Community-based forest management in the forest District of Kediri: cultivation of pineapple and turmeric under forest stands

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Abstract. Community-based forest management (CBFM) is a forest management system that is carried out by communities and forest companies with a mutual benefit principle. One of them is to bring benefits to the community from the plants cultivated. Each combination of plants yields a different income. The research aims (a) to calculate the profit of pineapple and turmeric cultivation under forest stands in the Forest District of Kediri, (b) to calculate the profit sharing between communities and companies, and (c) the value of forest product fees of pineapple and turmeric. Data were collected through observation and interviews and employ benefit-cost analysis. Shared profit was calculated based on cooperation agreements and the fee was calculated based on the prevailing tariff. The results of the study showed (1) the profit of the pineapple business was IDR 18,800,000 per ha per season, of which IDR 12,635,000 was for the community, IDR 5,415,000 was for the company's profit share IDR 750,000 was for forest product fees. (2) the profit of the turmeric business was IDR 13,600,000 per ha per season, of which IDR 9,205,000 was for the community, IDR 3,495,000 was for the company profit share, and IDR 450,000 was for forest product fees.

1. Introduction
Community Forest Management (CBFM) is a forest management system carried out by Perum Perhutani and the community with the principle of mutual benefit, mutual strengthening, and mutual support in forest management activities. This is expected to increase community support for sustainable forest management as well as community welfare. Initially, CBFM is designed with a focus on increasing the success of wood-based forest management. This is indicated by the existence of rules on sharing timber forest products but no rules on sharing non-timber forest products (Direksi Perum Perhutani, 2001). In its implementation, wood-based CBFM did not work as expected. Community support in forest management activities tends to be low since community income from wood-based CBFM is not every year, or only during thinning and logging. Furthermore, local government support is also limited since wood-based CBFM provides limited job opportunities (Arifandy & Sibaloho, 2015; Puspitojati & Saepudin, 2012; Puspitojati, Darusman, Tarumingkeng, & Purnama, 2012; Simon, 2006).

In its development, CBFM is also applied in wood-food-based forest management. This is demonstrated by the existence of regulations regarding the sharing of non-wood forest products (KPH Kediri Perum Perhutani, 2016) and the availability of policies that support the use of forest areas for...
food production (Departemen Kehutanan, 2007; Kementerian Lingkungan Hidup dan Kehutanan, 2016, 2019; Peraturan Pemerintah, 2021; Puspitojati, 2013, 2015). Community support in forest management activities tends to be high since wood-food-based CBFM generates income every year. Furthermore, local government support can be expected to be high since wood-food-based CBFM provides wide job opportunities (Arifandy & Sihaloho, 2015; Ediningtyas, Lumintang, & Susanto, 2007; Puspitodjati, Karyana, Pujowadi, & Hakim, 2020; Puspitodjati, Saepudin, & Mulyana, 2015).

Each combination of plants yields a different income. Each combination of crops planted by farmers produces different incomes. The combination usually accommodates the social, cultural, and economic tendencies of the local community. Therefore, it is necessary to know how much income is generated per hectare based on a particular combination of crops to provide an overview and considerations to be applied elsewhere. This research was conducted at the Forest District of Kediri which implements a variety of wood–food-based CBFM, including wood–pineapple CBFM and wood–turmeric CBFM. There is also a Social Forestry program that focuses on these commodities. The objectives of this study were (a) to calculate the profit of the business of cultivating pineapple and turmeric under the forest stands in the Forest District of Kediri, (b) to calculate the profit share for the community and the company, and (c) to calculate the value of forest product fees of pineapple and turmeric.

2. Research method
2.1. Data collection
Data collection was carried out in September 2018 in the working area of the Forest District of Kediri. Primary data were obtained through interviews with pineapple and turmeric farmers, as well as employees of Perum Perhutani. The primary data collected were related to pineapple and turmeric cultivation under forest stands. Meanwhile, secondary data were obtained through the recording at the Perum Perhutani office, library, and internet. Secondary data collected were references related to pineapple and turmeric as well as environmental and forestry policies that support the use of forests for food.

2.2. Data analysis
2.2.1. Approach. Forest management with the community is carried out with the principles of mutual support, sharing, and benefit. In practice, the cultivation of pineapple and turmeric under forest stands is fully financed by the farmers and the results are divided by taking into account the costs incurred by the farmers. Therefore, all production costs incurred by farmers are calculated, including labor costs and seeds provided by farmers themselves. However, land rent is not counted.

