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Sustaining farmers livelihoods through community forestry in Sikka, East Nusa Tenggara, Indonesia

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Abstract. *Njurumana GN, Ginoga KL, Octavia D. 2020. Sustaining farmers livelihoods through community forestry in Sikka, East Nusa Tenggara, Indonesia. Biodiversitas 21: 3786-3796.* One of the goals of managing global forest ecosystems today is to synergize their socio-economic, ecological and community livelihood benefits. Each forest type has various socio-economic and ecological characteristics that influence its management strategies and the provision services to the community. In general, the socio-economic benefits of forests in supporting community livelihoods are well known, however, the information which is specifically relevant to tropical monsoon forests is still very limited. This research aims to fill this knowledge gap, by providing information about the socio-economic conditions and provision of services of tropical monsoon forests to people's livelihoods. The research was conducted through structured interviews, FGDs, and field observations, by an analysis unit in community forests in the Sikka district. The information obtained was analyzed through descriptively qualitative and quantitative methods. The results showed an imbalance between the socio-economic conditions of people who rely on the tropical monsoon forest for their livelihoods and the carrying capacity of fuelwood, food, and fodder supply. This imbalance is due to the weak synergy and organization of stakeholders in optimizing how the provision services of forests are used to support farmers' livelihoods. Farmers' dependence on the tropical forest services is still high, therefore the strengthening of farmers' institutions becomes a key factor that determines sustainable management of the forest and enhances the value of its benefits to the community.

Keywords: Fuelwood, food, fodders, tropical monsoon-forest

INTRODUCTION

Enhancing forests based on economic, social, and environmental benefits, including by improving the livelihoods of people who depend on forests, is one of the Global Forest Goals (GFGT, 2019). Forests provide livelihoods to humans, especially among poor village areas in developing countries (Twala 2012; FAO 2015; Rasmussen et al. 2017). These communities are very dependent on the availability of material resources from forests for their daily needs (Babulo et al. 2009; Barbier 2010; Rasmussen et al. 2017; Ali & Rahut 2018; Damania et al. 2020). Forests provide various benefits to the community, including food, animal feed, water, energy, health, and spirituality (MEA 2005; Fisher et al. 2010; Hogarth et al. 2013; Angelsen et al. 2014; Wunder et al. 2014; Lee et al. 2015; Dash et al. 2016; Nepal et al. 2017; Ali and Rahut 2018; Chow 2018; Koffi et al. 2018; Barua et al. 2020; Umaya et al. 2020). Well-managed forest resources are a source of income for rural communities, with an income contribution of 17-45% - at an average of 22% (Vedeld et al. 2007; Babulo et al. 2009; Nielsen et al. 2012; Oli et al. 2016; Angelsen et al. 2014; Ali et al. 2020). Furthermore, sustainable management of forest resources has a role in reducing poverty (Shackleton et al. 2007; Ali and Rahut 2018).

Efforts to reduce poverty around forest areas are required because impoverished areas contribute directly to increased deforestation (Tsujinoa et al. 2016; Miyamoto 2020). FAO (2015) reported that 25% of the world's population rely on forests for their livelihoods, including 48.8 million Indonesians who live in state forests (Wollenberg et al. 2004). 10.2 million of these people are classified as poor (Brown 2004). The existence of communities around forest areas influences the dynamics of forest management policies in Indonesia. Currently, as many as 8,643,228 households live around forest areas, 2.81% of which are practicing shifting cultivation (BPS 2018).

Indonesia has various forest types, one of which is the tropical monsoon forests, which have a wide distribution. This type of forest is a strategic resource in forestry development. The government encourages the development of the forestry sector as one of the solutions to alleviate poverty in communities surrounding the forest. Social forestry policies are carried out through several forest area utilization schemes (Erbaugh 2019; Rakatama and Pandit 2020), one of which is Community Forestry (CF), which aims to provide space for participation of the community in managing forests. Tropical monsoon forest areas are one of the loci used in the development of social forestry, but there is no specific information on the carrying capacity of these areas in relation to community's livelihoods. This is needed because there are 2,308 (70.58%) poor villages inside and around the forests in East Nusa Tenggara (NTT) province. Many of these communities are experiencing socio-economic limitations, as indicated by the fact that

59% have low per capita expenditure and 78% have low education levels (BPS 2016).

Tropical monsoon forests have a high ecological vulnerability due to the pressures of climate change and fires, and require great efforts to be restored (Hamilton et al. 2020). Forest destruction has implications for the loss of potential income and the cost needed to rehabilitate those who lose their livelihoods (Barua et al. 2020). On the other hand, the value of traditional forest usage for communities is estimated at only 1.36% of the total value of forest ecosystem services (Kibria et al. 2017). Forest characteristics affect the value of the forest ecosystem services produced, and information about them is still very limited and thus has not yet aided in the formulation of specific management policies. This has led to research on tropical monsoon forests that are managed as sites for the development of social forestry. The important question in this research is what is the socio-economic reality of the people who depend on tropical monsoon forests, and how valuable are the benefits of providing forest services?. This question led in this study to an analysis of the socio-economic conditions of the village, the quality of human resources, income and expenditure of farmers, community perceptions, and the management and use of forests for fuelwood, food, and animal feed by farmers in Tuartana CF, Sikka District.

