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Developing community-based forest ecosystem service management to reduce emissions from deforestation and forest degradation☆

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ABSTRACT

At the site level, communities who manage and conserve forests are parties influencing as well as affected by deforestation and forest degradation. Hence, understanding their roles in supporting or avoiding deforestation and forest degradation is important to support national effort in reducing carbon emissions from forest. This study is aimed at: (1) examining communities' needs for forest products and services; (2) analysing communities' interests towards REDD+ activities in reducing emission from deforestation and forest degradation activities; and (3) analysing options to be developed into management plans for reducing emissions from deforestation and forest degradation. It examines 9 communities in the provinces of Papua, Central Kalimantan, and Riau. It employs a qualitative approach through stakeholder interviews, focus group discussions and field observations. The study found that communities face some constraints in managing forest ecosystem services that impede their role in reducing emissions from deforestation and forest degradation that can be expected from the utilisation of non-timber forest products and ecosystem services. Communities' interests in joining programs to reduce emission from deforestation and forest degradation are diverse, but their capacity in planning and in systematic forest use, in including carbon conservation programs are relatively low. Hence, strengthening community-level organisational structures and developing robust plans for sustainable management of forest ecosystem services are needed to support communities' participation in reducing emissions from deforestation and forest degradation.

1. Introduction

Indonesia's emission reduction program through Reducing Emissions from Deforestation and Forest Degradation (REDD+) has now moved from the readiness to the implementation phase. To ensure successful REDD+ outcomes, considerations of local contexts and dynamics (Eilenberg, 2015) and participation of local communities are essential (Resosudarmo et al., 2012). The role of local communities living within or surrounding forest areas in forest management is widely acknowledged (Gilmour, 2016). The interdependency between communities and the forest ecosystems where they live suggest that communities 'must play a key role in planning and implementing resource management activities, if those activities are to be sustainable on an ecological, social, and economic basis' (Gray et al., 2001, p.21). However, local communities' activities in utilising forest resources, to some extent, cause and are also affected by deforestation and forest degradation (Bong et al., 2016a,b).

The area of forests controlled and administered by communities doubled between 1985 and 2000 and is expected to increase further (White and Martin, 2002). Furthermore, devolution of forest tenure from national governments to local communities and individuals has increased over the last two decades making the proportion of communities and individual ownership over forest resources accounted for 14% (FAO, 2015; RRI, 2014). The devolution has also gained increasing attention in developing countries, including Indonesia. The Government of Indonesia has a target to expand the area of social forestry schemes to 13.8 million hectares (Menteri Lingkungan Hidup dan Kehutanan Republik Indonesia. SK, 2019). Limberg et al. (2005) define community-based forest management (CBFM) as 'forest management systems where local communities have some level of influence over decisions related to forest management or benefits'. CBFM in Indonesia is conceptually designed to transfer the state's authority over forest

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resources to local communities as is stated in Government Regulation No. 83/2016 (Menteri Lingkungan Hidup dan Kehutanan, 2016). However, the CBFM program in Indonesia has also been viewed by some parties as a process of recentralizing or restoring state control over forest resources (Maryudi, 2012a,b; Sahide et al., 2016a,b). It covers both government-led initiatives such as community forests, village forests, and community plantation forests, and existing management practices carried out by customary communities.

Maryudi (2011a,b) shows that local communities in Java have gained significant benefits from their involvement in forest management, both in terms of empowerment and livelihood improvements. Gbedomon et al. (2016) argues that collaborative forest management requires the exploration of alternative approaches that can improve the position and accountability of local communities. Participatory forest management is one approach that can be used by considering livelihoods, environmental quality, and forest governance improvement (Sikor et al., 2013). CBFM is exepcted to promote socio-economic development (Scheba and Mustalahti, 2015). Rahut et al. (2015) demonstrate that CBFM has improved community incomes and reduced poverty by 5–12%. Moreover, communities involved in CBFM also have better food security compared to those who are not (about 12–19% more). A study conducted in eight forest villages in Rwanda revealed that ecosystem service provision is important in fulfilling villagers' basic needs (Dawson and Martin, 2015). No less important, tourism brought jobs and government revenue sharing scheme. The greater benefits from ecosystem services have affected people's wellbeing positively (Dawson and Martin, 2015). CBFM's widespread adoption by conservation initiatives in the tropics (Rasolofoson et al., 2015) has inspired good forest governance, sustainable forest management and is one of the means to improve people's livelihoods (Pokharel and Nurse, 2004). CBFM is also an emerging, successful model of state-community partnerships for forest management and poverty reduction (Moktan et al., 2016). Thus, CBFM can be a powerful strategy for managing ecosystem services at a site level. One mechanism for utilising forest ecosystem services is through direct payments, referred to as “Payments for Ecosystem Services” (PES). Relevant to Indonesia for environmental payments is the promulgation of a recent regulation on Environmental Economic Instruments. Through PP 46/2017, ecosystem service providers able to obtain incentives from beneficiaries of environmental services facilitated by the government, both central and local governments.

