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Sustainable Production of Lampung Robusta Coffee: *A Cost-Benefit Analysis*

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ABSTRACT

The application of coffee agroforestry system in upstream watersheds is essential to analyze more deeply to answer global the demand for sustainable production. Information on the evaluation of agroforestry coffee systems sustainability in Sekampung upper watershed is still limited. This study aimed to analyze the economic sustainability of coffee production systems in the upper watershed. The research took place in Sekampung upper watershed located Air Naningan sub-district of Tanggamus, selected purposively. Datar Lebuay and SinarJawa villages were selected because both regions have most extensive dry land use. Besides, mainly the two villages are crossed with two large rivers flowing water into Way Sekampung and Batu Tegi Dam watersheds: Sangharus River and Sekampung Hulu River. The respondents were coffee farmers, selected based on land management status including private/clan holders, IUPHKm permits, and non-HKm. Respondent sampling was conducted randomly based on the land status of 400 people. Data was collected by interviewing individual respondents using a questionnaire. The method of measuring the economic feasibility of coffee production systems used was Cost Benefit Analysis (CBA) with sustainability indicators of NPV, Net Benefit, and EIRR. Considering the results of the analysis, it could be concluded that coffee farming in agroforestry cultivation systems and coffee monoculture systems in the different land tenure met the eligibility criteria and provided long-term economic benefits. The application of agroforestry coffee was a strategic option to increase the farmers' land productivity. Agroforestry coffee production in the long run was relatively resistant to the changing coffee prices despite extreme price declines. The option to increase the diversity of intercropping populations and MPTS could increase the farmers' land productivity.

Keywords: benefit, cost, analysis, coffee, agroforestry, HKm, Sekampung

JEL Classification System: Q15

Mathematics Subject Classification: 91-02

1. INTRODUCTION

Coffee has been well-known as a global trading commodity since many centuries ago. Global coffee consumption in 2016/2017 grew by 1.9%, from 157,38 million bag (a bag containing 60 kg) (ICO 2018). Enhancing global coffee consumption is essential to Indonesian coffee export. The primary export destinations of Indonesian coffee are United State, Germany, Malaysia, Italy, and

Japan. Indonesian coffee export volume in 2016 reached 414.65 thousand ton with a transaction value of more than $US 1 trillion. Coffee production center in Indonesia is concentrated in South Sumatera with 110.39 thousand ton, Lampung 110.39 thousand ton, North Sumatera 60.18 thousand, Aceh 47.38 thousand ton, and East Java 33.98 thousand ton. Coffee plantation structure dominated by smallholders scale (PR 95%), state plantation, and private. The coffee land area run by smallholders was around 181 million hectare in 2016 (BPS-Statistics Indonesia 2016).

The performance of coffee productivity in Lampung Province is vital to the national coffee supply. Coffee farming in Lampung primarily held by smallholders. It located in West Lampung and Tanggamus as a coffee production center. The coffee plantation area is up to 60.273 ha-wide (43.18%) in West Lampung with the productivity of 59,107 ton, and 44.330 ha (31.76%) in Tanggamus with a productivity of 36,520 ton (26.16%) (BPS Lampung, 2015). Coffee plantation in Lampung mostly developed surrounding forest and watersheds area. Way Sekampung and Way Seputih are the most significant watersheds in Lampung serving the primary sources of water irrigation. The coffee plantation also grows in upper Sekampung watersheds, Tanggamus. A large part of upper Sekampung watersheds territory located in the protection forest Reg. 39 KPHL Batu Tegi office. Upper Sekampung watersheds land is used mostly for planting dryland commodities such as coffee, cocoa, pepper, banana, etc.