MATERIALS AND METHODS

Study area

Tuartana CF is located in Hikong Village, Talibura Subdistrict, Sikka District, East Nusa Tenggara Province, Indonesia (Figure 1). CF covers an area of 246.88 ha (2.07%) of the total IUPHKm (Community Forest Utilization Permit) in the Sikka District, which covers an area of 16,775 ha. The entire area of Tuartana CF lies in the protected forest area of Wukuh Lewoloroh RTK 126, at latitude 08^0 30 '47 " - 08^0 32' 58" South and 122^0 38 '10 " - 122^0 40' 16" East, at an elevation of 500-975 m above sea level. This area has undergone degradation, with open land cover measuring 35.83% of the total area, high-density vegetation cover measuring 34.68%, and low-density vegetation cover measuring 29.48% (RKU 2017). The CF area, which is covered by fields and low-density vegetation, is used as farmland by 227 households involved in managing CF. This community involvement is expected to help encourage improved management and forest cover. The area with high-density vegetation cover is maintained as a biophysical protected area. Soil types at this location consisted of humic cambisol, covering 192.50 ha (55%) and district cambisol, covering 154.38 ha (45%). Based on topographic studies, an area of 132.54 ha (38%) consisted of steeply sloping land, 107.32 ha (31%) consisted of slightly steep land, 80.13 ha (23%) consisted of flat land 26.68 ha (8%) was classified as very steep (RKU 2017).

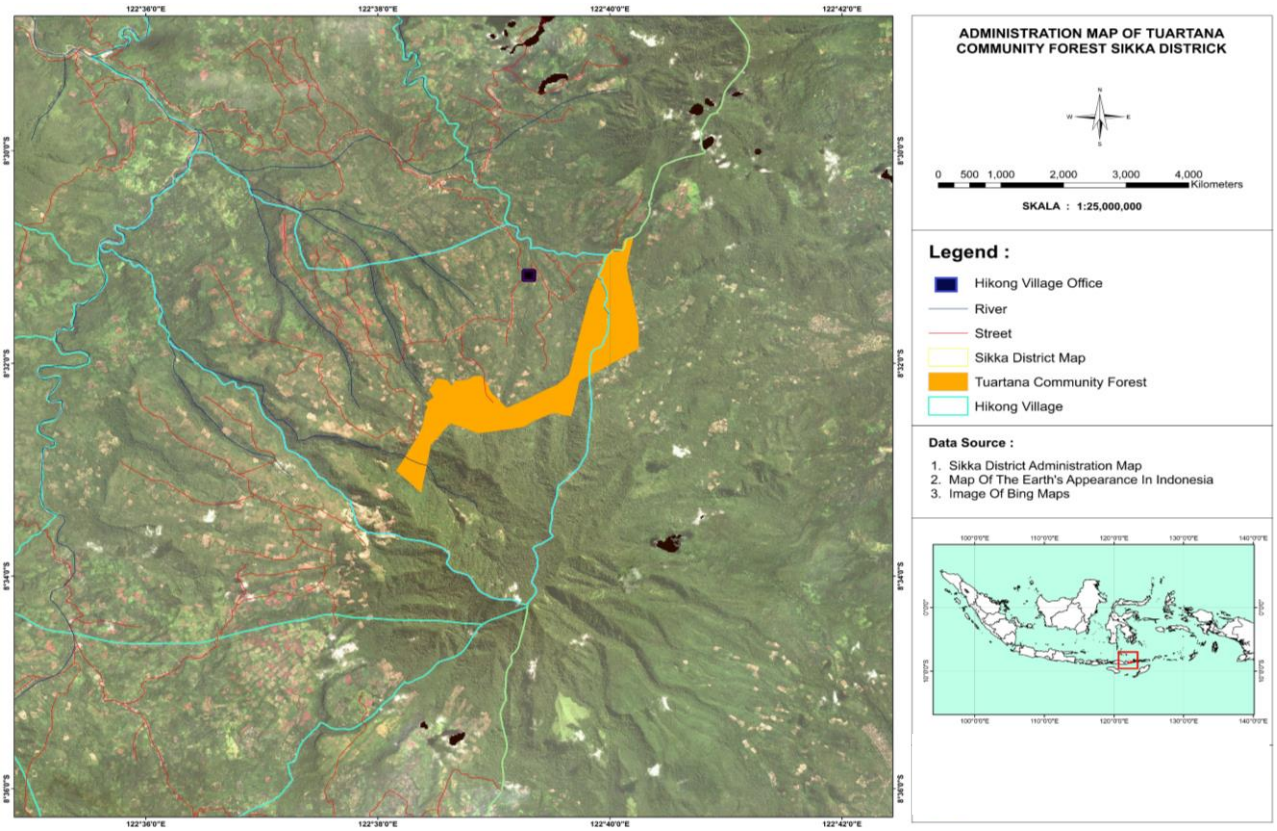

Figure 1. Tuartana community forest in Sikka District, East Nusa Tenggara, Indonesia

