Strengthening community participation in reducing GHG emission from forest and peatland fire

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Abstract. Strengthening community participation is needed to find solutions to encourage community more participate in reducing Green House Gas (GHG) from forest and peatland fire. This research aimed to identify stakeholders that have the role in forest and peatland fire control and to formulate strengthening model of community participation through community-based early warning fire. Stakeholder mapping and action research were used to determine stakeholders that had potential influence and interest and to formulate strengthening model of community participation in reducing GHG from forest and peatland fire. There was found that position of key players in the mapping of stakeholders came from the government institution. The existence of community-based fire control group can strengthen government institution through collaborating with stakeholders having strong interest and influence. Moreover, it was found several local knowledge in Kapuas District about how communities predict drought that have potential value for developing the community-based early warning fire system. Formulated institutional model in this research also can be further developed as a model institution in the preservation of natural resources based on local knowledge. In conclusion, local knowledge and community-based fire groups can be integrated within strengthening model of community participation in reducing GHG from forest and peatland fire.

1. Introduction

Land and forest fire and the impact had extended to various areas including Kapuas Regency in Central Kalimantan Province. Moreover, the impact of land and forest fire will get worse if taking place in peatland. Peatland fire in 1997/1998 as El Nino occurred in Indonesia, contributed emission 13-40% of global emission. [1-3]. The huge land and forest fire repeated in 2015. In Kapuas Regency, there are over four hundred peatlands locating at the former of One Million Hectare Peatland Development (Pengembangan Lahan Gambut/PLG)) since 1995. The PLG project opened hugely peatland including thick peat swamp forests with thousands of kilometers of canals construction that impact on peatland drainage ecosystems. Peatland drainage ecosystems initiated the prone area of land and forest fire occurring almost every year and causing massive carbon emission [4].

Early Warning System of Forest and Land Fire (EWSFLF) which is part of Forest and Land Fire Control still can not solve the problem of greenhouse gas emission from land and forest fire.
Currently, EWSFLF implementation may involve less the participation of the community. Some detection information and warning fire were used to provide information about fire activity from several government agencies. Currently, prediction information of fire period is managed by Indonesia Meteorological, Climatological and Geophysics Agency (BMKG). Moreover, the hot spot data were used as an indication of forest and land fire that was managed by The Ministry of Environment and Forestry (KLHK). Warning information of forest and land fire that has been used in national level has not been socialized to the community which are close to the location of fire-prone. In addition, the data and information of the forest and land fires probability are still centralized and dissemination of information is also impressed bureaucratic.

Currently, community institution has not been seen actively involved in forest and peatland fire control. Communities who live in fire-prone have the probability to organize themselves and contribute greatly in controlling forest and land fire by collaborating with the government and private sector. Institutional aspects and the involvement of community participation actively is to be important in reducing the spread of fire [5,6]. Consequently, it is needed to develop early warning system of forest and land fire to find solutions of the centralized and expensive current system as well as encouraging people to play more active the role in their own protection. Therefore, to achieve the reduction in greenhouse gas emissions from forest and land, it would require the development of early warning system involving community participation in Kapuas Regency of Central Kalimantan Province. This research aims to identify stakeholders who play role in controlling forest and peatland fire and to formulate strengthening model of community participation through the community-based fire early warning system.

2. Materials and Method
2.1. Study Area
Primary and secondary data collected in Kapuas, Bogor and Palangkaraya from April 2012 - September 2013. The informants were from the government agency and non-governmental organizations which associated with the activities of forest and land fire control as well as the community from fire-prone villages in Central Kalimantan and Kapuas Regency. Focused group discussion was done in Kuala Kapuas Kapuas Regency and Bogor City.

2.2. Data Analysis
Secondary data was legal documents and reports activities related to forest and land fire control in Central Kalimantan Province and Kapuas Regency which were derived from government agency and non-government organization. In addition, primary data collection was completed by structured interviews, in-depth interviews and focus group discussions (FGD). Structured interview conducted on government agency staff to explore the basic information related to the duties and functions of the institution, forest and land fires control program, the facilities of institutions and coordination with the other parties. The informants selection of stakeholder in this study were conducted in two ways: (1) snowballing sampling and (2) key person. Researchers began to collect information by finding the first gatekeeper or the first person who welcomed at place of the research that could give clues about the stakeholders and who could be interviewed in order to obtain the data research [7]. There were 15 informants of stakeholder which each institution chose a representative to be key person.

