Challenges of mangrove management in supporting climate change mitigation policy in East Kalimantan

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Abstract. East Kalimantan Government has set up mangrove programs such as rehabilitation, silvofishery, social forestry and land reform to support its commitment in reducing emission from deforestation and forest degradation. This paper investigates potential challenges in implementation of the programs by exploring local community’s understanding on the role of mangroves in climate change and their acceptance to the mangrove programs. The results are discussed in the context of theories related to community-based natural resources management and property rights. Survey using questionnaires is followed by in-depth interview and it shows that most respondents understand the importance of mangroves in climate change mitigation but are not well informed about the programs. They are also objected to the land reform and social forestry programs because the programs do not provide comparable compensation. This finding is congruent with the theories of property rights and co-management of natural resources. To increase community’s acceptance, legalization of occupied mangrove land, therefore, needs to be followed by other interventions such as awareness raising programs, financial support and market control as extra benefits for the local communities. The central and local governments also need to intensively communicate with the local communities to arrange technical, administrative and political mechanisms in collaborative mangrove management.

1. Background

Mangrove forests are one of four land-based sectors that have been targeted to emission reduction in East Kalimantan. Nevertheless, optimizing mangrove ecosystems to mitigate climate change faces some challenges, particularly socioeconomic aspects since most mangrove ecosystems in Indonesia are significant livelihood sources for local people. As such, for a successful climate change mitigation policy, in addition to ecological purposes of mangrove management needs to meet the requirement of improving livelihood of local community. Sustainable mangrove management in the future needs to be oriented to increase its benefits for surrounding community [1], while [2] disclose that management of ecosystem services needs to go hand in hand with interests and needs of various related actors. Furthermore, mangrove management in East Kalimantan also faces a land tenure issue where several state mangrove forests are claimed as private property by communities. East Kalimantan Government therefore sets up some programs such as rehabilitation, a silvofishery system, social forestry and land subject to agrarian reform or land reform (TORA) in order to develop sustainable community-based
mangrove management that is deemed to be able to reconcile ecological and social economic interests over mangrove ecosystems.

Current regime of mangrove management in Indonesia carried out by the government has yet been successful to achieve a sustainable mangrove ecosystem; this is indicated by large mangrove destruction in the areas where local community rights are less accommodated [3]. They conclude that clarity in incentives and recognition over local community rights to use a mangrove ecosystem would lead to the more sustained mangrove ecosystem. Moreover, some research finds that implementing silvofishery as a program offered to increase economic benefits of mangrove ecosystems while keeping its sustainability is still challenging and contested by local community even though other researches find that silvofishery is advantageous to increase monetary and non monetary benefits of mangrove in the same time. Evidence from the North Coast of Java shows that conventional management of shrimp ponds has led to the continuous decrease in pond productivity [4].

This paper generally aims to explore potential challenges in the implementation of mangrove management-related climate change mitigation policy in East Kalimantan. The potential challenges are investigated by exploring the extent of local community’s understanding on the roles of mangrove in climate change mitigation and local community’s acceptance to the programs offered by the government: rehabilitation, silvofishery, social forestry, and land reform (TORA), as policy instruments of the climate change mitigation. Correlation between the local community’s understanding and the extent of their acceptance to the mangrove programs is analysed using Spearman Correlation Analysis. Community’s understanding is investigated during this survey using questionnaires followed by in depth interview. This survey was carried out in 2018 in Mahakam Delta, the largest area of mangrove ecosystems in East Kalimantan Province. The respondents are selected based on non-probability sampling method. Their understanding is then weighed to determine positive and negative values, afterward it is correlated with their willingness to implement the mangrove programs using Spearman Correlation Analysis with the significance level of 0.05. The results are discussed in the context of theories related to community-based natural resources management and property rights. This combined empirical-context based-approach is aimed to comprehensively observe the challenges in the implementation of climate change mitigation policy.

The main content of this paper is divided into three parts: exploration of the mangrove programs introduced by the government, summary of local community’s understanding and acceptance including the Spearman Correlation analysis, and discussion of the results viewed from relevant theories. A final section provides summarized challenges in implementing climate change mitigation policy, based on the research findings, as a conclusion.