Procedures

The research in this study consisted of 3 main activities. Firstly, we collected secondary data from government institutions, in the form of Hikong Village Statistics, Sikka District Statistics, Sikka Forest Management Unit (FMU) statistics, and NTT Province statistics. Secondary data collection was carried out to analyze the socio-economic conditions of the community, including the number of households involved in CF, land productivity, processing, and income per capita. Furthermore, we collected primary data from farmers in the village. This was conducted to determine the socio-economic conditions of farmers involved in managing CF. Data and information collected included management initiation, area of arable land, the usage of firewood, food, animal feed, the accessibility to forest areas, and the income and expenditure per capita. We also carried out a community survey on several aspects relevant to managing CF. Thirdly, we conducted field observations on 21 units of farmland samples in CF locations, spread over 3 management blocks. These field observations were intended to confirm the data and information obtained during the interview at each farmer's house.

The respondents in this study were members of the Tuartana CF farmer group. Socio-economic data collection was carried out on a sample of farmer households involved in managing CF. Determination of respondents was carried out in phases with a simple random sampling method. The sample of farmers was 35 households (15%) out of 227 households involved in managing CF, including 10 (4%) as representatives of households led by women. Determination of the criteria of respondents refers to several criteria that were used in the selection of respondents (Njurumana et al. 2014; Njurumana 2016). Surveys and interviews were carried out in parallel at farmhouses, discussing with the head of the household together with family members. In addition, we conducted in-depth interviews and focus group discussions (FGDs) with the leaders of the CF farmer groups, traditional leaders, and other farmer group members. In a cultural sense, the interview approach of collecting this data within the village can be very beneficial. The traditions of the local community prioritize friendship, to ensure that emotional relationships with farmers and their families are maintained. Therefore, collecting data directly within the village means that the information obtained is more detailed, and bridges the limitations of farmers in terms of literacy. The researchers were directly involved in the collection of data and were assisted by staff from the Sikka FMU and management from the CF farmer group.

Data analysis

Data and information analysis were carried out qualitatively on socio-economic aspects, education and farmers' perceptions of managing CF, household income, and on the analysis of the forest resource value contributions to the livelihoods of CF farmers.

RESULTS AND DISCUSSION

Socio-economic conditions

Description of Hikong Village residents

Hikong Village is one of 2,308 villages around the forest area in NTT, and has a population of 2,196 people spread over 504 households. Dryland farming, which includes activities such as collecting forest products and conventional livestock farming, is the main source of income for 95% of households in the village. The number of people working in the dryland agriculture sector is higher than the average for households who work in this sector in the Sikka district 65% (BPS 2015), and NTT province 61% (BPS 2016). In general, the farming system carried out is still conventional, with limited financial input, knowledge, expertise, skills, and land area.

Land is one of the main factors affecting production in dryland farming. The size of farmland managed by farmers is still limited by conventional management. This is proven by as many as 97% of households owning farmland in the area range of 0.1-0.2 ha/HH or 0.025-0.05 ha/capita, which is below the average minimum requirement for subsistence farming (Susilowati and Maulana 2012). Low land production means that the welfare of farmers has not undergone significant changes. Farmers experience multidimensional limitations, including low value land assets, limited education and a lack of farming innovation. Therefore, this has an impact on land management and productivity, as well as the economic resilience of farmers, which contributes to increasing poverty levels. As many as 2,186 people (99.54%) in Hikong Village were described as living in poverty. Low land productivity also has implications for food security, meaning as many as 305 households (60.51%) are recipients of poor rice (*Raskin*) assistance from the government. The largest pre-prosperity (*pra-sejahtera*) group is women, with 1,272 people (58%). They can become very vulnerable if the management of forest resources is not carried out sustainably.

CF farmers belong to economically vulnerable groups, with 227 families from pre-prosperity families using forest land for dryland farming. Additional farmland through CF has not increased productivity, meaning there is no significant difference in socio-economic conditions between farmers involved or uninvolved in the CF program. The main obstacle is that additional farmland through CF has not been followed by facilitation activities for more professional management. The farming patterns applied are still conventional, whereas the accompaniment and extension activities from government institutions has not been provided.

