XV WORLD FORESTRY CONGRESS
Building a Green, Healthy and Resilient Future with Forests
2–6 May 2022 | Coex, Seoul, Republic of Korea

Social inclusion and utilization of non-timber forest products species variation in ecosystem restoration

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Abstract

In the era of ecosystem restoration, many parties have been participating in the ecosystem restoration in Indonesia. Many restoration activities aim to recreate functional ecosystem of the landscape. In this case, utilization of species variation that produce non-timber forest products (NTFP) can be considered, such as fruit trees, honey bee, stingless bee, mulberry and others. The study of restoration on peatland and lowland ecosystem have been conducted in two areas of Indonesia, namely Riau and South Sulawesi provinces. The restoration was conducted in the research scale in collaboration with villagers. In Kepau Jaya village, apiculture (honey bee and stingless bee) has been promoting to the villagers, while in Donri-donri village, sericulture (cultivation of mulberry and silk worm) has been promoting. Non timber forest products provide multi benefit for the environment and villagers. Social inclusion is a precondition in the success of ecosystem resoration.

Keywords: *Apis cerana*, *Heterotrigona itama*, mulberry, silkworm, rehabilitation

Introduction, scope and main objectives

The UN decade on ecosystem restoration has launched 10 principles of ecosystem restoration, which includes global contribution, broad engagement, continuum of activities, benefit to nature and people, addressing causes of degradation, knowledge integration, measurable goals, local and land/seascape contexts, monitoring and management and policy integration (FAO 2021). The success of forest restoration integrates a number of criteria, such as restore ecological functionality, provide various benefits, involve stakeholders, suit to local conditions, and manage adaptively (WRI 2021). In the local context, action on forest rehabilitation that can reduce the risk of adverse impacts on the surrounding community can be part of ecosystem restoration (Lamb & Gilmour 2003; Jariyah, 2014). Forest rehabilitation activities through the use of non-timber forest products (NTFPs) are one of the alternative solutions because they have multiple benefits in the environments in controlling forest degradation, and supporting human livelihood (Aswandi & Kholibrina 2019; Tata 2019).

Several NTFP plant species have been used in the forest landscape restoration and rehabilitation in Indonesia (Tata 2019). Plant species choices for ecosystem restoration are usually based on criteria of ecology, economic benefit and social aspect. Plant and site matching is an aspect of ecological criteria. Social aspect covers preference of tree by the communities, utilization of plants by the communities as source of food, shelter, fiber, medicine, and other. In addition, tree preference also aims to mitigate conflict in forest management. Economic aspect aims to provide benefit for the communities who are engaged in the forest rehabilitation (Cesar et al. 2021).

In here, we report social inclusion in forest rehabilitation in two different ecosystems in peatlands in Kepau Jaya, Riau province and lowland ecosystem in Donri-donri village of South Sulawesi province. Therefore, plant choices of the two sites were different. The two sites have different social conditions of tenurial conflict. The

similarity of those two sites is using social approach and community engagement in forest rehabilitation to mitigate social conflict and improve livelihood.

The objective of this study is to describe social inclusion in forest rehabilitation and the benefit of use NTFPs, particularly by practicing agroforestry and apiculture (i.e. honey bee and stingless bee cultivations) in Riau, and sericulture (i.e. mulberry cultivation and silkworm) in South Sulawesi, Indonesia.

Methodology

1-Study sites

The study was a research action, which was conducted in two sites, namely Kepau Jaya forest with specific purpose (FWSP) in Riau province, and in Donri-donri sub-district, Soppeng district, South Sulawesi (Fig. 1).

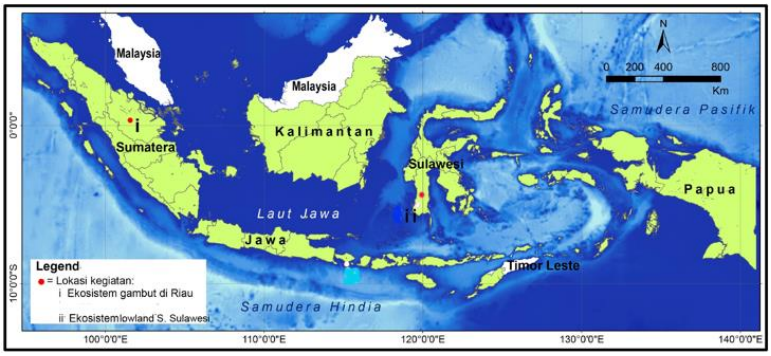

Fig. 1: Study sites. i) Kepau Jaya, Riau province. ii) Donri-donri sub-district, South Sulawesi province

The forest area with specific purpose of Kepau Jaya in Riau province is a peatland ecosystem with peat depth varies between 50 cm to > 400 cm. It covers an area of 1,027 ha, which dominated by Histosols soil. It has a climate type with mean annual rainfalls of 1,180 – 2,768 mm. Mixed lowland forest remains only 6 ha, dominated by *Shorea* spp., *Tristaniopsis merguensis*, and *Macaranga* spp. More than 80% of forest area has been occupied and planted with oil palm since 2000, which caused forest degradation and deforestation (Yunianto and Sutrisno 2019).