There are two main problems related to the involvement of local communities in REDD + in Indonesia: the lack of local community involvement in the management of state forests and conflict over state forests. State forest management in Indonesia has historicaly been dominated by large-scale entities through logging and plantation forest concession licenses (Brown, 1999). Community-based forest management (CBFM) accounted for only about 1% of the total area of production and protection forests. There are signs of improvement on this front, however, as the government has recently committed to accelerate social forestry; by March 2018, over 1.4 million hectares of state forest land had been allocated to local communities (Nurbaya, 2017). Furthermore, there are a multitude of customary community claims over state forests. According to the Alliance of *Indigenous Peoples* of the Archipelago (AMAN), 55 customary forests covering 1,062,690 ha, have been established across Indonesia (AMAN, 2010). Other claims that are not acknowledged by AMAN or the government may exist, especially communities making claims on land that has already been removed from state forestland or on state forestland that has been concessed (Myers et al., 2017a,b).

According to Royo and Wells (2012) the constraints for developing community-based forest management in Indonesia include: (1) the incomplete delineation of state and private/customary claims in forest land and resources; (2) the gap between formal CBFM arrangements and existing best practice; (3) complex and costly administrative procedures; (4) not enough government support; and (5) the inability of CBFM small and medium enterprises to access finance. Hence, the political will of the government, at all levels, in accelerating the development of community-based forest management, is the key. A study of the impediments to and advantages of community involvement in REDD + programs in Kalimantan by Blom (2010), implies that implementation of REDD + needs to consider the requirements of local communities. Hence, one of the challenges in implementing REDD + in Indonesia is how to involve local communities who often have limited access to forest resources. Muttaqin (2012) shows that the engagement of a local community in an emission reduction program through a REDD + program can be realised through community forestry arrangements.

CBFM would be a useful vehicle to implement REDD + at the local level if it fulfils certain required criteria (Agrawal and Angelsen, 2009). Furthermore, Agrawal & Angelsen (2009, p. 201) suggest that factors influencing the success of CBFM in implementing REDD +, include: (1) size and boundaries of forest areas; (2) predictability of benefit flows; (3) tenure arrangements;(4) level of local autonomy, and (5) provisions for monitoring and sanctioning rule violations. An example of this situation can be found in Laman Satong Village Forest in West Kalimantan which has been successfully implement community-based REDD + using Plan Vivo standard (FFI, 2012). As CBFM covers not only common property rights, but also state and private property rights, this concept is useful for analysing tenure arrangements in state forests. Another concept that can be used to analyse tenure arrangements is the theory of access promoted by Ribot and Peluso (2003a,b). By using ‘ability’ to replace ‘right’ Ribot and Peluso, 2003a,b claim that they expand the definition of property.

Even though Ostrom (1990) argues that local institutional arrangements are the most important factor in CBFM, community forest practices are also shaped and influenced by external actors (Schusser et al., 2015). When local institutions are not formally recognised, reforming national forestry legislation is needed to integrate REDD + into CFM (Agrawal, 2007). Another important factor to be considered in the design of REDD + at the community level is the degree of local autonomy in designing rules and institutions (Agrawal and Angelsen, 2009). Thus, the relationship between communities and other stakeholders, especially government agencies, is also important in understanding the context of CBFM.

Knowledge and familiarity of REDD + is also a critical element for communities to gain interest in REDD + and to support it (Howson and Kindon, 2019; Resosudarmo et al., 2012). Similarly, equitable distribution of benefits accruing to communities has also been identified as an important factor to incentivize community engagement in REDD + (Luttrell et al., 2013). The factors leading to the success or failure of REDD +, especially in a community level, include:

1. Power balance and struggle among stakeholders (including communities) (Makatta et al., 2015).
2. Harmonisation among different policy sectors and interests (Fujisaki et al., 2016).
3. Sustainable of forest management (Shrestha et al., 2014)
4. Ability of subnational policies and local projects to consider climate adaptation (McElwee et al., 2017).
5. The technical and political challenges of clarifying land tenure (Loft et al., 2015).
6. Recognition of rights for forest communities (Pelletier et al., 2016).

The article examines local community interests in utilising forest products and services and considers ways to support communities in emission reduction programs. This is done by three major analyses: (1) An examination of communities' needs for forest products and services; (2) An analysis of communities' interests towards REDD + activities in reducing emissions from deforestation and forest degradation activities; and (3) An analysis of the potential of ecosystem services in order to develop plans for the management of ecosystem services, including the

Table 1
Study sites.

Province	Forest Function	Study Sites
Riau	Production	Kepau Jaya Research Forest, Kepau Jaya Village, Kampar District
	Protection	Rumbio Customary Forest, Kampar District
	Conservation	Rantau Bertuah Village adjacent to Sultan Syarif Hasyim Grand Forest Park
Central Kalimantan	Production	Rakumpit Customary Forest, Gunung Mas District
	Protection	Katimpun Village Forest, Kapuas District
	Conservation	Kereng Bangkirai Village adjacent to Sebangau National Park, Palangkaraya City
Papua	Production	Elseng Customary Forest, Kemtuk Sub-District, Jayapura District
	Protection	Yapase Customary Forest, Depapre Sub-District, Jayapura District
	Conservation	Customary Communities of Sereh and Kemiri Villages adjacent to Cycloops Strict Nature Reserve, Jayapura District

reduction of emissions from deforestation and forest degradation.