Based on the land tenure, officially the farmer's land status can be categorized into private, tenant, and community-based forest management. KPHL Reg. 39 Batu Tegi has governed the partnership program involving the community in developing participatory forest management in protection forest territory. KPHL Batu Tegi has successfully directed and provided the partnership to 11 farmer group groups including 1,546 members with 2,582 ha-wide land (Fitriani et al., 2018; Ruchyansyah et al., 2018). However, the inflow of settlers to the protected forest area in the Reformation era of 1998 made the land management right to coffee plantations in Sekampung complicated. Some of the coffee plantation areas is still in the process of obtaining a management license from the Ministry of Forestry, and illegal settlers also found. The uncertain condition of land management rights to coffee plantations can affect production sustainability in upper Sekampung watersheds. Land conversion affects the quality of water inflow in Sekampung river to Batu Tegi Dam constituting the primary source of rice field irrigation in Lampung Province (Somura et al. 2018).

The expansion of coffee plantation without sustainable production will affect environmental destruction. Without the agroforestry practice, the coffee plantation tends to cause deforestation (WWF 2013). Coffee plantation expansion using forest conversion scheme is still high in number in Indonesia (Syam et al. 1997). Furthermore, coffee production through agroforestry and conservation practice is a necessary condition to implement sustainable production.

Hulu Sekampung has more than 90-cm subsoil depth, in this condition; annual plantations such as coffee can be accomplished by applying soil and water conservation principles (Banuwa et al., 2008). However, there is still a coffee monoculture cultivation pattern in the farmer's land holding the forest management license. The trade-off occurs between higher productivity of coffee in monoculture patterns and lower production of coffee agroforestry. The change of coffee cultivation

patterns affects soil fertility and farmer's income (Ruchyansyah, Wulandari, and Riniarti 2018). The consideration of pursuing high productivity generates a trade-off against environmental supportability, particularly in monoculture and intensive coffee businesses. The achievement of coffee farmers' social and economic sustainability still needs further investigation. Some farmers have not reached prosperous condition yet (Soliha 2012).

How the coffee agroforestry implemented in upper Sekampung watershed is vital to analyze more in-depth to find out its contribution to sustainable coffee production. Global demand for sustainable agricultural production recently rises significantly, including in the coffee sector. Global demand for sustainable production mandated in the Sustainable Development Goals. Sustainable agricultural policies in Indonesia build on Law No. 12 of 1992. The farming need run in sustainable circumstance. The farmer's technology application in adopting sustainable land management will determine the environmental services of upper Sekampung watersheds capacity.

The analysis of coffee agroforestry sustainability in Upper Sekampung watershed will provide sustainable production. The agricultural production sustainability means that the activities are economically, ecologically and socially sustainable. The measurement of the effect of sustainable programs and policies in the future involves simulations based on economic assumptions (Bourguignon et al., 2004; Todd and Wolpin 2006). The use of natural resources needs to pay attention to the principle that the benefits of additional resource extraction activities will exceed or at least an equal to the alternative cost (opportunity cost). Sustainable coffee production with an agroforestry system is essential to maintaining the environmental services in the upper Sekampung watershed. Therefore, the attempt of promoting a coffee production system with agroforestry needs to be carried out continuously to minimize the emergence of externalities in the upper Sekampung watershed. Assessment of the economic sustainability of coffee agroforestry systems is vital to promoting sustainable production.

The application of the Cost-Benefit Analysis (CBA) instrument is needed to find out whether or not the agroforestry coffee system can provide long-term benefits to farmers and their environment. This method can significantly address the land use by coffee producers more efficiently, particularly in the use of agro-ecological practices in increasing economic output for each hectare of productive land (Pronti 2018). The information on the evaluation of the agroforestry coffee system sustainability in upper Sekampung watershed is still limited. Therefore, this study aims to analyze the economic sustainability of coffee production system in Sekampung watershed.

2. GENERATION OF THE DATA

2.1. Operational definition

Coffee monoculture production system is a planting system using the land only to produce one type of plant; in this case, coffee. The agroforestry coffee production system is a coffee planting system with various types of shade plants and intercropping plants. Shade plants are trees shading the coffee plants. The shade tree known in the study area is MPTS (multipurpose tree species)

divided into non-wood MPTS (fruit and spice trees) and wood MPTS (forestry plants), the combination of which is called silviculture.