2. Sustainable mangrove management programs

The total area of the mangrove ecosystem within Mahakam Delta that is determined as a KPHP (production forest management unit) under Provincial Forest Service authority which covers 113,553.66 Ha. It is located within three subdistricts: Anggana, Muara Badak, and Muara Jawa. While about 75% of the total area is located in Anggana Subdistrict, more than 50% of the total area has been occupied by local community that develops shrimp ponds as their primary livelihood source. It has hitherto been more than 61,000 ha of mangrove ecosystems in the KPHP area converted into shrimp ponds. Some area has been also converted into dry-land agriculture, plantation, settlement, and mining operation area. Such condition has resulted in complicated socioeconomic and political issues.

Historically, since 1970's the Mahakam Delta has not been granted any forest use permits but for oil and gas mining. Mining concessions have been granted to some mining companies including Japex, Total E&P Indonesia, and Virginia Company (VICO). Land cover of Mahakam Delta brings massive degradation within 21 years, in which by the year of 1997, its land cover was still dominated by mangrove forests, but it was later converted into shrimp ponds that peaked in 2006 to the present [5]. The absence of a forest management unit at the site level in Mahakam Delta for a long time has triggered degradation and conversion of mangrove forests into fish and shrimp ponds, including claims of forest land tenure by community.
Even though since 2010 the number of active shrimp ponds has started to decline due to decrease productivity and high maintenance cost, production of shrimp ponds have continued to significantly contribute to regional economic development in East Kalimantan. The production accounted for 28,977 tonnes by 2017, that is worth around IDR 1.3 Trillion or about 34% of the total revenue from fisheries sector in Kutai Kartanegara Regency as it is presented at Table 1. Those disused ponds are usually re-developed when the price of shrimp rises, coupled with the financial support from investors or middle men. Moreover, the provincial government has targeted development of shrimp ponds as one of the three economically leading sectors that play important roles in regional economic development. It means that the government is most likely to continue supporting the expansion of shrimp pond development.

| No. | Subdistrict     | Household | Total Area (Ha) | Production (ton) | Economic Value (IDR in thousand) |
|-----|-----------------|-----------|-----------------|-----------------|----------------------------------|
| 1   | Samboja         | 1,649     | 932             | 4,114           | 157,734,312                     |
| 2   | Muara Jawa      | 1,298     | 12,036          | 4,336           | 199,081,396                     |
| 3   | Anggana         | 2,298     | 48,449          | 9,364           | 437,778,009                     |
| 4   | Muara Badak     | 1,766     | 14,022          | 5,282           | 236,711,164                     |
| 5   | Marang Kayu     | 843       | 1,234           | 5,881           | 246,042,363                     |
|     | **Total**       | **7,854** | **76,673**      | **28,977**      | **1,277,347,244**               |

Source: Regional Office of Marine Affairs and Fisheries of Kutai Kartanegara [6]
On the other hand, the government has declared its commitment of green development since 2010, and it was further confirmed by 2016 with the declaration of REDD+ programs to mitigate climate change. To reconcile climate change mitigation and economic development purposes, the government has set up various programs of sustainable mangrove management such as silvofishery and mangrove rehabilitation. Since the challenges in mangrove management are not only technical but also social issues, particularly land tenure, the government also introduces land tenure conflict resolution-related programs such as land reform (TORA) and social forestry in order to resolve the issues.

The mangrove rehabilitation program has been introduced since 2000, initiated by Total E&P and a Watershed Management Technical Unit (BPDAS) under Ministry of Forestry that has been merged into Ministry of Environment and Forestry since 2015. Total E&P claims that it has rehabilitated the Mahakam Delta through planting around 1 million mangrove trees per year since 2000. Not only is the rehabilitation carried out in state mangrove forests but also in private mangrove forests. Mangrove rehabilitation has also been carried out by the Ministry of Marine and Fishery Affairs since 2010, focusing on the coastal area under its authority. The data from the Ministry show that around 194,000 mangrove trees have been planted during the year period of 2010-2016. The current most authority over the mangrove ecosystem in the Mahakam Delta, the KPHP that was established in 2011, has started working on intensive rehabilitation by 2015. Mangrove inventory conducted by the KPHP, however, showed that the rehabilitated mangrove area within the KPHP’s delineated area from 2010 to 2015 was only 1,077.6 ha [7].