The FGD with various stakeholders at the community level and the institution level was done separately. FGD activities was conducted to reveal their knowledge related to forest and land fires, early warning systems and their expectations for the future. The FGD at the community level was followed by 10 participants [8]. Meanwhile, the FGD participant from government institution consisted of six agencies from the Regional Disaster Management Agency (BPBD) of Central Kalimantan Province, BPBD of Kapuas Regency, Forestry and Plantation Agency of Kapuas (Disbunhut Kabupaten Kapuas), Meteorology and Geophysics Agency of Central Kalimantan Province.
Stakeholder Analysis was used to determine the key actor involving in the implementation of policy and institutional of forest and land fire prevention. Interview result became a reference to conduct the classification and assessment of the level of interest and influence [9] and stakeholder mapping [10]. In 2 x 2 matrix, each stakeholder was mapped based on two criteria, namely the influence and interest. This mapping indicates a potential relationship that may be built namely a potential conflict, complementarity and cooperation [10].

The formulation of early warning system of forest and land fire comes from various stakeholders reflection on the incidence of forest and land fires and early warning systems that happen. The reflection according to the criteria in action research is the effort to understand the problem and criticize what has happened [11]. The formulation of early warning system of forest and land fire is the result of community and key stakeholder reflection who answered some aspects in terms of based community early warning systems from UNISDR [12], consisting of four key elements: (i) knowledge of risk, (ii) monitoring, analysis and threatening prediction, (iii) the deployment of warning and alert message and (iv) the ability of community to respond the received warning.

3. Results and Discussion
It was arranged key actor level based on ownership of the task, function and program that directly leads to action forest and land fire control. Moreover, the key actor were also assessed on its role in supporting the financial aspect and policy of forest and land fire control. The arrangement of key actor level was made in classification form of a role of the activities, interest and influence of stakeholder into the success of the program. Identification result of the interest and influence of the parties related to the reduction of GHG from forest and land fire was classified as can be seen in Table 1.

Table 1. Classification of the parties according to the influence and interest in reducing of GHG emission from forest and peatland fires in Kapuas

| No. | Stakeholder Groups                                      | Role in program                  | Stakeholder interests on the success of the program | Stakeholder influence on the success of the program |
|-----|---------------------------------------------------------|----------------------------------|----------------------------------------------------|---------------------------------------------------|
| 1   | Regional Disaster Management Agencies of Kapuas (BPBD)  | Decision maker and organizer     | 4                                                  | 5                                                 |
| 2   | Environmental Agency of Kapuas (BLHD)                  | Executor                         | 3                                                  | 3                                                 |
| 3   | Forestry and Plantation Agency of Kapuas (Disputation) | Executor                         | 5                                                  | 3                                                 |
| 4   | Agriculture, Horticulture and Food Crops Agency of Kapuas | Executor                         | 3                                                  | 2                                                 |
| 5   | District Development Planning Agency of Kapuas (Bappeda)| Supporter                        | 2                                                  | 4                                                 |
| 6   | Manggala Agni                                          | Executor and Supporter           | 5                                                  | 2                                                 |
| 7   | District Government                                    | Utilizer and Supporter           | 2                                                  | 2                                                 |
| 8   | Village Government                                     | Supporter                        | 5                                                  | 3                                                 |
| 9   | Fire Brigade Community (Community Group for Forest Fire Management/ Community Care Fire / Fire Extinguishing Team) | Utilizer and Supporter           | 5                                                  | 2                                                 |
| 10  | Indigenous Institute                                   | Supporter                        | 2                                                  | 3                                                 |
(Mantir)

| No | Institution                                                                 | Role               | Importance |
|----|-----------------------------------------------------------------------------|--------------------|------------|
| 11 | Non-Governmental Organization (Indigenous Peoples Alliance of the Archipelago/AMAN) | Supporter / Opposition | 2          |
| 12 | Cooperation Project Local Governments and Donors (KFCP)                     | Supporter          | 3          |
| 13 | Police                                                                      | Executor           | 3          |
| 14 | Provincial government (POSKO of Province)                                   | Supporter          | 3          |
| 15 | Meteorological, Climatological and Geophysics Agency of Central Kalimantan Province (BMKG) | Supporter          | 2          |

Note: 1 = little / not important, 2 = quite important, 3 = moderate, 4 = very important, 5 = a key player.

