Financial Analysis of Oil Palm, Rubber, and Tengkawang Community Forest Cultivation Models in West Kalimantan

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***Abstract*—Tengkawang is the flora mascot of West Kalimantan Province and has long been the mainstay of life for people living around forest areas. Its fruit can be processed into fat and sold as green butter, borneo tallow, or tengkawang oil, which is used as a chocolate substitute, and ingredient in lipstick, candles, and medicines. Its wood is used as raw material for the sawmill and plywood industry. Currently, tengkawang trees are threatened with extinction and have been replaced by rubber and oil palm plantations. The objective of this study is to analyze the financial feasibility of three land cultivation models and formulate a land cultivation model in community forests. This study used three models of land cultivation, namely tengkawang cultivation, rubber cultivation, and oil palm cultivation, which are managed through monoculture. This research used a descriptive method with survey and interview techniques using questionnaires. The financial analysis findings indicate that all three land cultivation models are viable, with profitability ranking in the following order: tengkawang, rubber, and oil palm. Consequently, tengkawang proves to be the more financially rewarding option when compared to rubber and oil palm.**

Keywords*— *cultivation; financial analysis; oil palm; rubber; tengkawang

I. Introduction

Tengkawang is the name of the fruit and tree of the Shorea species which is commonly called as meranti that has long been known in Indonesia. This species belongs to the Dipterocarpaceae family. The natural distribution area of tengkawang species includes India, Thailand, Malaysia, Indonesia, Sarawak, Sabah, and the Philippines. In Indonesia, tengkawang trees are found on the islands of Kalimantan and Sumatra. The largest tengkawang-producing area is in West Kalimantan Province, namely in Sanggau, Kapuas Hulu, Sintang, Pontianak, Sambas, and Ketapang [1]. This plant has long been familiar to the people of West Kalimantan because of its long history of utilization. Its utilization has been going on for generations and its cultivation has been carried out for a long time, approximately in 1881 [2].

Tengkawang tungkul is a type of meranti whose seeds can be used as a source of vegetable oil. When compared to seeds from other meranti, tengkawang tungkul seeds have the highest vegetable oil content. Tengkawang tungkul fruit contains 4060% edible fat [3]. The tengkawang tungkul type is preferred by the people of West Kalimantan because it is a producer of large-sized tengkawang fruit. All harvested tengkawang fruit is then processed in an oil factory in Pontianak to be exported as a substitute for brown butter for the chocolate industry in Japan and Europe [4].

The presence of tengkawang in natural forests is already very small. One of the reasons for this is rampant illegal logging and exploitation without regard to the sustainability of the tengkawang-producing species. In addition, in recent years many tengkawang logs have been cut down due to the relatively low price of the fruit and the increasing market demand for tengkawang wood commodities along with the depletion of timber in Kalimantan. Data from [5] states that tengkawang tungkul is categorized as facing a very high risk of extinction in nature (endangered).

The latest data recorded by the Central Bureau of Statistics shows that tengkawang tallow trade transactions in 1998 had a total export value of US$ 3,997,560 for 1,072,104 kg of tengkawang tallow. Japan was the largest market for tengkawang tallow (US$ 2,073,223) followed by Italy (US$ 663,925), the Netherlands (US$ 296,460), and Singapore (US$ 49,952) [4].

In addition to cultivating tengkawang, almost all Sanjan people in the research site cultivate rubber and oil palm. In 2010, through the Community Forest development program, the Sanjan community planted 20,000 trees covering 90 ha outside the Customary Forest area. Of this amount, 40% was rubber. In 2011, the Sanjan people again planted 50,000 endemic timber seedlings covering 125 ha. Of these, 20,000 rubber trees were planted [6]. The area of smallholder rubber plants in West Kalimantan in 2011 was 583,287 ha with a production of 248,013 tons, while the area of smallholder oil palm plants in 2011 was 255,235 ha with a production of 436,210 tons [7]. In 2021 the area of smallholder rubber plants increased to 591,710 ha with a production of 306,282 tons, while the area of

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smallholder oil palm plants in 2021 increased rapidly to 2,003,188 ha with a production of 6,614,710 tons [8].