2. Research methods

The article aims to identify ways to support local communities in utilising and managing forest ecosystem services. It is conducted in the following areas in Indonesia:

1. Riau Province: Kampar, Siak and Pekanbaru Districts
2. Central Kalimantan Province: Palangkaraya, Kapuas, and Gunung Mas Districts
3. Papua Province: Jayapura District.

Research sites were selected to represent the entire range of forest classifications based on Law 41/1999 on Forestry (article 6): conservation, protection, and production forests. Table 1 shows the selected study sites.

Data was collected through focus group discussions with local communities. A focus group discussion (FGD) is useful for obtaining the perceptions of participants in a conducive environment (Krueger, 1988). A focus group is useful to explore the way particular groups of individuals think and talk about phenomena, to generate ideas, and to generate diagnostic information (Stewart and Shamdasani, 1990). FGDs were conducted at the provincial and village levels. A FGD at the provincial level was conducted twice for each location with stakeholders that have significant roles in forest management and climate change such as Provincial and District Governments, Village Governments, NGOs, Community Representatives. The provincial level was selected for the FGDs as Law 23/2014 on Regional Government states that the implementation of government affairs in the forestry sector is shared between the central government and provincial governments. At the village level, FGDs were also conducted twice for each location. The selection of FGD participants at the village level was based on the criteria of the community involved in forest management in each location, both those involved in organizing the forests and those who use the forest resources. To clarify the results of the FGD in each location, we conducted in-depth interviews with community leaders/customary leaders, community assistants (NGOs or universities) and forest management representatives. An in-depth interview is a face-to-face discussion between researcher and key informants to understand the informant's perspective in relation to their experience and knowledge that are stated through their own words (Rahayu, 2008). In-depth interviews were conducted to gather information on communities' initiatives for avoiding deforestation and forest degradation, characteristics of natural resources and communities, history of forest management, and prospects for developing the potential of their natural resources. A total of 128 respondents were interviewed as part of the in-depth interview process.

The data analysis used in this study is thematic analysis (TA). TA is a method for systematically identifying, organizing, and offering insight into themes across a data set (Braun and Clarke, 2006). Primary data from interviews were presented in the form of transcripts which are then sorted by theme, including community motivation in forest management, challenges and potential use of environmental services, interest in participating in REDD+ programs and incentives/institutional options for REDD+ at the community level. Communities' motivation in managing forest resources was assessed against the following criteria: (1) benefits obtained from forests; (2) forms of forest management; (3) efforts in maintaining and sustaining forest resources; and (4) factors motivating communities in conserving forest resources. Communities' interests in participating in REDD+ programs were assessed by experts using the follow criteria: (1) community willingness to manage forest resources; (2) community initiatives in establishing forest management institutions; and (3) development of management plans. Level of participation was evaluated as high if local communities comply with all criteria, medium if they comply with only 2 criteria, and low if only comply with 1 criterion.

3. Communities' motivation in managing forest resources

The study finds that communities perceive forests as having economic potential to support their livelihoods. Even in conservation areas, communities still perceive that forests are a source of both wood and non-timber forest produtcs, despite regulations limiting their use. However, communities also cited non-monetary values as the reason why they want to manage their forests well. Table 2 details the forest products, forest services, and cultural values that motivate communities to manage their forests sustainably.

Various functions of community-managed forests, as illustrated by Table 2, show a strong relationship between communities and forests. The forest is perceived as providing for the needs of daily life. A study in Nepal shows that people view prudent forest management as beneficial for the region and promoting sustainable living (Dev et al., 2003).

Community motivations in the study sites are fostered by existing norms in maintaining natural resources for future generations. Of the three research sites, the role of customary institutions (*adat*) is still strong in Papua, while in other provinces, the behaviour of communities is largely determined by local institutional arrangements or those imposed by the state. Effective community rules to maintain the forests' non-timber values or benefits are a form of social capital that can support initiatives to reduce emissions from deforestation and forest degradation at the community level. A similar situation occurs in Mexico and India where communities are motivated to engage in conservation because of their perceived value of ecosystem services, although it requires maintaining a balance between conservation with development (Allendorf et al., 2013).

Communities living within or surrounding various types of forest area have different priorities in managing forest resources. As explained in Table 3, communities managing conservation forests focus on soil and water conservation, biodiversity protection and reduction of flood and drought risks. Communities surrounding protection forest focus on the utilisation of non-timber forest products and ecosystem services. In production forests, communties are interested in timber utilisation for subsistence and in swidden cultivation. Understanding the different

Table 2
Forest monetary and non-monetary values motivating community forest management.