2.2.2. Profit, profit share, and forest product fees. The cooperation agreement process is carried out through a process of discussion and negotiation between the FMU and the community with reference to the regulations from Perum Perhutani, KPH Kediri, and the Minister of Environment and Forestry concerning Social Forest. In the cooperation agreement, it is stated that the profit-sharing from the net profit of the pineapple and turmeric business is 70% for farmers and 30% for companies (KPH Kediri Perum Perhutani, 2016, 2017). Net profit is equal to operating income minus production costs minus forest product fees (FPF). The FPF rate is 6% X the benchmark price (Kementerian Lingkungan Hidup dan Kehutanan, 2017). The tariff for pineapple (other fruit groups) is IDR 30 per kg and the tariff for turmeric (other tubers) is IDR 30 per kg.

3. Results and discussion
3.1. Forest District of Kediri
3.1.1. Forest and forest products. Perum Perhutani Forest District of Kediri manages a forest area of 117,332 ha, consisting of 79,404 ha of production forest and 37,927 ha of protection forest. The timber plants cultivated by the Forest District of Kediri are teak, pine, and sengon. Meanwhile, food crops (and animals) that are cultivated include mangosteen, duck, avocado, pineapple, durian, cloves,
coconut, honey, coffee, corn, rice, and papaya. The forest management is carried out by the company together with the community.

3.1.2. CBFM cooperation agreement. The CBFM cooperation agreement was carried out by the Forest District of Kediri together with the Forest Village Community Institution (FVCI), namely FVCI Wonorejo in the case of wood–pineapple CBFM and FVCI of Petani Hutan Sejahtera in the case of wood-turmeric CBFM. The CBFM cooperation agreement contains the rights and obligations of each party in forest management (KPH Kediri Perum Perhutani, 2016, 2017).

Company rights and obligations
The company (Perum Perhutani) has the right to (a) evaluate and supervise CBFM activities, (b) direct, admonish and revoke utilization rights that have been granted to farmers, (c) obtain profit sharing (pineapple) according to the agreement and (d) get assistance from farmers to secure the forest. The company's obligations are (a) allocating the land needed by farmers, (b) complying with all agreed provisions, and (c) providing guidance to farmers.

Farmers' rights and obligations
Farmers have the right to (a) use the land under the forest stands, (b) submit opinions, suggestions, and proposals on the implementation of CBFM, (c) receive guidance, and (d) receive profit sharing (pineapple, turmeric) according to the agreement. Farmers' obligations are (a) maintaining forestry staple crops, (b) assisting in securing and protecting forest areas, (c) providing agroforestry plant seeds (pineapple, turmeric) and other supporting facilities, and (d) delivering profit sharing (pineapple, turmeric) to the company.

3.2. Pineapple business
3.2.1. Cultivation of pineapple under forest stands. Pineapple plants are suitable for cultivation in the lowlands to highlands, namely at an altitude of 0–1200 m above sea level, latosol, aluvial, and regosol soil types, with fairly even rainfall throughout the year, ranging from 1,000–1,500 mm/year. The optimum temperature for pineapple cultivation is 29–32°C. Pineapple plants require open areas but are still suitable for cultivation under forest stands with a shade level of less than 30% (Nasela, 2017).

Plant propagation is carried out vegetatively using seedling shoots, stem shoots, or crown shoots. Seedlings grow and bear fruit more quickly than seedlings of stem shoots, and seedlings of stem shoots grow and bear fruit faster than crown seedlings. Furthermore, large seeds grow and produce fruit faster than small seeds. Farmers generally provide their seeds. The seeds used are subject to availability.

Seedlings were planted at the beginning of the rainy season on beds made between sengon stands planted at a distance of 3 m X 3 m. Seedlings were planted in planting holes measuring 30 X 30 X 30 cm, with a spacing of 50 cm X 50 cm. Plant maintenance is carried out through weeding, piling, thinning, and fertilizing. These maintenance activities are generally carried out simultaneously as needed.