Institution as stakeholder continuously receives the impact of the activities or policies, where the institution also has an interest into the process and results of the activities and policies that affect [13]. Then, [14] added that the stakeholder plays as the key actor who has strong influence and interest related to the problems, needs and attention to success of the program. Institution that takes place in quadrant with high influence and interest is the institution that has highest participation towards the success of the action of forest and land fire control. These institutions have the technical participation through programs and political participation through duties and policies affecting capability in taking measures and supervision of certain situations and improve the independent action in strengthening and development of institutional and program [15].

**Figure. 1.** Matrix of stakeholder’s interest and influence in forest and land fire early warning system in Kapuas Regency, Central Kalimantan Province, Indonesia

According to [10] classified stakeholder based on the influence and interest as subjects, key players, crowd, and context setters. Subject has high interest but low influence. Although supporting the activity, subject capacity into the impact may be nothing. The stakeholder can be the influence when form the alliance with the other stakeholder. Key players are active stakeholders because they have high interests and influence to the development of a project. Crowd is stakeholder who has low
interest but high influence. These are the reasons why crowd is involved in decision making. Context setter has high influence but low interest causing significant risk to be monitored. The mapping result of influence level and interest of the various stakeholders related to the forest and land fire control program in Kapuas, Central Kalimantan Province is shown in Figure 1.

Quadrant I position (subject) at Figure 1 is derived from government agencies, non-governmental organization and community. Stakeholders in Quadrant I is Department of Agriculture Food Crops and Horticulture (DPHTP) Kapuas, Mangala Agni Regional Operations II (Daops II) Kapuas, Community Development of Fires Control in Forest and Land (MPA / RPK / CPC / KMPK) and project KFCP (Kalimantan Forest and Climate Partnership). Stakeholders of community such as MPA / RPK / CPC / KMPK have high interest in forest fire control as they relate to the land that they have to protect. However, the ability of stakeholder is inadequate related to fund, facilities and human resources. This condition is similar to the research of Herawati et al. [16] on the program of in Community Plantation Forest (HTR), research of [17] and research of [18] when the high interest of community into the natural resources, especially related to economic and social interests. In Kapuas Regency, there are community based of forest and land fire of fire control institutions that formed and receive the guidance in Kapuas Regency. These institutions are KMPK, MPA, RPK and CPC. KMPK and CPC were formed and nurtured by local Kapuas governments namely BPBD and Social Service consisting of 23 and 15 groups. MPA is under the guidance of Agni Mangala Kapuas, while RPK was formed and receive guidance from the KFCP project (The Kalimantan Forest Carbon Partnership) in which each of them is formed of four and seven groups. Number of community-based fire control in Kapuas is 49 groups.

Stakeholder group in Quadrant I has plus point that most of the community has high interest in controlling forest and land fire. This is a valuable potential in strengthening community participation in forest and land fire control. However, the weakness of Quadrant I is most of the stakeholders coming from formal institutions (DPHTP and Mangala Agni) and the International cooperative institution (KFCP). Although those three institutions have programs related to community involvement in early warning fire, but the portion of the program and budget are minimum so they do not have strong influence in strengthening communities participation in each program.

Quadrant II position (key players) are occupied by BPBD (Regional Disaster Management Agency) of Kapuas, Environmental Agency of Kapuas (BLH), Department of Forestry Plantations of Kapuas (Disbunhat) and the local government. Those four stakeholders have important role in preventing fire, extinguishing, handling post fire, controlling land fire, developing community capacity, and empowering communities. These are common actions at any natural resource management project in which the manager who gets the power legally is always in main stakeholder position [19].

All stakeholders in Quadrant II come from the government as a formal institution. It has plus point where the institution would have strong legal and sustainable program. However, the weakness of the composition of stakeholders in Quadrant II is the absence of institution that comes from community so that forest and peat land fire control program potentially does not get strong response and participation from the community.

Quadrant III position (context setter) are occupied by Regional Development Planning Agency of Kapuas (Bappeda), the Traditional Institute in village level and Meteorological, Climatological and Geophysics Agency (BMKG). These stakeholders can influence the development of community-based early warning system as these have high influence. Bappeda plays in the planning and development authorities including planning of disaster management program. Indigenous Mantri becomes a reference in determining forest fire and land danger warning information that can be trusted. BMKG has data to be a reference in determining the preparedness status of local government disaster related to climate and weather.