Another site is in a lowland of Donri-donri sub-district South Sulawesi. It covers an area of 22,200 ha, at the altitude of 67 m above sea level, with land covers of paddy rice field, estate crops, grass-land and forest. The mean annual rainfall ranging from 0-235 mm (BPS Soppeng Regency 2020).

2-Tree species selection and agroforestry practices

In Kepau Jaya, agroforestry system was applied in the rehabilitation of the FWSPof Kepau Jaya, by planting native plant species (such as *Melaleuca leucadendron* and *Cratoxylum arborescens*), multi-purpose tree species (such as *Melaleuca cajuput, Moringa oleifera, Arenga pinnata,* and *Coffea liberica*), fruits and vegetable crops (such as *Luffa aegyptiaca, Capsicum annum*, and *Cucumis melo*).

Apiculture in the FWSP of Kepau Jaya was conducted in collaboration with the communities who occupied the forest area. Maize and *Xanthostemon* sp. were planted as pollen and nectar sources of honey bee (*Apis cerana*) and stingless bee (*Heterotrigona itama*). The demonstration plot of agroforestry and apiculture was established as a model for community engagement in forest rehabilitation in Kepau Jaya.

Sericulture, a different model of community engagement was developed in Donri-donri village, South Sulawesi province. Sericulture is a production of raw silk by means of raising silk worm and mulberry cultivation, as feed source of silk worm (Sohn 2003). Integration of hybrid mulberry consisted of several species, and cultivated in conventional technique. Varieties of mulberries included conventional *Morus*, such as *Morus nigra, M. multicaulis*, and hybrid *Morus* of M. NI (*M. nigra* x *M. indica*), M. AsI (*M. austarlis* x *M. indica*), and M. KI (*M. khunpai* x *M. indica*).

The planting stocks of mulberry were derived from stem cuttings. The planting stocks were planted in the shrubs area. Manure amount of 2 kg per a planting hole was added as a basic fertilizer. At the age of 9 months after planting, the leaves can be harvested for silkworms' feed.

Results

1-Community engagement and supporting facilities

Since the tenurial conflict occurred in the FWSP of Kepau Jaya in 2000, the rehabilitation forest was not successful. The farmer migrant occupied the forest area and cultivated the land with oil palm. They cut down the planted trees, as they considered the planted trees as a threat to the oil palms. To mitigate tenurial conflict, social approach was then applied, by approaching the village leader and influential people, the community was then involved in forest rehabilitation. A farmer group of 'Tuah Tani Tonggak Negeri' was created. The farmer group got capacity building in agrosilvopasture, beekeeping techniques and honey collecting (Fig. 2a). The farmer group was supported by providing bee colonies of *A. cerana* and *H. itama*.

Bee colonies required good environments for producing high quality and quantity of honey. The awareness of the communities in the importance of forests and good environments slowly increased. In addition, products of vegetable crops from agroforestry practices can be used for daily life and sell for additional income.

In Donri-donri village, local community was involved since the beginning of forest rehabilitation. They involved in planting design, planting mulberry, and maintenance of the plot (Fig. 2b) Hence, they have sense of belonging to the planted mulberries, which increase the people awareness of good environments.

Traditional sericulture in South Sulawesi usually done beneath the slanting house. This resulted low quality of cocoon, because of high humidity and limited fresh air circulation. Supporting facilities in sericulture was needed by the community, to improve quality of cocoon and increase yield. The community was supported with building for sericulture, cultivation rack of silkworm, tools for cocoon, cocoon's drying box with solar panel. The drying box is used to improve the quality of cocoon, so that it has good quality and price.

Fig. 1: Communities engagement in forest rehabilitation. (a) Capacity building in apiculture (*A. cerana*) technique in Riau; (b) sericulture technique (silkworm and mulberry cultivation) in South Sulawesi.

2-The early growth of NTFPs

In Kepau Jaya, forest rehabilitation was consisted of several tree species, which were planted in an agroforestry system. The growth of feed plant: *Xanthostemon* sp. was 1 m at the age of 2 years after planting Fig. 3a). It produces nectar regularly at every season. Honey production from *A. cerana* and *H. itama* was 200 g and 200 ml per colony, respectively. Although this quantity was still low, but it can be increased, by improving the skill of farmers in beekeeping.

The success of sericulture depends on the availability of mulberry leaves and good quality of silkworm. Two hybrids *Morus* of M. NI and M. Asl have high leaves productivity and nutrient content, while M. KI hybrid is resistant to drought (Santoso 2000). The mulberry trees that were planted in the shrubs area could improve land cover (Fig. 3b). The growth and protein content of mulberry is shown in Table 1.