Farmers have not yet become involved in the management of Non-Timber Forest Products (NTFPs) on CF land. Generally, they play a dual role as farmers, collectors of forest products and breeders, meaning farmers' welfare has not experienced significant changes. The welfare indicator was approved by Hikong Village statistics, which reported 498 households (99%) inhabited very simple houses with walls made of woven bamboo. Furthermore, as many as 297 households (58.92%)

inhabited community houses with cement floors. Both of these figures are higher than the average value for the Sikka district and NTT provinces (BPS 2015). The socio-economic condition of these farmers is an illustration of the general state of community poverty in the villages around and within the forest area in NTT.

General description of Tuartana Community Forestry

The legality of managing CF is influenced by Minister of Forestry Decree No.388/Menhut-II/2010, which regulates the establishment of Egon Ilimedo and Wukoh Lewoloroh protection forest areas covering an area of 16,755 ha as CF working areas. Subsequently, the forest utilization permit (IUPHKm) from the Sikka District Head No.: 127/HK/2012 covering an area of 346.88 ha was divided into three management blocks, namely Hikong, Natargahar, and Natarmude. Each management block is dominated by steep and very steep land topography, meaning caution is needed in its management so that damage is not caused. Utilization of land for food crop cultivation requires the addition of soil and water conservation inputs to mitigate surface damage. Steep topography conditions limit the accessibility of farm roads and the mobilization of produce from CF land. Therefore, the mobilization of produce is very dependent on manual human labor, with the distance to the farmers' settlements often being the furthest that product is able to be moved. This condition needs to be addressed by stakeholders to strengthen integrated multi-sector coordination in intervening land use planning and supporting infrastructure. Local governments need to pay special attention to building synergy in unraveling biophysical constraints that have a direct impact on reducing the production capacity and community income from CF land farming.

Human resources

Poverty of CF farmers is a reflection of their limited access to formal education. The level of formal education varies, with as many as 74% reaching primary school level, 15% reaching junior high school level, and 11% reaching senior high school level (Hikong Village Profile 2017). Communities around forest areas have difficulty in accessing educational institutions, including opportunities to attend training and teaching. This results in a great difference between education levels in village areas and education averages at district and provincial levels (BPS 2016). Quality of human resources involved in managing CF is one of the challenges in optimizing forest management and community economic development. Limited knowledge of farmers has a direct implication on their weak bargaining power during negotiations on management, utilization, product diversification, and marketing. Therefore, giving access to land use through CF needs to be supported in a structured and sustainable way, with the input of training and infrastructure programs. Empowerment of CF farmers becomes a deciding factor in managing and utilizing forest resources efficiently, effectively, and competitively to support forest management goals.

Income and expenditure

The income and expenditure of farmers are an output of their ability to produce goods and services. The low ability of farmers to do this has implications for development in the management of potential forest resources, product diversification, and marketing networks. This limitation contributes to the low income per capita of farmers, with an average of IDR. 276,950/month. This value is lower than the poverty line threshold in NTT province of IDR 401,220/month (BPS 2018). In general, the level of welfare of farmers is still below the average poverty threshold at both local, national, and global levels.

Household expenditure is one welfare indicator that is influenced by the value of income. The average farmer's per capita expenditure is IDR 150,550/month, far lower than the average from the Sikka district of IDR 634,800/month, and the average from NTT province of IDR 681,450/month (BPS 2018). The main purpose of farmers' expenditure is to buy basic necessities such as food. To reduce food expenditure, one of the strategies carried out by farmers is to enrich the CF land with food sources such as paddy fields and tubers. These efforts have not yet been followed by management innovations, meaning land productivity is still low, and this has encouraged farmers to source food from outside the village.

Limited accessibility to farmland affects farmers' income and expenditure. The potential from forest resources on CF land is sufficiently available, but it is constrained by the low accessibility for the mobilization of produce, meaning it has not yet made a real contribution to increasing farmers' income and expenditure. Therefore, mobility of farming produce from production sources to human settlements depends on the strength of the farmers. In addition, some commodities have high costs and are perishable during transportation over long distances to trade centers. This means that a number of key commodities produced such as candlenut, tamarind, cashew, pineapple, and cassava have not provided significant increases to farmers' incomes.

The low income and expenditure per capita of farmers gives an indication of the high poverty rate of the people living around the forest. The high potential of forest resources does not guarantee an increase in community welfare, as long as collaboration across sectors is still low. Poverty in CF farmers is a reflection of the poor synergy and collaboration of stakeholders in helping farmers to manage the potential of forest resources. The role of the local government is needed, especially for empowerment and for offering community assistance programs. Decree of NTT Governor No. 404/KEP/HK/2018 concerning superior NTFPs is expected to be an entry point for parties to collaborate and encourage integrated cultivation programs in forest areas. This regulation encourages farmer group partnerships with BUMDes (Village-Owned Enterprises), BUMD (Regional-Owned Enterprises), and other strategic partners to improve the development of superior commodities such as cashew, tamarind, candlenut, areca nut and betel in Sikka (Njurumana and Octavia 2020).