No.	Location	Monetary Value	Non-Monetary Value
Riau Province			
1.	Kepau Jaya Research Forest, Kepau Jaya Village, Kampar District	Forest stands (*Shorea* sp., *Dyera* sp. & *Alstonia* sp.),	Research site improves human resource capacity
2.	Rumbio Customary Forest, Kampar District	Wood, non-wood forest products, water	Customary value, water source, carbon, carbon, landscape beauty
3.	Rantau Bertuah Village adjacent to Sultan Syarif Hasyim Grand Forest Park	Honey, palm sugar	Landscape beauty
Central Kalimantan Province			
4.	Rakumpit Customary Forest, Gunung Mas District	Ironwood forest, non-wood forest products, wild animals	Indigenous identity, carbon, and water regulator
5.	Katimpun Village Forest, Kapuas District	Gemor (*Notaphoebe coriacea*), Tutup kebali, Pantung, Rattan, Galam, Gandis (rambutan hutan), Nepenthes, wild boars, Deer, Wak-wak, Lizards, Beavers, and honer bears.	Water regulator for peat area, carbon storage potential
6.	Kereng Bangkirai Village, Palangkaraya City (adjacent to Sebangau National Park)	Gemor (*Notaphoebe coriacea*), resin, aloeswood, earth peg, kelanis, *Dyera* sp., fish, and Fir	Landscape beauty
Papua Province			
7.	Elseng Customery Forest, Kemtuk	Wood, Water, *Cendrawasih* bird, hunted animals (wild boars, wood rats)	Water regulator, carbon storage, spiritual values, and indigenous identity
8.	Yapase Customary Forest, Depapre Sub-District	Water, game (e.g., wild boars), *Cendrawasih* bird	Water regulator, landscape beauty, carbon storage, spiritual values, and indigenous identity
9.	Customary Communities of Sereh and Kemiri Villages adjacent to Cycloops Strict Nature Reserve, Jayapura District	Water, *Cenderawasih* bird	Landscape beauty, water regulator, biodiversity potential, spiritual values, and indigenous identity

Table 3
Communities' motivations in managing forests.

Forest function	Motivation
Conservation	- Soil and water conservation - Biodiversity protection - Reduction of flood and drought risks
Protection	- Non-timber forest product and ecosystem service utilisation
Production	- Utilising the area for farming and plantations - Maintaining tradition

communities' interests in utilising forests with various functions is the first step towards identifying ways to support community involvement in emission reduction programs, including through collaborative schemes. Collaborative management approaches between the community, government, and other institutions require a shared commitment and can be used as a strategy to foster sustainable forest management, potentially encouraging community-level participation in REDD+ schemes (Gray et al., 2001; Sample et al., 2006).

4. Potential and constraints in the utilisation of forest ecosystem services

Based on the study of ecosystem services in Asia, van Noordwijk and Leimona (2010) find that a workable ecosystem services utilisation scheme requires addressing livelihood needs, taking into account the interactions of the five forms of capital (human, social, physical, financial, and natural). Furthermore, Jackson and Palmer (2015) suggest that, in designing ecosystem services utilisation schemes, understanding the concept of ecosystem services is necessary to avoid the risks of the commodification of nature. Error! Reference source not found. Summarises the potential and constraints in utilising ecosystem services in the study areas, as identified by respondents.

The case of Riau Province shows the underutilisation of ecosystem services potential and, at the same time, the complexities in utilising this potential. In Kepau Jaya Research Forest, despite the encroachment of nearly the entire area, there is still an opportunity to involve communities in reforesting the area through agroforestry schemes. Currently, activities of the research forest are focused on resolving community encroachment and restoring the forest condition to its designated functions. Researchers from FOERDIA (a research institute under the Ministry of Environment and Forestry) facilitated meetings between the Kepau Jaya Research Forest and the Kepau Jaya communities, with the intention of obtaining the perceptions of the latter on forests and to help resolve conflicts between these two stakeholders. The meetings and discussions were expected to provide the Kepau Jaya communites with the understanding on the importance of forests and in maintaining their functions Three agreements were reached from these activities: (1) FOERDIA Research Institute, together with Kepau Jaya communities, will conserve the remaining 6 ha of forest, (2) Researchers from FOERDIA will facilitate community in management activities and maintain security within the forest research area, (3) FOERDIA Research Institute will provide communities with rubber seedlings to replace oil palm, which will be gradually cleared. Communities chose rubber to replace oil palm because it can grow in peatland.

With its natural springs, pleasant environment, and other natural attractions, Rumbio Customary Forest has the potential for water-based ecosystem services, ecotourism, and carbon sequestration. Within this forest, in Ghimbo Potai block, infrastructure to support tourism, including footpath, shelters, benches, and guardhouses have been built. The potential natural attractions for ecotourism include natural springs and streams, large trees, cool climate, unique species of flora and fauna such as Nephentes, *Durio* sp., *periuk-periuk*, earth peg, and thorned monkey. Within the forest are also non-timber forest products such as resin, rattan, mushrooms, fruits, flowers and medicinal plants. However, the utilisation of ecosystem services in Rumbio Customary Forest faces several constraints. Notably, they are 1) lack of government recognition of the customary forest and 2) the weak role of customary institutions in forest management. Gbedomon et al. (2016) emphasize the importance of locally appropriate institutions for empowering local communities, as well as reducing threats and enhancing forest condition.

SSH Grand Forest Park also has ecotourism potential due to its natural forest, lakes, and Takuana River. The park also has tourism facilities including guest houses, a mosque, jogging tracks, children playgrounds, outbond facilities, and camping grounds. The relative accessibility from the provincial capital is also a major consideration for

visitors. However, there are obstacles to involving communities in ecotourism activities. They include tenurial conflicts, encroachment of oil palm plantations, the park's limited budget, and lack of collaboration with third parties in ecotourism management.