To stimulate public interest in preserving the existence of tengkawang trees, quantitative data on community forest tengkawang cultivation is needed. This study aims to analyze the financial feasibility of tengkawang, rubber, and palm oil cultivation and formulate a model for community forest land cultivation.

II. Research Method

A. Location and Object of Research

Sanggau is one of the districts in West Kalimantan that produces a lot of tengkawang fruit. This research was conducted in Sanjan Hamlet, Sungai Mawang Village, Sanggau Regency, West Kalimantan Province. The selection of the location was carried out purposively sampling, namely the location where there is a type of tengkawang tungkul-producing tree (Shorea stenoptera Burck) that is widely utilized by the local community. The potential of tengkawang trees in the location is still well maintained because the community has local wisdom in managing tengkawang trees.

The objects of this research are (1) people who cultivate tengkawang, rubber, and oil palm plants as respondents, (2) fruitful tengkawang plants, rubber plants, and oil palm plants that have been harvested, (3) institutions or agencies that can provide data information in this research, namely traditional leaders, Village Heads and Sub-District Heads, the Forestry and Plantation Service of Sanggau Regency.

B. Data Collection

Data collection was conducted in the following ways [9]: (1) observation by making direct observations of biophysical conditions in the field related to the implementation of tengkawang, rubber, and oil palm cultivation activities, including types of activities carried out, production costs and income earned, (2) literature study, namely data collection by reviewing literature and reports from agencies related to tengkawang, rubber and oil palm cultivation activities in Sanggau Regency, West Kalimantan Province, (3) in-depth interviews and focus group discussions (FGDs).

Primary data collected included costs and revenues from tengkawang, rubber, and oil palm operations. Data sources in the field were obtained from key informants, namely key community figures such as the customary chief, village head, and other agency leaders. Other informants were obtained from other communities encountered on intentional or unintentional occasions (case informants) in the field. Primary data collection was conducted using survey methods, observation or structured interviews, questionnaires, discussions, and direct interviews with farmers. In addition, in-depth interviews were conducted with local government officials to explore information about local government programs in the management of tengkawang, rubber, and oil palm. Secondary data including general conditions of tengkawang, rubber, and oil palm management were collected through literature searches or reports from relevant agencies, namely the Forestry and Plantation Service,
the Industry and Trade Service, and the Central Bureau of Statistics.

C. Data Analysis

There are three models analyzed in this community forest enterprise, namely the first model in the form of tengkawang monoculture (the planting distance is 5m x 4m), the second model in the form of rubber monoculture (the planting distance is 7m x 3m), and the third model in the form of oil palm monoculture (the planting distance is 9m x 9m). Data analysis will be done using financial analysis. The criteria used in calculating the financial feasibility are NPV, Net B/C, and IRR
[10].

III. Result and Discussion

A. Research Location Profile

Administratively, Sanjan Hamlet is included in the government area of Sungai Mawang Village, Sanggau Kapuas Sub-district, Sanggau Regency, West Kalimantan Province. From Sanjan Hamlet to the city of Sanggau the capital of the regency, it can be reached within 20 minutes by motorcycle. The area of Sanjan Hamlet is 5,260 ha, which consists of residential areas, forest areas, fields, and community-owned gardens. The majority of the population of Sanjan Hamlet are Dayak Kodatn people with the main livelihood of the community being farming fields and rubber cutting.

The boundaries of Sanjan Hamlet are North bordering Ngkalet Hamlet, South with Sei Mawakng Hamlet and Rantau Prapat Hamlet, East with Nyandang Hamlet, and West with Senunuk Hamlet. Sanjan Hamlet is an area dominated by hilly areas and several rivers that divide the area, namely the Solang River, Gang River, Sabal River, Sanjan River, and Awik River
[11]. An inventory of tengkawang trees, it is known that in the forest cover of Sanjan Hamlet, there is only one tengkawang-producing tree species, namely tengkawang tungkul (S. stenoptera Burck).