Community perception

There is a deepening understanding among villages of the CF importance value, therefore the support of infrastructure is carried out together with farmers. Farmers' perceptions of CF characteristics are grouped into 5 (five) categories; very unimportant, unimportant, slightly important, important, and very important. Based on these categories, as many as 78% of farmers recognize that CF permits are very important and 22% recognize that permits are important in supporting the availability of farmland for communities. Farmers realize that the existence of CF has direct benefits as a source of food, fuelwood, animal feed, medicinal plants, and NTFPs. This awareness provides an opportunity to synergize community empowerment programs with forest conservation, especially in regards to building strong partnerships with village institutions to support the active participation of farmers in the rehabilitation and conservation of forest areas. One example of this strategy is the development of superior NTFPs. Farmers recognize and appreciate that village institutions have a strategic role in encouraging the management and use of CF. Surveying of farmer perceptions showed that 56% stated that the role of village institutions is slightly important, 41% stated that it was important and 4% of farmers stated that it was very important. Village institutions play a role in encouraging and facilitating the participation of farmers in the management and utilization of CF land, which can help with conflict mitigation that might occur among farmer groups.

Poor conditions occur in terms of infrastructure and accessibility to trade centers, extension institutions, financial institutions, and transportation. The majority of farmers (52%) stated that access to these institutions was classified as very low (bad), with 48% stating that it was low. These perceptions are in line with the facts, with the majority of areas suffering from limited and high-cost transportation facilities, particularly in farm areas that are further from the village. This condition needs to become a focus of policymakers to provide service solutions to the community around CF locations. In addition, it is necessary to strengthen village institutions as facilitators to encourage regular meetings between CF farmers and partner institutions such as BUMDes and cooperatives. This will help to build cooperation in overcoming technical obstacles in the distribution and marketing of CF products.

The socio-economic reality of the community is an important input that needs attention in forest management. Optimizing the management of forest resources for poverty reduction is determined by the quality of human resources. Forest resource management is expected to play a role in reducing poverty, which is a major challenge for the global community today, making it the first priority for the SDGs (Liu and Li 2017; Malerba 2020; Xu et al. 2020). Poverty has a multidimensional impact, with one effect being an increase in the rate of deforestation, which can result in further economic losses (Yamamoto et al. 2019; Miyamoto 2020; Phimmavonga and Keenan 2020; Edwards et al. 2020). Degraded forests will limit the choice of potential livelihoods, especially in terms of the materials and benefits provided by the forest (Nerfa et al. 2020; Ahmed and Gasparatos 2020). Conservation efforts and community access to biodiversity around forests can facilitate welfare improvements (Ali and Rahut 2018; Mammides 2020; Miller and Hajjar 2020). Therefore, it is important that the economic value of land managed by farmers in various forest use schemes is considered as an investment, because forest land is of strategic value as a trigger for economic empowerment (Nielsen et al. 2012) and the fulfillment of basic needs and community welfare (Sewel et al. 2020).

Management and utilization of community forestry

Management of community forestry

Management is a systematic effort to achieve a goal. The determining factor for achieving management objectives is the availability of strategies and program input (Ekawati et al. 2018). The management of CF is not yet optimal due to the lack of knowledge, technology, information, and institutional input of farmers. Innovations in the use of farmland such as spatial planning for food crop cultivation and long-life plants for NTFPs have not been properly managed. This means the landscape is dominated by only a few plant species, one of which is candlenut (*Aleurites moluccana* L. Willd), which covers 65% of CF management area (RKU 2017). The irregular structure and composition of plants have implications for the availability of nutrients for plant growth. Only plant species that are able to adapt will get optimal benefits to support their production, while other plants will be unable to grow. This has led to a decline in the productivity of food crops and fruits in recent years in the community. Therefore, assistance is needed for the spatial use of land and crop regeneration, including the possibility of increasing the arable land area available to farmers who have succeeded in carrying out rehabilitation and reforestation on critical CF land.

Appropriate spatial arrangement and land additions are needed because the area of CF land managed by farmers tends to remain stable, while the number of CF farmer family members tends to increase by 0.3%/year (BPS 2015). Therefore, social problems are likely to appear because the average area of farmland is only available at 0.3 ha/capita, which is not enough to sustain a growing population. This problem requires serious assistance, with the aim of intensifying management to increase land productivity, while avoiding the expansion of plantation land into protected forest areas. Limited land area has also increased urbanization, encouraging young people in villages to find work in urban areas, the service sector, and to work abroad.

