Peranan para pihak berdasarkan tingkat kepentingan dan pengaruh terhadap kebijakan adopsi inovasi stimulansia

No.	Stakeholders (*Pemangku kepentingan*)	Interest (*Kepentingan*)		Influence (*Pengaruh*)	
		Score (*Nilai*)	Level (*Tingkatan*)	Score (*Nilai*)	Level (*Tingkatan*)
E1	Deputy Head of Unit Perhutani (*Wakil Kepala Unit*)	24	High (*tinggi*)	22	High (*tinggi*)
E2	Chief of Non Timber Production Bureau (*Kepala Biro Produksi Bukan Kayu*)	22	High (*tinggi*)	20	High (*tinggi*)
E3	Head of KPH (*Kepala KPH*)	20	High (*tinggi*)	18	High (*tinggi*)
E4	Deputy Head of KPH (*Wakil KPH*)	19	High (*tinggi*)	17	High (*tinggi*)
E5	Chief of Non Timber Forest Product Section (*Kepala Seksi Produksi Bukan Kayu*)	16	Moderate (*sedang*)	15	Moderate (*sedang*)
E6	Chief of Marketing (*Kepala Seksi Pemasaran*)	14	Moderate (*sedang*)	12	Moderate (*sedang*)
E7	Head of BKPH (*Kepala BPKH*)	14	Moderate (*sedang*)	13	Moderate (*sedang*)
E8	Head of RPH (*Kepala RPH*)	12	Moderate (*sedang*)	12	Moderate (*sedang*)
E9	Forest Ranger (*Polisi Hutan*)	12	Moderate (*sedang*)	11	Low (*rendah*)
E10	Tapping Foreman (*Mandor Sadap*)	12	Moderate (*sedang*)	11	Low (*rendah*)
E11	Tappers (*Penyadap*)	22	High (*tinggi*)	10	Low (*rendah*)
E12	Academics (*Akademisi*)	11	Low (*rendah*)	15	Low (*rendah*)
E13	Researchers (*Peneliti*)	9	Low (*rendah*)	14	Moderate (*sedang*)
E14	Forestry Services Official (*Dinas Kehutanan*)	10	Low (*rendah*)	17	High (*tinggi*)
E15	Ministry of Env. and Forestry (*KLHK*)	12	Moderate (*sedang*)	9	Low (*rendah*)

a role in determining regulations governing plantation forest management, specifically the management of pine forests. However, in the field, it is technically determined by Pehutani.

Contextual relationships among stakeholders of their driving power and their dependence can be illustrated as in Figure 1. Further, it can be explained in Figure 1 that the stakeholders who play an important role in the stimulant adoption policy are mostly plotted in Quadrant IV (Independent) i.e. Perhutani officials who consit of: Deputy Head of Unit Perhutani (E1), Chief of Non-Timber Production Bureau (E2), Head of KPH (E3), Deputy Head of KPH (E4), and Chief of Non-Timber Forest Product Section (E5). The elements in this quadrant have a considerable driving power. This implies that the policies decided by stakeholders will

support the success of adapting stimulants. Perhutani has high interest and influence with regard to the authority and posseses the greatest responsibility as a manager that includes plannings, protection, utilization, and evaluation of the forest management work programs, particularly the management of pine forests in Java. This condition is often encountered in any natural resource management activities, wherein legally authorized managers always occupy positions as key stakeholders (Li, Ng, & Skitmore, 2012; Maguire, Potss, & Fletcher, 2012; Ichsan, Soekmadi, Adiwibowo, & Kusmana, 2017).

Chief of Forest Product Marketing Section (E6) and Head of BKPH (E7) are in Quadrant III (Lingkage). Stakeholders in Quadrant III have high driving power and intervention
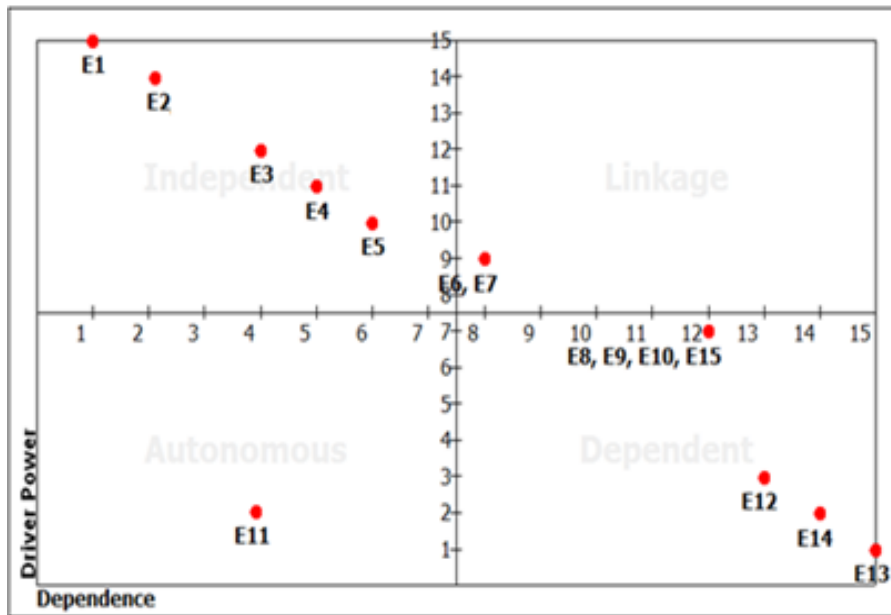
Source (*sumber*): primary data/processed 2018 (*data primer/diolah, 2018*)