In Central Kalimantan, Rakumpit Customary Forest has significant potential for ecosystem services which include natural springs, carbon, biodiversity (orangutan, monkeys, hornbills and bears), ecotourism, educational tourism, and cultural tourism. However, this potential has not been adequately explored and developed due to the following constraints (1) low human resource quality; (2) limited access to technology and information; (3) incongruent administrative area (Rakumpit customary forest administratively lies within the area of PT Taiyong, a logging company in Gunung Mas District, but the owners of the customary forest reside in Palangkaraya City; and (4) the absence of customary institutions.

The ecosystem service potential in Katimpun Village Forest include water regulation for peatland and carbon storage. Compared to other CBFM sites in this study, Katimpun village is more advanced in terms of the clarity of land ownership and rights to forest area management as the forest has been officially declared a village forest. According to Agrawal and Angelsen (2009), Katimpun Village should be a successful case of CBFM as it has all the factors necessary for successful CBFM. However, the absence of a customary forest management plan undermines the utilisation of this potential. The absence of “champions”, who are able to initiate and develop village forests, has also contributed to the unsuccessful development of CBFM in Katimpun Village. The study has facilitated the preparations of a customary forest management plan through FGD attended by communities, Village Forest managers, and village leaders. The FGD identified that low accessibility to the village forest is an obstacle for communities to manage the Katimpun Forest Village.

The Sebangau National Park in Kereng Bengkirai, established in 2004 and encompassing 568,700 ha, has high potential for the provision of ecosystems services. However, the regulatory framework that defines permitted uses, as well as the park relationship with surrounding communities presents a challenge in developing this potential. The establishment of the park has affected communties' access to forests. According to the park and staff of WWF who support the park, communities are not restricted to enter the area, but they are prohibited from cutting down trees. Some community members, however, complained of the resulting difficulties in obtaining timber to build houses. This has strained the relationship between the park managers and the community.

In Papua, local communities continue to use their Elseng Customary Forest in traditional ways for subsistence, including harversting timber and collecting non-timber forest products (water, firewood, sago, and hunted animals). There is potential for communities to market non-–timber forest products when prices are high, hence improving their livelihoods. The area around Aib village is classified as Production Forest where a timber company is currently conducting logging activities. However, Aib villagers do not take part in these activities. To foster community engagement, the adoption of environmentally-friendly community logging might be an option. The community use of forest is limited to subsistence, and its protection is governed by customary laws. They include the prohibition on felling trees near riverbanks, discarding of waste into rivers, and animals that can be hunted. Currently, Yapase forest is still in good condition and there are very few illegal activities by outsiders. Some villagers, representing the Yapase village, have been trained in forest carbon measurement. Local people realize that their forest has an important role in absorbing air pollution and potentially contribute to address climate change issues. The ability of these indigenous communities to maintain and conserve forests based on their customary rules are evident, consequently the local government has made no effort to mentor them in ecosystem service management.

Sereh and Kemiri villagers living adjacent to Cycloops Strict Nature Reserve are aware of the forest's ecosystem service potential, which include water regulation and high biodiversity. However, some ecosystem service potential such as the aesthetic value of the landscape and carbon storage have not been developed. The reserve, however, is increasingly facing several challenges. Communities from the nearby upland areas have recently begun to encroach and occupy indigenous territories within the Cycloops Nature Reserve and clear forests for plantations. These activities have degraded slopes and reduced the flow of water from rivers and natural springs. Sereh and Kemiri villagers have warned the people involved in clearing the forests. However, the clearing activities have continued. In addition to identification of the potential and constraints of community utilisation of forest ecosystem services, understanding community interests in REDD + is critical to determine how to support their engagement. This is described next.

5. Community interest in REDD +

Communities have different levels of interest in the implementation of REDD +. Community interest in REDD + is influenced by their livelihood characteristics and accessibility to REDD + information. The study identifies that the higher the livelihood dependence on forests, the higher the desired compensation of REDD + activities. This finding is consistent with that of (Komba and Muchapondwa, 2017) in Tanzania where households who harvested forest products demanded a greater compensation for participating in REDD +. After learning of the objectives and incentives provided by the REDD + program, however, their expectations were lowered.

The next issue concerns the distribution of REDD + benefits. Community managed forests in Latin America, Asia, and Africe have experienced issues in regards to the equitable distribution of benefits (Pelletier et al., 2016; McElwee et al., 2017). As a relatively new initiative, REDD + will likely face similar challenges, including in the distribution of carbon-payment benefits (Pelletier et al., 2016).

Communities in our study sites expressed doubts over REDD +, since they still perceive that REDD + will provide money for them as an additional income since they already sustainably manage their forests. However, they showed some motivation to perform activities within the REDD + framework. This motivation is linked to their understanding that the purpose of REDD + is to conserve forests. Communities are beginning to understand the benefits of forests based on their recent experiences with the effects of forest destruction. Communities expect that REDD + will provide them with a higher income compared to their current activities. Appiah et al. (2016) argue that there are trade-offs between improvement of forest-based community livelihoods and conservation, and that conservation initiatives with no immediate livelihood improvement outcomes may not be successful. Furthermore, Appiah et al. (2016) state that in relation to the community's use of forest land, sustainable agriculture and forestry practices prior to REDD + is an important pre-requisite for the successful implementation of REDD +.