The plus point in quadrant III is derived from the group of stakeholders which are traditional institutions that have high impact, especially as resources of drought predictions based on local indicators. The weakness of the stakeholders are BMKG has no high interest so that warning
information response dissemination of forest fire hazard is not up to the community level and the response of community is low.

Position in quadrant IV (crowd) are took place by the four stakeholders namely District Government, NGO (Non Governmental Organization) AMAN, Police of Central Kalimantan Province Government. The stakeholders also give attention to the development of early warning system for forest and land fire. However, the activities are only temporary with weak effect.

The lack in the composition of stakeholders in Quadrant IV is low role of the Provincial Government (POSKO of Central Kalimantan) in supporting the strengthening participation of community in forest and land fire control. As an institution that makes laws, provincial government has to increase its role throughout the district or town in Central Kalimantan Province for strengthening the institutional and participation of community for the control of forest and land fire.

According to all stakeholders which are mapped, it can be identified three relationships that occur between stakeholders which engages in the development of early warning system for forest and land fire namely a potential conflict, complementarity and cooperation. Potential interest conflict occurs between community or group of communities with the institutions that have the duty and function in the prevention of forest and land fires. Government institutions are less in socialization so many people do not know the regulations on land clearing and yard guidance and fire danger warning information. Potential conflicts also occur between KFCP and community. KFCP is not entirely successful in the dissemination and expansion of participation causing resistance from some local group of communities. Complementary occurs between Agni Mangala Kapuas, KFCP, Disbunbut, BLH and based community forest and land fire control group. These institutions are often in an activity that is in increasing the capacity of community for forest and land fire prevention. The potential cooperation can be established for all stakeholders, especially among providers of information and the dissemination of information to the community and the local government, BMKG, Manggal DOPS Agni II Kapuas, BLH, DPHTP and BPBD. They can cooperate to integrate the data of early warning forest and land fire that can be understood and responded well by the community. The local government and community of forest and land fire control could help the government to provide actual data on their villages to government agencies. In addition, the local government and community can help disseminate information of the dangers of forest and land fire from the government quickly and utilize effective communication in community.

Reflection from the community and government agencies regarding the early warning system of forest and land fire which has been conducting currently is formulated by a model dam strengthening community participation lowers GHGs through the development of early warning systems in Kapuas as presented at Figure 2. This model on the potential relationship between stakeholders are dynamic and result reflection of government agencies and the public that refers to the four key elements of early warning system according to UNISDR (2009), namely (i) knowledge of risk, (ii), analysis and peramalam hazards, (iii) information and communication warning message and (iv) response.

Reflections on the knowledge of risk will answer questions about local knowledge community concerning long drought in the Kapuas Regency, Central Kalimantan Province. One form of local knowledge of the tribes in Kapuas is how they predict the coming drought. There are some local wisdoms in Kapuas how the community predict as presented in Table 2.

Based on Table 2, there are four public knowledge as indicators of fire-prone period in the Kapuas Regency that are easy to use and understand namely Beje, fallen leaves, animal collect on the riverbanks and Bali Calendar. These local indicator are easy to understand and even be able to provide clearly a period of time especially in Bali Calendar.

According to monitoring, analysis and prediction hazard aspect, community have an understanding that most of fire occur on land that is unmaintained, especially in peatlands. Based on ground check and interview, the location that almost burnt in every drought are shrubs, former purun grass shrubs, secondary swamp forest, reeds and former agricultural land. The local knowledge also corresponding to study by [20] in Kapuas District that found the fire prone area located in grassland, shrubs and secondary swamp forest.
Table 2. List of Local Knowledge of Community in Disaster Risk in Kapuas, Central Kalimantan Province.

| No | Knowledge of Community | Application Level |
|----|------------------------|-------------------|
|    |                        | Easy | Medium | Difficult |
| 1. | Beje (fish trap pool ) is receding | v    |        |           |
| 2. | Many Fish go down to the river mouth |        | v      |           |
| 3. | Snakeskin fish clot in the air | v    |        |           |
| 4. | The umbrella of the sun |        | v      |           |
| 5. | The fall of the leaves of trees | v    |        |           |
| 6. | The animals collect on the riverbank | v    |        |           |
| 7. | Season Kapat or severe drought | v    |        |           |
| 8. | Use Farming Calendar (Bali Calendar) | v    |        |           |