Table 1 showed that leaf production and nutrient content of hybrid Mulberry usually higher than wild species. The leaves can be harvested 4-6 times per year. Every 1-ton leaf production can be used to feed 1-3 boxes of silkworm, while every 1-ton Mulberry leaf may feed 4-6 boxes of silkworm (Rahmatullah 2012).

Table 1: The growth and protein content of several *Morus* species (wild and hybrid) at Donri-donri village

Species	Total height (m)	Leaf number	Leaf production (g)	Protein content (%)
M. Asl	2.5	82	86.1	14.7
M. NI	2.6	99	162.8	14.9
M. KI 34	2.7	112	162.6	13.8
M. KI 41	2.7	124	156.7	14.0
M. multicaulis	1.8	36	178.1	<10
M. nigra	2.1	78	70.4	<10

Mulberry cultivation and sericulture are laborious. However, community earns benefit from sericulture and may improve their livelihood. In addition, this activity reduces their dependency to forest. Sericulture and mulberry cultivation produce silkworm cocoon within 30 days. One box of silkworm contains 25 thousand eggs, which yielded 25-30 kg cocoons. Spinning cocoon into yarn resulted 3-4 kg of silk threads. The farmer may sell cocoon or yarn. The price of cocoon varied from IDR 40,000 to 50,000 per kg; whilst price of silk thread varied between IDR 0.5-0.6 million. The market of cocoon, yarn and silk in South Sulawesi and Indonesia is very promising, as demand of silk threads are increasing.

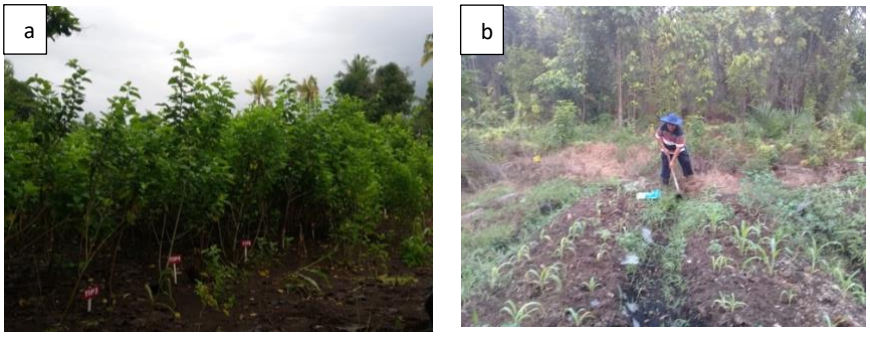

Fig. 3: The growth of NTFPs. (a) Two wild species of *Morus* and 4 *Morus* hybrids as feed plants of silk worm (*Bombyx mori*). (b) Maize and *Xanthostemon* sp. as pollen and nectar sources of beekeeping (*A. cerana* and *H. itama*).

Discussion

In ecosystem restoration and forest rehabilitation, both apiculture and sericulture techniques provide economic benefits for the communities and ecologically friendly. Both techniques used NTFP species, which need good environments to increase their products. In a polluted environment, such as application of pesticide, may reduce the productivity.

Every effort in forest rehabilitation has challenges and opportunities. Introducing a new commodity and technique to the community, such as apiculture (beekeeping) and sericulture (mulberry and silkworm cultivation), may take long process. The community would follow and adopt the new commodity and technique when there is a good example or model and it has good market (Jones-Garcia & Krishna 2021).

The opportunity of application NTFPs is that they can be used and processed as various products. Like stingless bee cultivation, for example, it has unique taste of honey and they also produce high value of propolis. Product diversification resulted form sericulture and apiculture may increase added value of the NTFPs, like for example damage cocoon can be used as cosmetics and handicraft (Andadari and Muin 2019).

Community engagement and capacity building raise the independency of farmers, so that they may improve their livelihood. Empowering the community aims to mitigate social problems (Jariyah 2014). Social inclusion in forest rehabilitation mitigates social conflict, because the community is considered as partner to achieve the common goals of sustainable forest management.

Conclusions

Social inclusion in forest rehabilitation of Kepau Jaya and Donri-donri villages increased the awareness of the communities in the importance of forest and good environments. The improvement of awareness in return raises the environment conditions, which support land productivity and increase productions. The NTFP products from apiculture and sericulture will improve local livelihood. Social inclusion can also mitigate tenurial conflict in the FWSP of Kepau Jaya.

Acknowledgements

This research was financially supported by national research budget (DIPA) of the Forest and Environment Research Development and Innovation Unit of Makasar and The Research & Development Institute of Forest Fiber Technology Kuok.

The views expressed in this information product are those of the author(s) and do not necessarily reflect the views or policies of FAO.

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