Thinning of tillers is needed to produce large and quality fruit. Furthermore, pineapple fertilization is carried out using organic fertilizers (manure) or a combination of organic and inorganic fertilizers (artificial fertilizers). Organic fertilization is carried out at the time of planting at a dose of 10-15 tons per ha. Meanwhile, combination fertilization was carried out 2 times. The first fertilization was done when the plant was 3 months old with a dose of 300 kg of urea per ha, 100 kg of TSP per ha, and 150 kg of KCL per ha. The second fertilization was carried out when the plant was one year old with a dose of urea 150 kg per ha, TSP 0-50 kg per ha, and KCl 100-200 kg per ha.

Pineapple harvest is done in stages from 17 months to 22 months. Pineapple harvesting is gradually influenced by the type of seed planted and also by market considerations. Pineapple can be harvested from fruit maturity level 1 to fruit maturity level 6 based on the level of color development of yellow skin of the fruit, namely, (1) old fruit (not yet looks yellow), (2) breaker (coloryellow appears in the
eye at the base of the fruit), (3) >breaker-25% ripe, (4) >25-50% ripe, (5) >50-75% ripe and (6) >75% ripe. Harvesting is done by cutting the fruit stalk using a knife. Pineapple yields can reach 60 tons per ha but farmers are generally only able to produce about 25 tons per ha.

3.2.2. Profit of pineapple business. Details of costs, revenues, and profits of pineapple business under forest stands are presented in Table 1. It can be seen that the cost of pineapple cultivation is IDR. 43,700,000,- per ha per season, with details of production input costs of IDR. 22,750,000,- per ha per season and labor costs of IDR. 20.95 million,- per ha per season. Production inputs that require large costs are seeds and manure. The need for seeds is around 45,000 plant seeds, with a price of IDR 200,- per plant seed. Furthermore, the need for manure is 15 tons per ha, which is expected to provide conditions conducive to plant growth. Meanwhile, activities that contribute to large labor costs are land preparation, plant maintenance, and harvesting. Land preparation requires 90 HOK which is allocated for land clearing activities from plant debris, loosening soil, and making beds. Plant maintenance requires 150 HOK which is allocated for replanting, weeding, hoarding, and thinning of plants. Furthermore, harvesting and post-harvesting require 110 HOK allocated to harvest pineapples in stages.

Table 1 also shows the income and profit from the pineapple business. The income from the pineapple business is IDR 62,500,000 per ha per growing season. This income was obtained from the sale of 25 tons of pineapple for IDR 2,500 per kg. The gross profit of the pineapple business or the profit before the payment of the forest product fees (FPF) is IDR. 62,500,000 – IDR. 43,700,000 = IDR. 18,800,000,- per ha per season. Furthermore, the net profit of the pineapple business or profit after FPF payment is IDR. 18,800,000 – IDR. 750,000,- = IDR. 18,050,000,- per ha per season.

Table 1. Analysis of pineapple business under forest stands (1 ha)

| Descriptions                              | Volume  | Price | Sum (IDR)   |
|-------------------------------------------|---------|-------|-------------|
| A. Production costs                       |         |       |             |
| 1. Production input                       |         |       |             |
| - Seeds                                   | 45,000  | 200   | 9,000,000   |
| - Urea                                    | 450     | 2,000 | 900,000     |
| - TSP                                     | 100     | 2,500 | 250,000     |
| - KCl                                     | 300     | 7,000 | 2,100,000   |
| - Manure                                  | 15,000  | 500   | 7,500,000   |
| - Drugs                                   |         |       |             |
| - Farming tools                           | 1 packet| 1,000,000| 1,000,000   |
| 2. Labor (working days)                   |         |       |             |
| - Tillage                                 | 90      | 50,000| 4,500,000   |
| - Organic fertilizer (manure)             | 15      | 50,000| 750,000     |
| - Urea, TSP, KCl fertilizer               | 24      | 50,000| 1,200,000   |
| - Planting                               | 30      | 50,000| 1,500,000   |
| - Plant maintenance                       | 150     | 50,000| 7,500,000   |
| - Harvesting and post-harvest             | 110     | 50,000| 5,500,000   |
| B. Revenue = production X price           |         |       | 62,500,000   |
| 1. Average production 25.000 kg/ha        |         |       |             |
| 2. Average price IDR 2,500/kg             |         |       |             |
| C. Forest product fees                    | 25,000  | 30    | 750,000     |
| D. Profit                                |         |       |             |
| 1. Before fees payment (B–A)              |         |       | 18,800,000   |
| 2. After fees payment PSDH (B–A–C)        |         |       | 18,050,000   |
| E. Profit sharing (2)                     |         |       |             |
| 1. Community = 70% X D (2)                |         |       | 12,635,000   |
Descriptions | Volume | Price | Sum (IDR) |
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2. Company = 30% X D (2) | | | 5,415,000 |
Remarks:
• Cooperation area 9.45 ha
• Pineapples are harvested in stages 18–22 months after planting