According to Ehara et al. (2014), the identification and understanding of forest priorities can assist in planning REDD + activities. Hence, as explained in the methods section, communities' interests in participating in REDD + programs were assessed by experts using the follow criteria: (1) community willingness to manage forest resources; (2) community initiatives in establishing forest management institutions; and (3) development of management plans. The results of the assessment are shown in Table 5.

Table 5 shows that most communities involved in this study are interested in participating in REDD + programs for various reasons. The most attractive attribute of REDD + for communities is the incentives offered by the scheme. However, the Riau case shows that villagers in Kepau Jaya have less interest in REDD + since they are more attracted to oil palm (Table 4). Unlike Kepau Jaya case, however, the customary community of Rumbio are keen to participate in emissions reduction programs since they have a close relationship with forests and are

Table 4
Perceived potential and constraints in utilising ecosystem services in the three study provinces.

Province/type of community	Ecosystem service utilisation	
	Potential	Constraint
Papua/Customary	• Flora and fauna • Forest landscape • Forest carbon aesthetic value of landscape • Natural spring	• Less compliance with customary rules/erosion of customary rules • Illegal hunting • Yapase Forest Protection potential is not yet identified optimally • Land encroachment • Illegal logging • Illegal mining
Central Kalimantan/ Customary + Ordinary	• Water ecosystem servicesForest carbon • Peatland carbon service • Aesthetic values	• Illegal hunting by community • Forest fires • Limited funds • Limited human resources and access to technology and information • Limited or ineffective customary institutions • Illegal logging • Overlapping customary forest and timber concession areas
Riau/Ordinary	• Water ecosystem services • Landscape's aesthetic value • N for nature tourism • Forest carbon services • Non-timber forest product • Certain types of flora and fauna	• Land encroachment • Limited funds • No or ineffective customary institutions in forest monitoring • Market demand and high price of oil palm is more attractive than the value of ecosystem service utilisation

Table 5
Assessment of community interest in REDD + activities.

No.	Location	Level of interest	Criteria
1.	Kepau Jaya Research Forest, Kepau Jaya Village, Kampar Regency	Low	FOERDIA Research Institute, together with Kepau Jaya communities, will maintain 6 ha. However, there are no community institutions or forest management plans.
2.	Kanagarian Rumbio Customary Prohibited Forest, Kampar Regency	High	The community protects the forest through the promulgation of customary law. There is a customary forest management agency and forest management plan.
3.	Rantau Bertuah Village Surrounding Sultan Syarif Hasyim Grand Forest Park	Medium	In order to prevent people outside the village to occupy the GFP, the community formed a group named after "kelompok peduli tahura". However, there are still conflicts over tenure and no forest management plan has been developed yet.
4.	Rakumpit Customary Forest, Gunung Mas Regency	High	The community is willing to conserve the ironwood trees in the customary forest. Customary institution strengthened through the support of Muhamadiyah Palangkaraya University. A forest management plan has been developed with the support of a local NGO.
5.	Katimpun Village Forest, Kapuas Regency	High	Communities want to rehabilitate and benefit from Katimpun Village Forest located in Protection Forests. Community received a village forest permit from MOEF in 2014.
6.	Kereng Bangkirai Village, Palangkaraya Municipality (surrounding Sebangau National Park)	Low	Communities in Kereng Bengkirai prefer to benefit from the tangible value of forests. A community forum was formed to support Sebangau National Park to protect the forests.
7.	Elseng Customary Forest, District of Kemtuk	Medium	The communities want to protect their customary forest, and this initiative is encouraged by a local government regulation (Perdasus). There are also unwritten customary laws.
8.	Yapase Protection Forest, District of Depapre	High	The Yapase customary institution has been recognized by the local government. The customary law is applied to forest management, eg. community members who break customary laws must plant trees.
9.	Customary Community of Kampung Sereh and Kemiri (surrounding Cycloops Nature Reserve)	High	The community want to protect Cycloops Nature Reserve especially from encroachment carried out by migrant communities. There is a customary institution and the head of customary group often involved in the development of forest management plans by the local government.

protecting their forests, both for livelihoods and for cultural reasons. The presence and activities of Pelopor Sehati Foundation, an NGO that advocates sustainable forest management, has also been significant in raising community awareness about emissions reduction programs that center on avoiding deforestation and minimising forest degradation. Similarly, villagers of Rantau Bertuah have shown interest in forest conservation. They established a forum involving concerned villagers, *Forum Masyarakat Peduli Tahura*, to collaborate with the Grand Forest Park management in rehabilitating the degraded forest. However, the unclear status of the village land, whether it is within the forest zone or outside the forest zone, has undermined the collaboration.