Silvofishery program has been introduced in the Mahakam Delta since 2007, following the rehabilitation program conducted by Total E&P and Ministry of Marine and Fishery Affairs. However, intensive silvofishery programs started to be introduced by the KPHP since 2015 as part of its strategic work plan. The KPHP has established a 7 ha silvofishery demonstration model in Sepatin Village, but has not worked well due to technical issues. Silvofishery was principally offered to deal with ecological and economic issues faced in mangrove management. Research conducted by [8] discloses that silvofishery in the Mahakam Delta is beneficial for coastal conservation area as well as local community’s livelihood improvement in the Mahakam Delta. However, flexibility in mangrove planting techniques including total area allocated for mangrove trees within shrimp ponds needs to be taken into account, particularly in the early stage of the program implementation to avoid resistance from the farmers [9].

Furthermore, to deal with land tenure issues, the government has offered social forestry programs since 2015 and land reform, so-called Target Objek Reformasi Agraria (TORA) since 2017. The programs shows that the government recognizes local community’s rights over mangrove forests by legitimating occupied state mangrove forests as a private or communal property rights with certain requirements and procedures such as a maximum land rights of 5 ha per household under the TORA program. In the end of 2018, around 64,000 ha of the Mahakam Delta that have become shrimp ponds and settlements are stipulated as the land reform’s object. Nevertheless, the KPHP proposes to reduce the total area of the land reform’s object by excluding the shrimp pond area. As the result, in 2019 the targeted area was limited to only a piece of settlement-converted mangrove forests in the Mahakam Delta. Meanwhile, social forestry was that time introduced through partnership or a co-management scheme between the KPHP and local community, a community forest permit, and a village forest permit. The KPHP has targeted around 30,000 ha of shrimp pond-converted mangroves to be managed collaboratively with the farmers under the partnership scheme. The co-management regime proposes a benefit sharing mechanism between involved community and the KPHP. The involved community are imposed to share their gain from shrimp ponds as much as IDR 5,000 per kilogram of harvested shrimps to the KPHP as the forest management that facilitates silvofishery development.
3. Local community’s understanding on and acceptance to the mangrove programs

During the survey, respondents are confirmed about their understanding on the role of mangrove ecosystems on climate change mitigation and the aforementioned mangrove programs introduced by the government. The survey shows that about 82% of the total respondents understand the role of mangrove in climate change mitigation. They mention that mangrove could reduce surrounding temperature during dry season and become a good habitat for fish and crab nursery. Mass media such as television, radio and internet and forest extension officers play a significant role in raising community’s awareness on the climate change. Meanwhile, the respondents who are aware of the mangrove programs offered by the government, namely mangrove rehabilitation, silvofishery, social forestry and land reform, are only approximately 17%. The respondents, during in depth interview, report that mangrove program outreach activities conducted by the authority were less intensive. When it is confirmed to KPHP officers, it reveals that the outreach activities are only focused on key people such as a head of a community group. It is expected that the key people would be able to be agents of behavioral changes for others. However, it may not be the case, which results in uneven information distribution to all targeted community within the Mahakam Delta area. On the other hand, [10] stresses the importance of awareness raising programs to succeed mangrove rehabilitation in the Mahakam Delta.