3.2.3. Profit-sharing and fees. The details of the profit-sharing received by the community and the company, as well as FPF payments are presented in Table 1. It can be seen that the profit-sharing received by the community and the company from pineapple business under forest stands is IDR 12,635,000 per ha per season, and IDR 5,415,000 per ha per season respectively. Meanwhile, state revenue from pineapple FPF payments is IDR 750,000 per hectare per season.

3.3. Turmeric business
3.3.1. Cultivation of turmeric under forest stands. Turmeric plants are suitable for cultivation in the lowlands to highlands, namely at an altitude of 0–1200 m above sea level, latosol, aluvial, and regosol soil types, with fairly even rainfall throughout the year, ranging from 1,000–4,000 mm/year. The optimum temperature for turmeric cultivation is 19–30°C. Turmeric plants require open areas but are still suitable for cultivation under forest stands (teak, sengon) with a shade level of less than 30% (Warsana & Samadi, 2019).

Plant propagation is done vegetatively using rhizomes. Seedlings are taken from pieces of rhizome that have 1-2 shoots and weigh 20-40 grams. The injured part of the seedling (the cut end of the rhizome) is dipped in a thick solution of kitchen ash and kept in a damp, dark place until shoots form. Next, the seeds are put into sacks, soaked in a solution of fungicide for 8 hours, and dried in the sun for 2-4 hours.

Seedlings were planted at the beginning of the rainy season on beds made between sengon stands planted at a distance of 3 m X 3 m. Seedlings are planted 3–5 cm deep along the bed, with shoots facing up. Turmeric spacing is 50 cm X 40 cm or 50 cm X 50 cm. Plant maintenance is carried out through weeding, piling, and fertilizing. The first weeding of weeds is done when the turmeric is 2–4 weeks old and the next weeding is done every 3-6 weeks until the plants are 6-7 months old. Hoarding is done to loosen the soil and fill the turmeric rhizome that appears on the soil surface. The first hoarding is done when the turmeric plant has formed a clump that has 3-4 pseudostems. Subsequent hoarding is carried out as needed.

Furthermore, turmeric fertilization can be done using organic fertilizers (manure) or a combination of organic and inorganic fertilizers (artificial fertilizers). Fertilization with organic fertilizers is carried out at the time of planting (1 kg per plant), 2–3 months (2–3 kg per plant), and 8–10 months (2–3 kg) 3 kg per plant). Meanwhile, combination fertilization was carried out 2 times, namely at the time of planting using organic fertilizer as much as 3 tons per ha and when the plants were 2–4 months old with Urea, TSP, and KCL fertilizers in a row at a dose of 100 kg per ha, 200 kg per hectare. kg per ha and 200 kg per ha.

Turmeric is generally harvested when the plants are 10–12 months old, before the rainy season. Harvesting is done using a fork or hoe, and the turmeric rhizome is not injured. Furthermore, the turmeric rhizome is cleaned of soil and adhering dirt, if necessary, wash it. Then, the turmeric is dried in the sun for 1 (one) week and stored in an open and not humid place. Turmeric yields can reach 10–40 tons of fresh rhizomes per ha.

3.3.2. Profits of turmeric business. Details of costs, income, and profits of turmeric business under forest stands are presented in Table 2. It can be seen that the cost of turmeric cultivation is IDR. 38,800,000, - per ha per season, with details of production input costs of IDR 20,100,000, - per ha per season and labor costs of IDR 18,700,000 per ha per season. Production inputs that require large costs are seeds and manure. The seed requirement is 1.5 tons per ha which are needed to make about 50,000 plant seeds. Furthermore, the need for manure is 20 tons per ha, which is expected to provide
conditions conducive to plant growth. Meanwhile, activities that contribute to large labor costs are land preparation, plant maintenance, and harvesting. Land preparation requires 90 HOK which is allocated for land clearing activities from plant debris, loosening soil, and making beds. Plant maintenance requires 110 HOK which is allocated for replanting, weeding, and hoarding activities. Furthermore, harvesting and post-harvesting require 110 HOK which is allocated for dismantling clumps and their rhizomes using a hoe and fork, sorting, washing, draining, and packing.