B. Financial Feasibility

In conducting financial analysis, it is necessary to analyze data on the stages of activities carried out in running the tengkawang, rubber, and oil palm cultivation, analyzing the cost and income components of the tengkawang, rubber, and oil palm cultivation, and feasibility analysis using NPV, Net B/C, and IRR parameters. The stages of activities carried out to run the tengkawang, rubber, and oil palm cultivation consist of planning, land preparation, seed procurement, planting, replanting, plant maintenance, and harvesting [12]. Planning, land preparation, seed procurement, and planting activities were carried out in year 1. Replanting activities are only carried out in year 2. Plant maintenance activities are carried out every year and harvesting activities begin in year 8 for tengkawang, year 5 for rubber, and year 3 for oil palm.

The source of income from the tengkawang and rubber cultivation is the harvest of tengkawang fruit and rubber sap, logs, and firewood, while oil palm cultivation is the harvest of oil palm fruit. Cash flow data related to cash-out activities in the form of costs required in the exploitation of tengkawang, rubber and oil palm and cash inflow components in the form of proceeds from the sale of wood, tengkawang fruit and rubber sap and oil palm fruit, based on prices prevailing at the time of the study. Market prices at the research site were: tengkawang logs Rp1,000,000 per m3, tengkawang fruit Rp2,750 per kg, rubber sap Rp6,500 per kg, oil palm fruit Rp1,200 per kg. The interest rate used is 6% per year.

C. Tengkawang (Model 1)

Sources of income from the tengkawang cultivation are harvested tengkawang fruit, tengkawang logs, and firewood. According to [13] trees are important to the community because they can produce firewood, wood for house construction, and medicine. Cash flow data related to cash-out activities in the form of costs required in tengkawang exploitation and cash inflow components in the form of proceeds from the sale of tengkawang logs, firewood, and tengkawang fruit, based on prices prevailing at the time of the study. The results of the financial analysis of tengkawang farming are presented in Table 1.

The data in Table 1 shows that with a 96-year crop cycle, the payback period is 19.2 years. The NPV >0, which is Rp233,466,000, means that tengkawang cultivation within 96 years will be able to generate benefits with a present value of Rp233,466,000. The Net B/C value >1, which is 3.92, indicates that the total benefits to be received will be a surplus of 3.92 times the total costs (expenditures) spent. The IRR value is 11.3%, which is greater than the prevailing interest rate at the time the investment was implemented (6%). This means that tengkawang farming is feasible. The results show that tengkawang farming is one of the most promising alternatives that can be done to preserve tengkawang and the economy of the community. According to [14], the use of non-timber forest products can contribute significantly to the economy of forest communities.

The average annual tengkawang income (EAA) of Rp11,782,207 is obtained by cultivating 1 hectare of tengkawang. If the per capita expenditure per month is Rp1,120,000, then the expenditure per head of farming family per year with 5 people per head of family is Rp67,200,000, so to be able to meet their needs, tengkawang cultivation per head of family requires a business scale of 5.7 hectares.

D. Rubber (Model 2)

The source of income from the rubber business is rubber sap and firewood. Based on the results of the financial analysis in Table 1, the rubber business produces NPV>0, Net B/C>1, and IRR>6%, with a crop cycle of 25 years and a payback period of 9.8 years, this rubber business model is feasible.

The NPV value of Rp105,151,000 means that rubber cultivation within 25 years will be able to generate benefits with a present value of Rp105,151,000. The Net B/C value is 5.04, indicating that the total benefits to be received will be a surplus of 5.04 times the total costs (expenses) spent. The IRR value is 17.6%, which is greater than the prevailing interest rate at the time the investment was implemented (6%). This means that rubber cultivation is feasible.

The average annual rubber income (EAA) of Rp7,460,722 is obtained by cultivating 1 hectare of rubber. If it is assumed that the consumption expenditure of each farmer family per year with 5 people per family head is Rp67,200,000, then to be able to meet their needs, rubber cultivation per family head requires a business scale of 9.0 hectares.

E. Oil Palm (Model 3)

The source of income from oil palm cultivation is the harvest of the fruit. Based on the results of the financial analysis in Table 1, NPV>0, Net B/C>1, IRR>6% with a crop cycle of 25 years and a payback period of 12.2 years, the oil palm cultivation model is feasible.