The management of CF aims to guarantee the sustainability of forest resources through community empowerment. Exactly how community participation will change in the future is an important question in managing CF. Farmer participation through reforestation of NTFP species has led to an increase in forest cover, and the development of NTFP commodities has implications for increasing the number of commodities available as a source of income for farmers. This behavior will maintain the balance of forest management benefits and their impact on

improving farmers' livelihoods, so that the effect of forest benefits on poverty alleviation can be increased. Efforts to improve the benefits of forests to communities require concrete action, because many cases show that even though the potential for providing forest resources is high, it is not yet directly proportional to efforts to improve community welfare (Fischer et al. 2008; Pearce 2011; Kangalawe and Noe 2012). This is due to the fact that the basis for spatial planning of forest management has not been optimal and the ability of farmers to diversify and increase the value of forest products is still low. Action is needed to encourage species that help to improve conservation strategies, increase land cover, and improve community welfare, and this represents one of the long-term management solutions for CF.

The intensification of NTFP commodities has been started by some farmers managing CF. The main obstacle to this is the limited area of farmland, which means that the planting of NTFPs and food plants cannot be done in large quantities. Farmers plant in the rainy season, with an intensity of 2 times/year. The average planting activity is 21 trees for NTFP commodities, and 46 trees for food commodities. NTFPs include candlenut (*Aleurites moluccana* L. Willd 1805) and cashew (*Anacardium occidentale* L.). Food crops include cassava (*Manihot esculenta* Crantz), sweet potato (*Ipomoea batatas* L.), suweg (*Amorphophallus campanulatus* BI), gembili (*Dioscorea esculenta* L.), avocado (*Persea americana* L.) and banana (*Musa paradisiaca* L.). Planting activities are adjusted to the availability of growing space, the availability of plant seeds, and the opportunities different plants offer for enrichment and replanting. For example, the planting of key cultural species such as areca nut (*Areca catechu* L.) and betel (*Piper betle* L.) increases biodiversity while also providing benefits to the community (Njurumana et al. 2014; Njurumana 2016; Njurumana 2019; Njurumana and Octavia 2020). Ekawati et al. (2018) said that a management policy must represent 3 (three) key elements, namely goals, strategies to achieve these goals, and operational inputs to drive the strategy. CF management policies have not yet fully implemented policy instruments that support management objectives. The main obstacle to this lies in the availability of inputs to support management strategies, such as Business Work Plans (RKU) and Annual Work Plans (RKT), which were only available at the end of 2017, meaning field assistance activities only started in 2018.

Utilization of community forestry

There are various benefits to providing services from the forest to support people's lives, especially in the availability of resources used as a source of fuelwood, food, and animal feed. Providing CF services to the community is very important in building household resilience and reducing expenditure per capita.

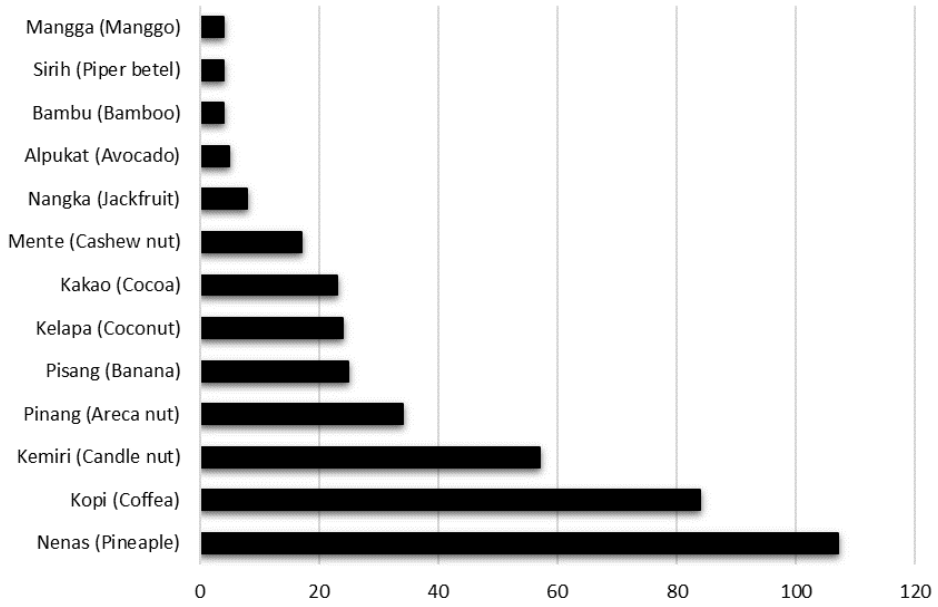

Figure 2. Averages number of trees as main commodity on Tuartana Community Forestry area (unit land management)