Table 2 also shows the income and profits of the turmeric business. The income from the turmeric business is IDR 52,500,000 per ha per growing season. This income was obtained from the sale of 15 tons of turmeric for IDR 3,500 per kg. The gross profit of the turmeric business or the profit before the payment of the Forest Resources Provision (FPF) is IDR 52,500,000.

| Description                                                                 | Volume  | Price  | Sum (IDR) |
|------------------------------------------------------------------------------|---------|--------|-----------|
| **A. Production costs**                                                      |         |        |           |
| 1. Produktion input                                                          |         |        |           |
| - Seeds                                                                      | 1,500 kg| 4,000  | 6,000,000 |
| - Urea                                                                       | 100 kg  | 2,000  | 200,000   |
| - TSP                                                                         | 200 kg  | 2,500  | 500,000   |
| - KCl                                                                         | 200 kg  | 7,000  | 1,400,000 |
| - Manure                                                                     | 20,000 kg| 500    | 10,000,000|
| 2. Labor (working day)                                                       |         |        |           |
| - Tillage                                                                    | 90      | 50,000 | 4,500,000 |
| - Organic fertilizer (manure)                                                | 15      | 50,000 | 750,000   |
| - Urea, TSP, KCl fertilizer                                                  | 24      | 50,000 | 1,200,000 |
| - Planting                                                                   | 25      | 50,000 | 1,250,000 |
| - Plant maintenance                                                          | 110     | 50,000 | 5,500,000 |
| - Harvesting and post-harvest                                                | 110     | 50,000 | 5,500,000 |
| **B. Revenue = production X price**                                          |         |        |           |
| 1. Average production 15,000 kg/ha                                            |         |        |           |
| 2. Average price IDR 3,500/kg                                                |         |        |           |
| **C. Forest product fees**                                                   | 15,000  | 30     | 450,000   |
| **D. Profit**                                                                |         |        |           |
| 1. Before fees (B – A)                                                       |         |        | 13,600,000|
| 2. After fees (B – A - C)                                                    |         |        | 13,150,000|
| **E. Profit sharing**                                                        |         |        |           |
| 1. Community 70% X D (2)                                                     |         |        | 9,205,000 |
| 2. Company 30% X D (2)                                                       |         |        | 3,945,000 |

Remarks: 1) Cooperation area 17.25 ha, 2) Turmeric is harvested 10–12 months after planting

3.3.3. Profit-sharing and fees. The details of the profit-sharing received by the community and companies, as well as state revenues from FPF payments are presented in Table 2. It can be seen that the profit-sharing received by the community and the company from turmeric business under forest stands is IDR 9,205,000 per ha per season and IDR 2,945,000, per ha per season respectively. Meanwhile, state revenue from turmeric FPF payments is IDR 450,000 per hectare per season.
4. Conclusion and recommendation

4.1. Conclusion
Community-based forest management in the Forest District of Kediri generated revenue to the community nearby forest, the forest company, and the state. The revenue in the form of profit of pineapple business was IDR 18,800,000 per ha per season, of which IDR 12,635,000 was the profit share for the community, IDR 5,415,000 was the profit share for the company, and IDR 750,000 was for forest product fee. Moreover, the revenue in the form of profit of turmeric business was IDR 13,600,000 per ha per season, of which IDR 9,205,000 was the profit share for the community, IDR 3,945,000 was the profit share for the company and IDR 450,000 was for forest product fees. Overall, it can be said that the cultivation of pineapple and turmeric increases the benefits of forests for communities and companies, as well as increasing state revenues.

4.2. Recommendations
Pineapple and turmeric cultivation under forest stands carried out by PerumPerhutani Forest District of Kediri together with the community generates adequate income for the community, the company, and the state. This is in line with the policies of environmental and forestry that encourage the use of forests for food production (Kementerian Lingkungan Hidup dan Kehutanan, 2016, 2019; Peraturan Pemerintah, 2021). Therefore, the use of forests for food production needs to be cultivated on a wider scale to increase the contribution of the environment and forestry sectors in supporting food security, increase the income of communities and companies, in addition to increasing government revenues from forestry fees.

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