Figure 1 Diagram of driving power and dependency relationship of stakeholder elements
Gambar 1 Diagram hubungan kekuatan penggerak dan ketergantungan elemen pemangku kepentingan.

in policy formulation of stimulant adoption. Both of the stakeholder elements are also closely linked to other elements. Head of RPH (E8), Forest Ranger (E9), Tapping foreman (E10), Academicians (E12), Researchers (E13), Officials in Forestry Services (E14) and Ministry of Environment and Forestry Officials (E15) are plotted in Quadrant II (Dependent). Stakeholders in Quadrant II are bonded, highly dependent on other stakeholders and have high influence. Their aspiration/intention is considered in pine forest management activities. However, they have relatively low interest towards regional management activities. These stakeholders could influence pine forest management policies by contributing criticism, problem-solving suggestions, and research results. However, those contributions merely stand as consideration and aspiration by Perhutani.

Pine tappers (E11) are in Quadrant I (Autonomous) which implies that stakeholders have low effect and are not associated with stimulant adoption policy but have great importance in the management of pine forests. The high dependence of tappers in Perhutani is primarily concerned with economic interests to sustain their livelihood. Sundawati & Sanudin (2009) reveal that the high importance of community living around Lake Toba catchment area is due to their dependency to Lake Toba ecosystem as their livelihood source. The low impacts of stakeholders in the Quadrant I are due to the incapacity or exclusion of tappers in pine forest management policies, particularly in tapping pine. Tools and facilities of pine tapping, such as tapping devices, sap gutter, bucket for collecting sap and stimulant types, are provided by Perhutani. Perhutani, however, has a considerable interest of pine tappers to tap their pine trees. Therefore, an effective communication is essential which could be implemented through regular meetings for the sake of obtaining mutual agreements between Perhutani and pine tappers. Communication is mainly related to the economic impacts after adopting stimulant, whether positive impacts on increased revenue tapper or otherwise, as it also how to maintain the pine sap pricing

mechanism that can benefit both sides. Perhutani needs to listen to the inputs from tappers as a basis for determining stimulant adoption policies. Rangkuti (2009) states that communication becomes more important to produce balance in the perspective of information exchange through established institutional channels, supported by two-way communication, both vertical and horizontal.

Element Diagraph of stakeholder based on its driving power is illustrated in Figure 2. Hierarchical structure of the stakeholder element consisted of 10 levels. Deputy Head of Unit Perhutani (E1) is at level 10, who is a key element of successful stimulants adoption. This is in line with the results of Herawati *et al.* (2010) which state that the provincial and district levels of forestry services have a high influence and interest in the implementation

of the Community Plantation Forest (CPF) programs.Thus, they play a key role to the successful implementation of CPF program policy. Thefore, the highest level decision maker has a high influence in adopting the programs.

B. Relationships Among Stakeholders

Stakeholder relationships analysis is conducted by identifying relationships among stakeholders based on five criteria, ie interaction, continuity, synergy, strength, and the presence or absence of conflicts.The results of stakeholder relationships analysis can be seen in Table 3. Table 3 shows that between Perhutani's top management, tapping foreman and pine tappers, have good interaction, continuity and synergy relationship.Their legal power of Perhutani make it possible
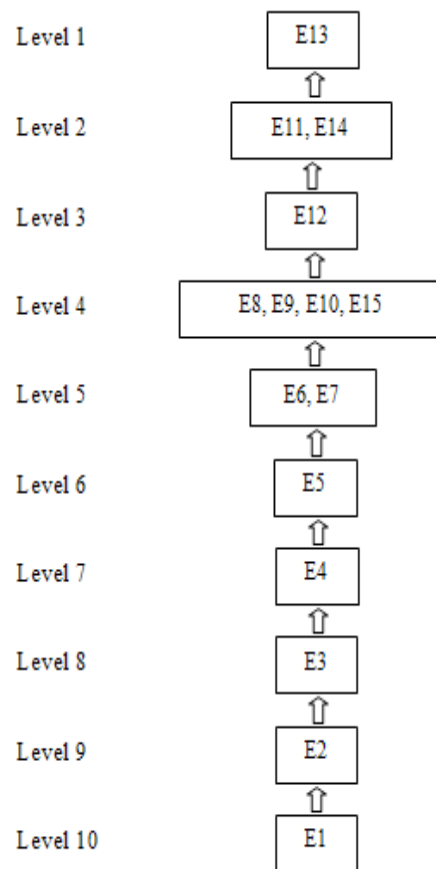

Figure 2 Hierarchical structure of stakeholders
Gambar 2 Struktur hirarki pemangku kepentingan.