Provision of fuelwood

Fuelwood is a basic requirement of village communities (Jose 2012; Lee et al. 2015), as proven by the fact that all Hikong Villagers use wood for fuel. At a provincial level, fuelwood usage is carried out by 68.42% of people and in Indonesia, as a whole, the figure is 32.23% (BPS 2012). CF areas are a key source of fuelwood, with 74% of households using it, at an average contribution of 49% to household needs. This is lower than the contribution of Mutis Protected Forest, which reaches 87.45% (Dako et al. 2018). The average consumption of fuelwood in farmer households is 1.68 m^3/capita/year, and the contribution of CF is 0.54 m^3/capita / year. Overall, CF contributed to meeting the demand for as much as 460.08 m^3/year. The fuelwood used by farmers originates mostly from excess wood or fallen tree branches. Cutting down species of kaliandra (*Calliandra calothyrsus* Meissn), gamal (*Gliricidea* sp.), lamtoro (*Leucaena leucocephala* (Lam.) De Wit.) and bamboo (*Bambusa* sp.) in the CF location was mostly due to the regulation of growing space and the need for fuelwood. Fuelwood is used for carrying out various activities in CF locations, or for increasing fuel stocks in house yards and gardens.

Improving access to CF has given legitimacy to the use of fuelwood in the community, while management regulations ensure that usage is more selective, efficient, and effective. This regulation controls the balance between fuelwood fulfillment for poor people (Yang et al. 2020) *with* the fulfillment of global responsibilities of increasing forest cover, reducing gas emissions and storing carbon (Lecocg et al. 2011). This highlights the need to cultivate species of fuelwood producers with high calorific values, while also setting utilization quotas and guaranteeing legal certainty for violations (Jumbe and Angelsen 2011; Caurla et al. 2013). Therefore, plantation of high economic value NTFP commodities needs to be increased, as a substitute for community income sources derived from the sale of fuelwood (Mukul 2016; Uprety et al. 2016; Hussain et al. 2019). This mechanism helps protect high conservation value wood species not used as fuelwood, so they can support carbon sequestration and climate change mitigation (Kongsager and Corbera 2015; Jasaw et al. 2017; Tamang et al. 2019; Aggarwal and Brockington 2020).

Provision of food

Food from the cassava family and fruits are two of the main services from the forest that are utilized by the community. Several species of cultivated sweet potatoes have high nutrition and calories, including the cassava (*Manihot esculenta* Crantz) with a nutritional value of 146 calories and 34.7 grams of carbohydrate/100 grams (Suprapti 2005), sweet potatoes (*Ipomoea batatas* L.) with 135 calories and 31.8 grams of carbohydrates/100 grams (Juanda and Cahyono 2000), taro (*Colocasia esculenta* (L.) Schott) with a nutritional value of 120 calories and 28.2 grams of carbohydrate/100 grams, suweg (*A. campanulatus* BI) with 120 calories and 28.2 grams of carbohydrate/100 gram (Slamet and Tarkotjo 1980), and gembili (*Dioscorea esculenta* L.) with 470 calories/100 gram (French 2006). The production of several cassava species contributes 48% of the food consumed by CF farmers. Farmers' families consume 6.52 kg/capita/month, and CF contributes 2.46 kg/capita/month (37.69%). Overall, CF production contributes as much as 25,151 kg/year to the food needs of farmers' families. The main contributor was cassava, which contributed 41.39%, sweet potato contributed 31.73% and taro contributed 26.78%.

Food sources from fruits come from banana (*Musa paradisiaca*), pineapple (*Ananas comosus* (L.) Merr), coconut (*Cocos nucifera*), mango (*Mangifera indica* L.) and jackfruit (*Artocarpus integra*). Pineapple is one of the main commodities cultivated by farmers, with a potential of 10-150 clumps/household. Pineapple production is quite high, but it is constrained by marketing - only 15-30% of the total production can be marketed and often sells at low prices. Food production from other fruit groups has not been measured by farmers, because populations of long-tailed ape pests (*Macaca fascicularis* Raffles, 1821) are very high. These pests contribute to reducing the potential for food and fruit harvests, thereby affecting the value of their benefits to farmers.

Overall, the role of forest ecosystems in providing food for humans, both on a local and large scale cannot be ignored. Various forest management schemes within the community prove that forest provision services have a strong relationship with village livelihoods. Parajuli et al. (2015) proved that the development of food crops under shade of forest plants had an impact on improving the welfare of 450 million people in Asia. This illustrates that the food insecurity that occurs has a strong relationship with the rate of deforestation, and requires a strong strategy to synergize forest conservation efforts and increase food security (Paudel 2018; Andrieu et al. 2019), including the development of functional food plant species in an environmentally friendly way (Bahar et al. 2020). Furthermore, forest protection will have implications for the sustainability of ecosystem services that support food productivity (Vira et al. 2015; Sunderland et al. 2019; Mutaqin et al. 2020) and will encourage the many benefits forests provide to humans and the environment.