Community’s acceptance to the mangrove programs is explored after the community has been informed the procedures of each program. The result shows that around 70% of the respondents object the social forestry and land reform programs, while more than 80% of them accept the rehabilitation and silvofishery programs. Spearman analysis to investigate respondents’ acceptance is correlated with their knowledge on climate change and ecological functions of mangrove ecosystems present insignificant correlation with the correlation value of 0.378. Nevertheless, the respondents require monetary benefits as the condition for their acceptance to the silvofishery and rehabilitation programs, in which they mention that sustainability of their acceptance is dependent on the extent of the programs to increase their income from the mangrove ecosystems. During the in depth interview, some respondents mention that silvofishery techniques introduced by the government is complicated and costly. This is supported by [11] who findS that development of silvofishery requires initial investment and farm clustering. In some cases, application of bio-pesticides as one requirement of silvofishery techniques do not work well to suppress pests and diseases that cause decrease in shrimp production. The respondents who disagree with silvofishery argue that silvofishery techniques introduced by the KPHP decrease pond productivity due to abundant decomposed mangrove leaves and growing pests and diseases. A silvofishery model has been developed by one of a rich farmer in different Subdistricts in Kutai Kartanegara Regency, but it requires high initial investment that becomes a restriction for other farmers. Many farmers within the Mahakam Delta rely on middlemen, so-called the Ponggawa, for their working capital including the market expansion. The ponggawas are usually affiliated with big corporate, exporters of aquaculture products in East Kalimantan.

Furthermore, the respondents accept the rehabilitation program as the current program conducted in abandoned ponds and they are paid as temporary labour. However, inclusion of local community in mangrove rehabilitation activities needs to be more addressed to make sure equitable distribution of mangrove benefits to the community. Some respondents mention that contract management regime in rehabilitation program is in favour to private companies rather than local community. Nevertheless, the increase in shrimp price and financial support from the ponggawa can encourage farmers to re-activate current abandoned ponds that have been rehabilitated. Rehabilitation programs therefore need to consider continuous monetary benefits from mangrove ecosystems to improve local community livelihood.

The land reform and social forestry programs as land tenure-related conflict resolution need to provide comparable compensation for affected local community. Most respondents object a partnership scheme of the social forestry offered by the KPHP as they are imposed to pay round IDR 5,000 non tax state revenue (PNBP) per one kilogram of harvested shrimps as their sharing to the KPHP, the land authority. Most respondents also object the land reform program because most of local
community in the Mahakam Delta occupy more than 5 ha of mangrove land. The respondents perceive that the programs would diminish their income and rights over their mangrove land.

4. Changes in property rights regimes in mangrove management

In addition to unclear property rights, mangrove ecosystems in the Mahakam Delta have been considered as abandoned and unproductive land [12]. This neglectful view creates inappropriate policy in mangrove management and large mangrove destruction, mostly due to conversion into other land uses for more productive purposes such as shrimp ponds and other agricultural activities. To deal with natural resources degradation, many Southeast Asian Countries develop co-management regime to achieve sustainability by involving local community in natural resource management [13-15]. The regime is aimed at empowering and securing local community livelihood and at the same time protecting natural resources [15, 16].

Property rights is one essential factor in sustainable mangrove management [12, 17]. The land reform and social forestry programs are manifestation of the Indonesian Government’s concerning on implementing property rights concept to address land tenure conflict in natural resources (mangrove) management. The programs shift the property regime in mangrove management, from state property to private and communal property. However, the programs have yet implemented the whole concept of property rights, and this is resulting in objections from the local community.

First, “a primary function of property rights is guiding incentives to achieve a greater internalization of externalities. Property rights develop to internalize externalities when the gains of internalization become larger than the cost of internalization” [18]. Property rights is principally beneficial to clearly define who should bear the externality of natural resources management. Property rights, however, will work well if the benefits gained by the rights holders are higher than the externality cost. Shifting state property rights to private or communal property rights over the mangrove land in the Mahakam Delta through the land reform and social forestry programs seems not to generate extra benefits for the local community. On the other hand, it is considered to threaten the local community’s rights over the mangrove land they currently occupy. The land reform and social forestry in the Mahakam Delta are aimed to formalize landownership of the occupied mangrove land for the farmers with small landholdings. Certainty of the land ownership is corrective policy of the government to deal with land tenure-related conflicts and is expected to be able to improve smallholders’ livelihood by widening access to land as a vital economic capital. However, TORA has to be carefully implemented since the forests designated for TORA would be likely to be clearly cut and eliminate essential ecological functions of the forest. Therefore, strict requirements need to be applied to the TORA implementation, particularly for the essential ecosystems like mangroves. In this case, the smallholders granted TORA can be required to apply silvofishery system for their shrimp ponds-converted mangrove land, or plant some mangrove trees around their settlement-converted mangrove land. Moreover, the requirements have to be able to ensure that the TORA beneficiaries will not expand their occupation.