Farmer income from farming comes from coffee farming and other farming like multiple cropping and (wood and non-wood) shade plants. The farmers holding the membership of forestry management taken into account are only those benefiting from MPTS and non-wood forestry plants. Farming cost is a component of farming expenditure, for coffee farming, intercropping, and shading, and conservation. Cash cost is the one incurred to produce farming products, while the cost calculation is the unpaid one, but assumed to be paid including labor (worker)(in family, and land lease.

Land productivity is the total production of all crops planted on a plot of land and calculated by equating it to coffee production measured with kg of coffee/ha. The indicator of coffee agroforestry's economic sustainability is the assessment on eligibility investment criteria including NPV, Net B/C, and EIRR. IUPHKm is the registration of community-based forest management issued by Ministry of Forestry, while Non-HKm is the farmers not affiliated with either private or IUPHKm land management right.

The location of the study was selected purposively, upper Sekampung watershed located in the Air Naningan sub-district, Tanggamus Regency. Air Naningan sub-district has ten villages with two villages having the most extensive dryland farming area: Datar Lebuay and Sinar Jawa. The two villages crossed by two large rivers flowing water into Way Sekampung watershed and Batu Tegi Dam: Sangharus River and the Hulu Sekampung River (Figure 1). This location has a hilly topography with elevation > 15°. Respondents were selected based on land management status including holders of property rights, IUPHKm license, and non-HKm. About 400 coffee farmer respondents were chosen randomly based on land status. Data was collected by interviewing individual respondents using a questionnaire.

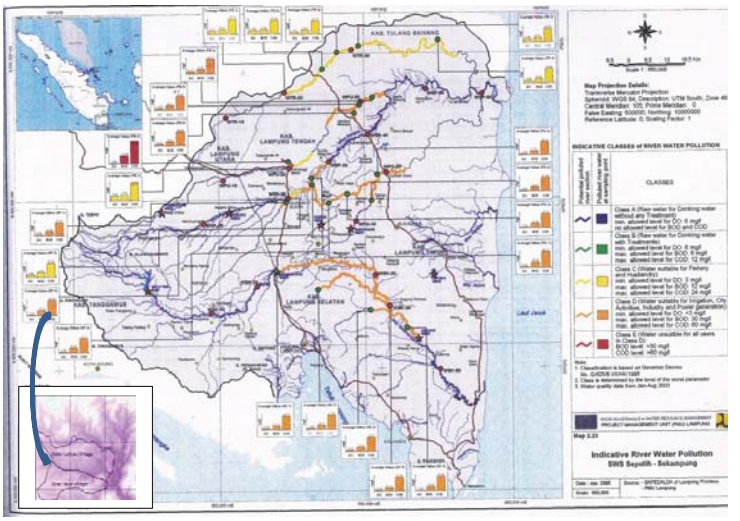

Figure 1. Research Location in Upper Sekampung Watershed, Tanggamus, Lampung (Source: SWS Seputih-Sekampung, Ministry of Public Works, 2010)

2.2. Theoretical model

The method employed to measure the economic sustainability of coffee production system in the upper Sekampung watershed was a Cost-Benefit Analysis (CBA) approach. CBA is a project valuation method. The assessment of the long term benefit of the environmental project is necessary to cover out the cost. Total benefit in one year subtracted by total cost will inform a net profit of the project. Based on the net profit of the project a year then adjustment the net present value (NPV) is necessary to forecast at a different time forward. The usage of the discount factor needed to adjust the future value. The comparison of future value at a certain discount will inform the benefit of the project for the long term. The formula of NPV calculation based on (Albers and Robinson 2007; Chutubtim 2001; Karsiningsih 2016; Prasmatiwi and Suryantini 2011) publications:

a. NPV (net present value)