Provision of animal feed

Livestock is a significant economic asset for village communities, and are used for money, socio-cultural and religious affairs. All CF farmers acknowledged that they have and are currently raising livestock such as pigs and goats, and need a continuous supply of animal feed. CF land is a relatively high source of feed material, with 74% of farmers utilizing forest areas to meet the average animal feed requirement of 129.63 kg/month. Of this figure, CF land contributes 56.80 kg (43.82%). Overall, the management of CF land contributes directly to feed supplies of at least 107,434 kg/year. Animal feed production supports farmer incomes and ensures that livestock receive a sufficient amount of food, so that growth is normal, ensuring communities can participate in socio-cultural activities such as traditional rituals. Improved accessibility in the future will have a positive impact on increasing the production of animal feed in CF, along with increasing the development of feed-in gardens

and house yards, reducing the dependence on forests and supporting biodiversity conservation (Tamang et al. 2019). Through adequate technological input support, it is expected that the cultivation of animal feed on CF land, gardens and yards will promote land conservation, erosion control and soil fertility (Hoogmoed et al. 2012; Franzel et al. 2014; Das et al. 2016; Giday et al. 2018; Ahammada et al. 2019). Management of growing areas is needed to regulate the zonation balance of animal feed development with the demand for human food crops. This needs to take into account the sustainability of the forest ecosystem (Lusiana et al. 2012; Hoogmoed et al. 2012), while also avoiding weeds that adversely affect animal feed management (Khana et al. 2014).

The main finding of this research is that there is a correlation between institutional functions and social organizing in supporting the achievement of CF management objectives at a community level. Institutionally, the legality of managing CF has been addressed for a long time by the central government, but has not received serious attention from local governments (provincial and district) as stakeholders. This has resulted in interventions and collaborations in cross-sectoral management programs that have not been running as they should, resulting in long periods of inactivity. Furthermore, social organization among members of farmer groups is still weak, as a result of the low capacity of human resources, low household incomes, and poor social networking. This results in the bargaining power of farmers being very weak, and means that the initiation of community-based CF management programs often does not go as expected. The dynamics of managing CF are changing slowly, and require significant breakthroughs to achieve management goals through multi-stakeholder collaboration in the future. Collaboration is a key factor to build synergy, so that the potential for CF can be developed to encourage improvements in community welfare (Dupuitsa and Ongolob 2020; Du-Pont et al. 2020). To encourage collaboration, the main priority is to break down coordination barriers, then work together to facilitate programs at the farmer and institutional level, including removing obstacles to the application of CF (Poudel 2019).

Other findings from this research relate to the services provided by tropical monsoon forest ecosystems to support community livelihoods. Tropical monsoon forest ecosystems have different characteristics from wet tropical forest ecosystems, and have important implications for service provision to the community. The value of forest contribution becomes preliminary information to help understand the carrying capacity of the tropical monsoon forest ecosystem and its affect on the livelihoods of people living around the forest. This information helps stakeholders to create policies that prepare CF management plans and to help identify biodiversity that is socially-culturally and ecologically appropriate to be developed in the tropical monsoon forest ecosystem in Indonesia.

Social forestry programs within CF in the monsoon tropical forest area needs to take into account the socio-economic vulnerability of the community and the ecological vulnerability of the surrounding forest area. Socio-economic vulnerability related to the condition of human resources and community welfare is classified as very low, and requires intervention to increase its capacity to support the management and utilization of forest resources efficiently, effectively and sustainably. Ecological vulnerability is related to the vulnerability of tropical monsoon forest ecosystems, which are easily damaged and require a long time and a high cost for rehabilitation.

The results of this study provide an understanding of the relationship between the existence of tropical monsoon forest ecosystems and the socio-economic realities of the surrounding communities. The nature and characteristics of fragile tropical monsoon forests have direct implications for the sustainability of community livelihoods. Management of forest areas needs to be improved through better accessibility, post-harvest processing technology, product diversification, and improved marketing networks. In addition, inputs for the CF farmer empowerment program need to be more inclusive, so that they build synergy and collaboration across sectors to support the empowerment of the people involved in managing CF. Capacity building is conducted through the transfer of cultivation technology and the management of spatial planning to help sustainably increase forest productivity. Strengthening the synergy of cross-sector programs in facilitating the process of transformation and economic growth of environmentally friendly communities is needed. This can be done by providing facilities and infrastructure for processing products, improving access to farm roads for the mobilization of produce, and the integration of CF farms at the level of BUMDes, BUMD, and cooperatives that encourage increased value and forest sustainability. In addition, access to management and the utilization of forest areas needs to be followed by cross-sectoral commitments to encourage institutional strengthening of farmers through programs that encourage the achievement of forest management goals and community empowerment. Poor people will impoverish their environment, and environments that become poor will only increase people's struggle with poverty. Therefore, increasing the value of forest benefits on a sustainable basis is the key to improving the livelihoods and welfare of communities around the forest.

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