The local community has occupied the mangrove land before the area is determined as state forests under KPHP authority; even their mangrove land ownership has been legalized trough statement letter of controlling state land (Surat pernyataan pengusahaan tanah negara) or a land certificate from National Land Agency (BPN). Most local community has occupied more than 5 ha of the mangrove land. When the land reform program offers legality of the occupied mangrove land of at most 5 ha, and the social forestry program offers a co-management scheme between the community and the KPHP, the local community perceives that they have to relinquish some of their land ownership or share their benefits gained from the land. Local community is willing to share their gain when the benefit generated from partnership or a co-management scheme offered by the KPHP under the social forestry program exceeds their investment cost. This is congruent with Ostrom’s theory in common pool resources management (1990) and a finding of [19]. To succeed the social forestry program, the KPHP is therefore expected to facilitate not only land legality but also financial and marketing support for the local community’s activities in managing the mangrove land, considering that finance and
market are the most restriction faced by the local community. This concords with what is stressed by [20] who concludes that market integration is one of the underlying factors causing natural resources degradation. For this reason, the government needs to intervene in market development for mangrove-related products. In such circumstances, the financial and marketing support would be compensation for the local community for their lost benefits due to sharing mechanism with the KPHP.

Second, empowerment of local people as part of co-management is essential to achieve sustainability of natural resources management by “providing access to the decision-making process at all levels” [21, 22]. Third, a co-management scheme requires the agreement amongst related actors “as to how power is allocated and shared” [23]. All mangrove programs offered by the government in the Mahakam Delta are aimed at empowering local community in mangrove management; however, they miss the key concept of community empowerment that requires equality amongst involved actors in decision making process at all levels and agreement on the power distribution, rules of land use access, as well as structural and administrative mechanisms in managing natural resources. These processes need long intensive communication between the KPHP and the local community. Meanwhile, the current process in implementation of the mangrove programs offered by the government is closed to the form of patron and client, in which local community is positioned as an object of the programs.

5. Conclusion

Even though awareness raising campaign of mangrove programs has not been evenly introduced to the local community in the Mahakam Delta, the programs are potential to support climate change mitigation policy. However, implementation of the mangrove management program in supporting climate change mitigation policy faces some challenges. The local community is most likely to accept the programs if they are supported by continuous assistances, intensive awareness raising programs as well as ecologically and economically successful demonstration silvofishery. In addition, since local community is in favour to implement mangrove management programs for economic reasons, the government needs to facilitate local community’s access to financial support and market. The mangrove management programs need to consider continuous economic benefits from rehabilitated mangrove for the local community, so the community will be encouraged to conserve mangrove ecosystem.

On the other hand, unclear or absence of property rights leads to open access and mangrove forest degradation in Mahakam Delta. However, common or private property rights regime alone is not sufficient to deal with mangrove forest degradation. The local community objects land reform and social forestry programs as they perceive that the mangrove forests that they use for shrimp pond are their own property. The land tenure-related conflict resolution offered by the government has yet provided comparable compensation to the local community. The policy of shifting state property rights into private and common property rights in mangrove management needs to be supported by other relevant policy in accordance with various actors’ interests, such as financial and market interventions. To maintain ecological functions of the occupied mangrove land, changes in mangrove land property rights also need to be followed by strict rules of the sustainable mangrove management system, such as the obligation to practice silvofishery, retaining protective mangrove buffers and restricting conversion of the remaining mangrove forests around the Mahakam delta. Moreover, community based mangrove management as the form of common property rights regime needs to address the rules of land use access, administrative mechanism, decision making processes and structures to manage competing interests of involved actors, which are formulated through intensive communication processes amongst the actors.

References

[1] Sofian, A., et al., Ecosystem services-based mangrove management strategies in Indonesia: a review. AACL Bioflux, 2019. 12(1): p. 151-166.
[2] Luque, S., J. Gonzalez-Redin, and C. Fürst, *Mapping forest ecosystem services in Ecosystem services mapping*, B. Burkhard and J. Maes, Editors. 2017, Pensoft Publishers: Sofia. p. 324-328.