Source: interviews with community leader

Based on aspect of fire warning message, it is obtained information that early warning message of forest and land fires to community mostly come from village officials (Table 3). The message was conveyed by village officials on socialization of regents or government agency regarding drought and awareness status of forest and land fires. Both village official and community leader or activist can be a reference of information for the community regarding the arrival of long drought causing forest and land fire. Traditional leaders, especially at the village level, both religious figures and paramedics custom generally have the local knowledge of local indicators or signs of drought on the observation of nature. The tool that is used to disseminate information of early warning of forest fire is an informal meeting (Table 3). Informal meeting is usually able to collect a lot of people and has sufficient time to convey the message in attractive way and appropriate understanding.

Table 3. The tools of dissemination of messages regarding the dangers of forest fires and land in Kapuas District

| Institution | Tool of Message Dissemination |
|-------------|-------------------------------|
|             | Radio Communications | Phone | Cellular phone | Letter | Home visit | Informal meeting (Mosque, Church, Informal meetings, etc.) | Visual Aids (Warning boards, banners, billboards) |
| BPBD        | v    | v    | v    |         | v    | v    | v           | v |
| BLH         | v    | v    | v    |         | v    | v    | v           | v |
| Disbunhut   | v    | v    | v    |         | v    | v    | v           | v |
| Manggala    | v    | v    | v    | v      | v    | v    | v           | v |
| Agni        | v    | v    | v    |         | v    | v    | v           | v |
| MPA         | v    | v    | v    |         | v    | v    | v           | v |
| BPK         | v    | v    | v    |         | v    | v    | v           | v |
| RPK         | v    | v    | v    |         | v    | v    | v           | v |
| Local government | v    | v    | v    |         | v    | v    | v           | v |

| Total       | 2    | 3    | 3    | 2    | 4    | 5    | 4 |

| Percentages (%) | 25.0 | 37.5 | 37.5 | 25.0 | 50   | 62.5 | 50 |

Source: interview with leader and village government April-September 2012
The ability of communities to respond warning fire message was found that they got hazard warning information from several sources that were Agni Mangala, banners / bulletin boards of governors, circulars regent, village officials and information from the mass media. For those who provided information regarding fire warning, community got it from the village head and staff, Chairman of RT, community leaders and BPD (the village assembly). If wildfire happens, the community responds by distributing information about hazards and land clearing activity through community-based Group Fire Control. Study by [21, 22] also found that community-based fire control group in Mantangai District Kapuas Regency ie Fire Brigade (RPK) had recognized the existence and benefit by most villagers. They also asked for help on the parties that were considered capable to control namely the Head of Village and staff, other rural communities, other land owners, Mangala Agni, Disbunhut and BPBD.

![Diagram of strengthening community participation of forest and peat fire through community-based early warning system in Kapuas District, Central Kalimantan Province, Indonesia.](image)

**Figure. 2.** Model of strengthening community participation of forest and peat fire through community-based early warning system in Kapuas District, Central Kalimantan Province, Indonesia (The numbers represent stakeholders such as at Figure 1).

Strengthening model of community participation can be flexible and prospective. Flexible means that each stakeholder role can change according to the capacity of the institution and the intervention of outside party to strengthen these institutions. Prospective means that this institutional model could be relied upon not only overcome the problem of forest and land fires, but also a wider role in improving community capacity to participate in disaster management in general as well as protecting the citizens, property and land in their respective villages. Therefore, this institutional model is also prospective to be developed into a model institution in the preservation of natural resources based on...
local knowledge to the village level. This step is conducted by strengthening the presence and role of community based forest and land fire control group into one Village Community Institution (LKD) as a partner of the village government.

4. Conclusion
Public knowledge regarding how to predict the fire season has a potential value for the development of community-based forest and peatland fire early warning system. Community-based fire control group and traditional institution require strengthening of influence and importance to increase participation in controlling forest and peatland fire till the village level. Institutional model and strengthening of participation in this research could also be developed for the further research into a model institution in the preservation of natural resources based on local knowledge till the village level by strengthening of community-based fire control group as a partner of the village government. It is recommended that the local and institutional knowledge can be integrated in the strengthening participation model in reducing GHG from forests and peatland fire.

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