The NPV value of Rp91,268,000 means that oil palm cultivation within 25 years will be able to produce benefits with a current value of Rp91,268,000. The Net B/C value is 3.52, indicating that the total benefits to be received will be a surplus of 3.52 times the total costs (expenses) spent. The IRR value is 14%, which is greater than the prevailing interest rate at the time the investment was implemented (6%). This means that oil palm cultivation is feasible.

The average annual oil palm income (EAA) of Rp6,475,689 is obtained by cultivating 1 hectare of oil palm. If it is assumed that the consumption expenditure of each farmer family per year with 5 people per family head is Rp67,200,000, then to be able to meet their needs, oil palm cultivation per family head requires a business scale of 10.4 hectares.

Rubber cultivation in model 2, when compared to tengkawang cultivation in model 1, is financially less profitable, because it requires a larger scale of effort (model 1 = 5.7 ha, model 2 = 9.0 ha) and a smaller average income per year (model 1 = Rp11,782,207, model 2 = Rp7,460,722). According to [15] the profits from rubber cultivation will increase if rubber planting is combined with durian in an agroforestry system.

Oil palm cultivation in model 3 is financially profitable under model 2, requires a wider business scale (model 2 = 9.0 ha, model 3 = 10.4 ha) and smaller average income per year (model 2 = Rp7,460,722, model 3 = Rp6,475,689).

From this description, it can be seen that tengkawang cultivation is the most profitable alternative to drive the community's economy. Non-timber forest products can contribute significantly to the economy of forest communities and well-managed forests provide economic and ecological benefits [14]; [16]. For this reason, the role of local communities is needed to maintain forest sustainability [17]. According to [18], the factors that influence the reduction of customary forest area are the inconsistency of decision makers (stakeholders) in implementing customary law regulations, changes in land conditions, a decrease in economic levels, the need for the construction of public facilities that must be built on customary land, rapid population growth that is not balanced with the productivity of agricultural land, and the destruction of forest resource ecosystems.

TABLE 1. FINANCIAL ANALYSIS

Land Model	Cycle (year)	Financial Analysis				EAA (Rp)	Business Scale (ha)
		PP (year)	NPV (Rp)	Net B/C	IRR (%)		
Tengkawang	96	19.2	233,466,000	3.92	11.3	11,782,207	5.7
Rubber	25	9.8	105,151,000	5.04	17.6	7,460,722	9.0
Oil palm	25	12.2	91,268,000	3.52	14	6,475,689	10.4

Note: PP = Payback Period (year), NPV = Net Present Value (Rp), Net B/C = Net Benefit Cost Ratio, IRR = Internal Rate of Return (%), EAA = Equivalent Annual Annuity (Rp)

According to the outcomes of the financial assessment for each land cultivation model, it becomes apparent that tengkawang cultivation is the most lucrative among them, surpassing both rubber and oil palm cultivation. On the other hand, rubber cultivation proves to be a more profitable option when compared to oil palm cultivation.

The Dayak Kodatn community in West Kalimantan has its local wisdom in utilizing forest resources for its needs. Forest areas used for cultivation are managed in various ways by planting various types of forest trees, various types of fruit plants, and rubber plants to form forest garden areas (tembawang). This is a form of local wisdom from the local community to maintain biodiversity [19]. This local wisdom has been tested and proven that the forest they manage still exists today. Local wisdom is a value that is believed to be true and becomes a reference for local people in taking daily actions and becomes a determinant in the development of community civilization because local wisdom contains elements of intelligence, creativity, and local knowledge provided by the community [20]; [21].

In summary, it can be deduced that all three land cultivation approaches are viable, as they exhibit positive Net Present Value (NPV), a Benefit-Cost Ratio (B/C) greater than 1, and an Internal Rate of Return (IRR) exceeding 6%. In terms of profitability ranking, model 1 (involving tengkawang cultivation) ranks first, followed by model 2 (rubber) and model 3 (oil palm). Notably, the cultivation model involving tengkawang plants in the community forest demonstrates superior financial feasibility.

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