$$NPV = Vo + \frac{V1}{(1+i)^1} + \frac{V2}{(1+i)^2} + \cdots \frac{Vt}{(1+i)^t}$$

$$NPV = \sum_{t=0}^{n} \left(\frac{Vt}{(1+i)^t}\right)$$

with

V_t : the value at time t
i : discount rate
t : year time
n : year time projection

b. *Net Benefit*

$$Net\ B = \sum_{t=0}^{n} \left(\frac{Bt - Ct}{(1+i)^t}\right)$$

with:
B_t : the benefit of the project at time t
C_t : the cost of the project at time t
i : discount rate
t : year
n : year time projection

c. EIRR (*economic internal rate of return*)

$$\sum_{t=0}^{n} \left(\frac{Bt}{(1+r)^t}\right) = \sum_{t=0}^{n} \left(\frac{Ct}{(1+r)^t}\right)$$

with:
B_t : the benefit of the project at time t
C_t : the cost of the project at time t
r = EIRR (*economic internal rate of return*)
n = year time projection

d. Sensitivity

Economic indicators values (NPV, Net Benefit, and EIRR) should be calculated for each scenario. The feasibility scenario of coffee farming in the upper Sekampung watershed was carried out on coffee farming sensitivity conditions with the decreases in coffee prices by 10%, 30%, and 50%.

The reason is carried out recalling that the main factor experiencing the highest dynamics is coffee price, while other factors are considered constant and relatively unchanging.

3. RESULTS

Farmers are risk takers in utilizing the limited land they have. Annual crops plantation with a long period of production cannot be the only choice for the farmers. The choice of planting various commodities benefiting in the short and long terms is essential to substitute the plantation farmers' income. Farmers also multiple cropping and plant shade trees or referred to as MPTS (multi purpose tree species) in their coffee fields. The household gets income from various sources considering a variety of planting allocations. Farmers with private management land rights have the highest level of household income follow by farmer with HKM permit (local name: Hutan Kemasyarakatan; the term of community based forest management) and non-HKm farmers. The coffee farmers' household income coming from various sources show in Figure 2.

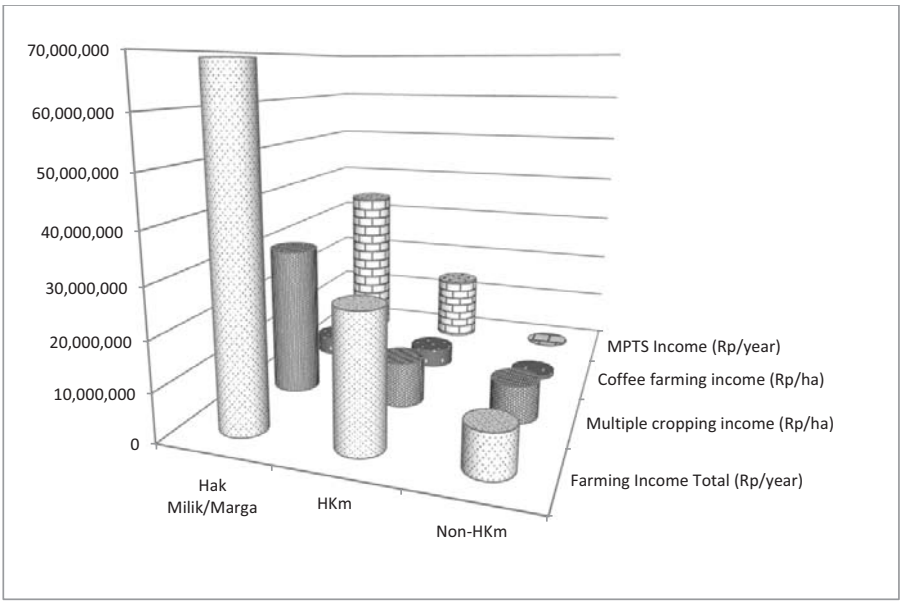

Figure 2. Coffee farmer's total income performance

Based on the coffee farmer's total income performance, an analysis of economic sustainability conducted. The *Cost-Benefit Analysis (CBA)* needs some assumptions to set the analysis to conduct. The assumption of economic works based on the fact in the field studies is required. The assumption displayed in Table 2.