[3] Banjade, M.R., et al., *Governing mangroves: Unique challenges for managing Indonesia’s coastal forests*. 2017, CIFOR: Bogor Indonesia.

[4] Aliah, R.S., *Evaluasi kondisi lingkungan perairan pantai utara Karawang untuk mendukung pengembangan budidaya perikanan*. J. Tek. Ling., 2013. 14(2): p. 67-73.

[5] Aslan, *Novel uses of active and passive remotely sensed data for monitoring spa-tiotemporal dynamics of mangroves*. 2017, Indiana University: Bloomington, Indiana.

[6] Dinas Kelautan dan Perikanan Kutai Kartanegara, *Laporan Tahunan Statistik*. 2014: Kutai Kartanegara.

[7] KPHP Delta Mahakam, *Rencana Pengelolaan Hutan Jangka Panjang (RPHJP) KPHP Delta Mahakam*. 2016: Kutai Kartanegara.

[8] Susilo, H., et al., *The Adoption of Silvofishery System to Restore Mangrove Ecosystems and Its Impact on Farmers’ Income in Mahakam Delta, Indonesia*. J. Fac. Agr., Kyushu Univ, 2018. 63 (2): p. 433-442.

[9] Shilman, M.I., *Kajian penerapan silvofishery untuk rehabilitasi ekosistem mangrove di Desa Dabong Kecamatan Kubu Kabupaten Kubu Raya Provinsi Kalimantan Barat*. 2012, Institut Pertanian Bogor: Bogor.

[10] Susilo, H., Y. TAKAHASHI, and M. YABE, *Evidence for mangrove restoration in the Mahakam Delta, Indonesia, based on households’ willingness to pay*. Journal of Agricultural Science, 2017. 9(3): p. 30-41.

[11] Bosma, R.H., et al., *Shrimp-based livelihoods in mangrove silvo-aquaculture farming systems*. Reviews in Aquaculture, 2014. 6: p. 1-18.

[12] Baten, M.A., *Property rights in mangroves: A case study of the Mahakam Delta, East Kalimantan, Indonesia*. 2009, Stockholm University: Sweden.

[13] Adhikari, K.P. and P. Goldey, *Social Capital and Its “Downside”: The impact on Sustainability of Induced Community-based Organizations in Nepal*. World Development, 2010. 38(2): p. 184-194.

[14] Behera, B., *Explaining the Performance of State-community Joint Forest Management in India*. Ecological Economics, 2009. 69(1): p. 177-185.

[15] Roy, A.K.D., K. Alam, and J. Gow, *Sustainability through an alternative property rights regime for Bangladesh’s mangrove forest*. The Geographical Review, 2013. 103(3): p. 372-389.

[16] Bhattacharya, P., L. Pradhan, and G. Yadav, *Joint Forest Management in India: Experiences of Two Decades*. Resources, Conservation and Recycling, 2010. 54(8): p. 469-480.

[17] Adger, W.N. and C. Luttrell, *Property rights and utilisation of wetlands*. Ecological Economics, 2000. 35: p. 75-89.

[18] Demsetz, H., *Toward a theory of property rights*. The American Economic Review, 1967. 57(2): p. 347-359.

[19] Pomeroy, R.S., B.M. Katon, and I. Harkes, *Conditions affecting the success of fisheries co-management: Lessons from Asia*. Marine Policy, 2001. 25: p. 197-208.

[20] Tucker, C.M., J.C. Randolph, and E. Castellanos, *Institutions, biophysical factors and history: an integrative analysis of private and common property forests in Guatemala and Honduras*. Human Ecology, 2007. 35(3): p. 259-274.

[21] Kant, S., *Economics of sustainable forest management*. Forest Policy and Economics, 2004. 6(3-4): p. 197-203.

[22] Roy, A.K.D., K. Alam, and J. Gow, *A review of the role of property rights and forest policies in the management of the Sundarbans Mangrove Forest in Bangladesh*. Forest Policy and Economics, 2012. 15: p. 46-53.

[23] Carlsson, L. and F. Berkes, *Co-management: Concepts and Methodological Implications*. Journal of Environmental Management, 2005. 75(1): p. 65-76.