In Central Kalimantan, study villages show different levels of interests in REDD + . The Rakumpit Customary Community in Mungku Baru Village shows a strong commitment to protecting forests; this feature reflects the high potential for joining REDD + . The 400 ha of ironwood forest is the pride of the Rakumpit Customary Community given the present scarcity of ironwood. Unfortunately, as a result of the regional administrative sub-division (*pemekaran*), this customary forest is now administratively located in a different district to that where the Rakumpit community currently reside. This has created complex adminstrative and logistical issues. Likewise, the Katimpun Village Forest users also show interest in REDD + since they have prior experience with the past and now defunct REDD + initiative, the Kalimantan Forest Climate Partnership (KFCP) Project. They also have secured legal management and use rights over state forests in the form of a Village Forest permit and have established a Village Forest institution to manage it. However, unlike the two aforementioned sites, villagers of Kereng Bangkirai have doubts about REDD + . These villagers state that the establishment of Sebangau National Park has limited their access to forests. The development of a REDD + project, in their view would be similar to the adjacent national park; it will limit access to forests and hinder their ability to collect NTFPs such as resin and rattan. The community in Kereng Bengkirai village have established a forum called *Forum Masyarakat (Formas)*, which aims to harmonize the aspirations and interests of the community with third parties, especially the Sebangau National Park Office. Some economic empowerment

Table 6
Strategies to Support Communities to Reduce Emissions from Deforestation and Forest Degradation.

Forest Function	Strategy
Conservation	• Strengthening the role of village-level institutions • Establishing partnerships with communities for community empowerment • Promoting forest and land rehabilitation activities • Designing carbon payment schemes from peatland through VCS • Promoting nature tourism • Developing economic/business alternatives for communities
Protection	• Strengthening existing customary forest management institutions • Designing forest carbon service payment schemes through Plan Vivo • Fostering formal recognition of customary forests • Promoting nature tourism • Designing water service utilisation scheme • Increasing public awareness or participation in forest protection • Establishing community groups for managing nature tourism • Allocating funds for ecosystem service utilisation • Designing schemes of peat carbon services through VCS • Fire prevention and management • Canal blocking • Constructing artesian wells • Building guard houses • Rehabilitation and enrichment planting
Production	• Designing cooperation schemes for managing forests with communities using partnership schemes or social forestry • Empowering communities starting with the formation of farmer groups • Establishing agroforestry systems • Preparing forest utilisation-based regulations at village level • Establishing village owned enterprises • Establish self-funded local nurseries • Demarcating customary forest areas • Supporting formal recognnition of customary forests • Establishing forest management institutions • Preparing customary forest management programs • Developing water ecosystem service scheme

activities have been conducted through this *Formas*, including the support and provision of livestock, fish farming, mushroom cultivation, orchid cultivation, training on *purun* grass weaving and rotan craft making.

Similar to the case of Central Kalimantan, in Papua too, community interests in REDD + is contextual. For example, the Elseng Customary Community shows no interest in REDD + . This disinterest is associated with their lack of knowledge about community forest schemes such as Village Forests and Community Plantation Forests. Rather, the community focuses on the government-licensed concession operating within the forests they have customary claims to. In contrast, the Yapase customary community is enthusiastic about activities that reduce emissions from deforestation and forest degradation. They participated in the training given by the Iniative for Low Carbon Development, a multistakeholder program initiated by Jayapura District, to measure and monitor carbon within their forests. They have managed the Yapase Protection Forest in a sustainable way by utilising non-timber forest products. Similarly, communities in Sereh and Kemiri Villages surrounding Cycloops Strict Nature Reserve are dependent on the reserve for their water and are striving to protect it. They cooperate with the Agency of Natural Resource Conservation (*Balai Konservasi Sumberdaya Alam,* BKSDA), and other government and non-government institutions to rehabilitate and patrol the reserve. These communities may not be familiar with REDD + terms, but their attittudes and perspectives in forest conservation based on local wisdom are a significant basis for implementing REDD + in their localities.

6. Supporting communities to reduce emissions from deforestation and forest degradation

The first important step in building a strong foundation for community level, ecosystem service utilisation is identifying supportive community perspectives on forest resources and ecosystem services, biophysical and socio-economic potential, and strengthening institutional arrangements for community-based forest management. Even in cases where communities have a strong relationship with forests, such as Kepau Jaya Research Forest, Sebangau National Park, SSH Grand Forest Park, and Cycloops Strict Nature Reserve, community involvement in forest management needs to be clarified and institutionalised.

Efforts to strengthen the institutional arrangements of Rumbio, Rakumpit, Yapase, and Elseng Customary Forests in Papua and Katimpun Village Forest in Central Kalimntan are an essential first step to develop a systematic utilisation of ecosystem services. Traditional forest management institutions need to be formally recognized, enhanced and strengthened through an inclusive and flexible organisational structure. This type of support can be provided by REDD + schemes. Other forms of support to encourage communities to proactively reduce emissions from deforestation and forest degradation include: (1) facilitating the preparations of management plans for utilising ecosystem services; (2) establishment of business units such as cooperatives and village-owned enterprises (BUMDes); (3) development of marketing infrastructure; (4) support for ecotourism development; and (5) facilitation of monitoring activities and protection from illegal activities. Based on communities' perceptions and the authors' analyses, strategies to support communities to participate in emissions reduction programs are illustrated in Table 6.