Table 3 Matrix of stakeholder relationship in stimulant adoption policies
Tabel 3 Matriks Hubungan antar pemangku kepentingan dalam kebijakan adopsi stimulan

Stakeholders (*Pemangku kepentingan*)	Deputy Head of Unit Perhutani (*Wakil Kepala Unit*)	Chief of Non Timber Production Bureau (*Kepala Biro Produksi Bukan Kayu*)	Head of KPH (*Kepala KPH*)	Deputy Head of KPHKPH (*Wakil KPH*)	Chief of Non Timber Forest Product Section (*Kepala Seksi Produksi Bukan Kayu*)	Chief of Marketing (*Kepala Seksi Pemasaran*)	Head of BKPHBKPH (*Kepala BPKH*)	Head of RPH (*Kepala RPH*)	Forest Ranger (*Polisi Hutan*)	Tapping Foreman (*Mandor sadap*)	Tappers (*Penyadap*)	Academicians (*Akademisi*)	Researchers (*Peneliti*)	Forestry Service Officials (*Dinas Kehutanan*)	Ministry of Env. and Forestry (*KLHK*)
Deputy Head of Unit Perhutani (*Wakil Kepala Unit*)		5	5	5	4	4	4	4	3	3	3	2	2	2	4
Chief of Non Timber Production Bureau (*Kepala Biro Produksi Bukan Kayu*)			5	5	4	4	4	4	3	3	3	2	2	2	4
Head of KPH (*Kepala KPH*)				5	4	4	4	4	3	3	3	2	2	2	4
Deputy Head of KPH (*Wakil KPH*)					5	4	4	4	3	3	3	2	2	2	4
Chief of Non Timber Forest Product Section (*Kepala Seksi Produksi Bukan Kayu*)						4	4	4	3	3	3	2	2	2	4
Chief of Marketing (*Kepala Seksi Pemasaran*)							4	4	3	3	3	2	2	2	4
Head of BKPH (*Kepala BPKH*)								4	3	3	3	2	2	2	4
Head of RPH (*Kepala RPH*)									3	3	3	2	2	2	4
Forest Ranger (*Polisi Hutan*)										4	3	1	1	1	1
Tapping Foreman (*Mandor Sadap*)											4	1	1	1	1
Tappers (*Penyadap*)												1	2	1	1
Academicians (*Akademisi*)													3	2	4
Researchers (*Peneliti*)														2	4
Forestry Service Officials (*Dinas Kehutanan*)															4
Ministry of Env. and Forestry (*KLHK*)															

Source (*sumber*): primary data/processed, 2018 (*data primer/diolah, 2018).*

to manage pine forest areas with activities and programs involving forest communities. Community living around Perhutani area work as pine tappers for their livelihoods. Perhutani nevertheless obtain labour to collect sap pine from their area. Moreover, by involving community in forest management activities, Perhutani has performed social aspects of forest management. As the community are benefitted from the forest, they would secure the forest area, thus lessening conflicts with Perhutani.

Good relationship between Perhutani with academicians and researchers is inevitable to support innovation adoption. Academicians and researchers can be involved through collaborative research with Perhutani. These stakeholders can influence pine forest management policies, by providing criticism, solutions to problems, the results of studies, even though, are only limited to being considered and heard by Perhutani. However, sometimes it needed by Perhutani to adopt innovation due to certain considerations.

Improper relationship between Forest service officials and Perhutani sometimes occurs in the empowerment of communities as workers. This condition can be overcome by coordinating forest management between the two parties. Nurfitriani, Darusman,

Nurrochmat, & Yustika (2015) state that strategy to optimize the potential conflicting stakeholder arrangements could be implemented through enhancing coalition, collaboration and stakeholder coordination.

In composing and implementing technical policies in pine forest management, Perhutani should continuously interact and synergize with Ministry of Environment and Forestry. Further, Perhutani should conduct an extended technical coordination with forestry service officials.

IV. CONCLUSION AND RECOMMENDATION

A. Conclusion

Perhutani officials are mostly plotted in Quadrant IV (Independent) because they posses legal authority in decision-making process. Perhutani involves in stimulants adoption policy. Pine tappers are directly affected to stimulants adoption policies and have enormous importance in the pine forests management. All parties who did not have direct interest in stimulants adoption policies but have concern are academicians, researchers, forest rangers, forestry service officials, and Ministry of Environment and Forestry officials. They play their important roles as intermediaries or facilitators who would influence decision making process.

Stimulants adoption policy is a top down policy. The position of Perhutani officials correspond with their influence and authority in decision making process.

Stakeholders relations which are in accordance to five categories are continuos interaction and continuous synergy with the absence of academicians and researchers. Thus, it is expected that conflicts would not be existed. To avoid conflicts in forest management area, coordination between Perhutani and forest service officials is indispensable.

B. Recommendation

Perhutani should be listening to the aspirations of stakeholders involved in stimulant adoption, because it is very useful for the policy-making process. For this reason, communication between Perhutani and other stakeholders must be established through the establishment of communication forums.

Perhutani as a decision maker in stimulant adoption policy should not only limits himself in formulating the policy but should also perform in monitoring and evaluating the implementation.

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