Table 6 shows how market and non-market mechanisms can be used to support communities in participating in REDD + programs. Incentives from REDD + can be distributed in the form of carbon credits, which is based on performance measured in terms of the amount of avoided carbon emissions or sequestered carbon compared to a baseline (Jameson, 2014; Pelletier et al., 2016). In addition, according to Pelletier et al. (2016), incentives can take the form of compensation for management inputs that foster sustainable forest management. However, following the Paris Agreement that advances payment-based results, incentive options suggested in this study revolve around carbon outputs or carbon credits. Carbon credits can be applied through carbon market schemes or bilateral or multilateral cooperation. The Paris Agreement encourages Parties to respect, promote and consider the rights of indigenous peoples and local communities when taking action to address climate change (UNFCCC, 2015). Furthermore, the Paris Agreement also specifically addresses the role of REDD + in reducing global emissions through a result-based payment mechanism as stated in Article 5 of the agreement. Hence, the role of REDD + and the involvement of local communities is essential in achieving Paris Agreement. Muttaqin (2012) suggests that the first step in designing community-based PES for REDD + is recognising forest tenure through the development of community-based forest management and the second step is designing payment mechanisms that may require establishing new, or modifying existing, local institutions.

In the carbon market, there are several standards that must be met by the seller/proponent, such as Plan Vivo scheme. The Plan Vivo Standard is a framework which provide community land use and forestry projects that they benefit to communities' livelihoods and protect ecosystems (Plan Vivo Foundation, 2019). This scheme provides certification of emission reduction activities in the forestry sector that ensure improved quality of life of communities living in and around the project. Plan Vivo aims to help communities to access carbon financing as a form of payment for ecosystem services (DNPI, 2013). Among the study sites, the Plan Vivo scheme could be proposed for the customary forests of Rakumpit and Rumbio. Both locations would be eligible for Plan Vivo because the communities have forest management rights and are involved in forest management.

Katimpun Village Forest cannot use this scheme because Plan Vivo is not intended for peatlands. It can, however, follow the VCS (*Verified Carbon Standard*) scheme. VCS is a GHG emission reduction program undertaken voluntarily to obtain certification of emissions reduction levels. Verified Carbon Standard (VCS) or known as Verra (since the beginning of 2012), is a program which set up rules and regulations that all Greenhuse Gas (GHG) emissions reduction programs must follow in order to be certified (Verra, 2018). The development of this standard aims to ensure the credibility of emissions reduction projects by setting rules and regulations. The VCS scheme is considered more modest than the Clean Development Mechanism (CDM) because the transaction costs are cheaper and have added value in the development of the scheme (DNPI, 2013). CDM is a mechanism provided by Article 12 of the Kyoto Protocol, designed to assist developing countries in achieving sustainable development by permitting industrialized countries to finance projects for reducing greenhouse gas emissions in developing countries and receive credit for doing so (Petersen, 2008). In the other study sites where communities have no formal management rights, they can be involved in a REDD+ initiative through a joint partnership scheme with the respective forest managers (concession holders or government forest management units).

7. Conclusions

The study shows that the communities' interests in utilising forest resources are mostly for obtaining monetary benefits, despite restrictions in their extraction as regulated by both customary and state laws. Furthemore, due to differences in permitted activities associated with the types of state-designated forest functions, local people's activities and priorities also vary. However, in three different functions of forests, communities can utilize ecosystem services. Water and the aesthetic values of the landscape are ecosystem services that are commonly utilised by communities. The study found that communities face constraints in managing forest ecosystem services that include: (1) limited funds; (2) lack of skills and knowledge; (3) limited access to resources (especially for those who live surrounding protected areas); and (4) weak institutional arrangements in community-based forest management initiatives. Thus, this impedes their role in reducing emissions from deforestation and forest degradation that can be expected from the utilisation of non-timber forest products and ecosystem services.

Furthermore, the communities' interests in joining programs to reduce emissions from deforestation and forest degradation are diverse, ranging from low to very high. The low interests appear to be associated with the communities' limited understanding of the concept and the intangible benefits of the program. In addition, most of them expect to receive immediate financial rewards by conserving their forests. Communities conserve forests due to different reasons. Customary communities generally perceive forest conservation as a mandate from their ancestors to be passed on to future generations, while non-customary communities view forest resource conservation as an activity specified in regulations that need to be adhered. However, there is a similarity about constraint faced by communities: low capacity in planning and lack of knowledge regarding carbon conservation programs. Hence, strengthening community-level organisational structures and developing robust plans for sustainable management of forest ecosystem services are needed to support communities' in reducing emissions from deforestation and forest degradation.

This study suggests to utilise market mechanisms to finance community-based REDD+ using Plan Vivo and VCS standards. These standards can help communities not only for managing their forests in a better way, but also provide opportunities for communities to obtain result-based payments. However, it is the responsibility of governments, including district, provincial and national governments to facilitate domestic as well as international markets for emission reductions certifcates.

Further research is also needed to quantify and value environmental services in every form of community forest management as conducted in Indonesia-Japan Project for Development of REDD+ Implementation Mechanism (IJ REDD+) activities (Muttaqin et al., 2018). In addition, it is also necessary to review which form of payments for environmental services are appropriate for each type of community studied in the article, similar to the study carried out by Parlinah (2017) in the Jatigede reservoir water catchment area of West Java, Indonesia.

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