Table 2.The *Cost-Benefit Analysis* assumption

Nu	Assumption
1	Program period 20 years
2	Cost and price based on farmer's expenditure on coffee farming in 2016
3	Production and coffee price effective in 2016 a. Coffee production per year per hectare using the average value on different land tenure b. Coffee price per kg is the farmer's average price
4	Production volume and farming cost are estimated based on the situation in 2016 to avoid the complexity of analysis. This necessary information is assumed to be constant for the next period in the future.
5	The annual capital interest rate is 18%
6	Land lease is spent by private and non-HKm tenure only, excl HKm members

Net present value (NPV) Analysis is conducted by conditioning the coffee planting pattern regardless other (monoculture) plants and coffee agroforestry taking the income of all crops into account. Considering the result of the analysis presented in Figure 3, show that positive NPV begins to obtain when coffee farming enters into its fourth age. Together, the two coffee cultivation patterns have an NPV higher than 0. Although the NPV of the coffee monoculture is a lower value than that of agroforestry coffee, it still has economic feasibility for the next 20 years because the NPV value in the 20th year will be more than 0.

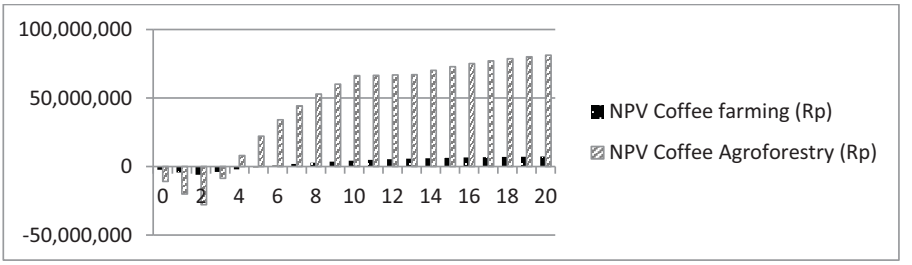

Figure 3. Net Present Values of coffee monoculture and coffee agroforestry (private)

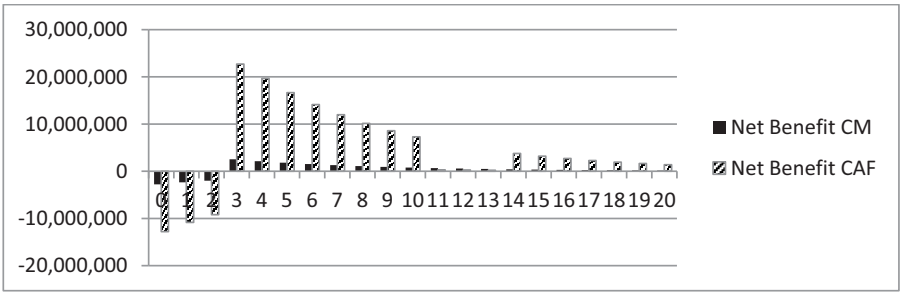

Figure 4.*Net Benefit* Value of coffee monoculture (CM) and coffee agroforestry (CAF) in private land tenure

Meanwhile, Figure 4 shows that the net benefit value of coffee agroforestry and coffee monoculture farming has a positive value since the 3rd year. Net Benefit Value of coffee monoculture farming with private land tenure is greater than 1 (2.20) while that agroforestry coffee is 3.92. It indicates that in the long run up to the next 20 year, the coffee agroforestry program will reach economic sustainability and provide long-term economic benefits to farmers. Meanwhile Figures 5 and 6 show the condition of NPV value and net benefit value of farmers for HKm members. HKm farmers have a positive NPV value of more than zero since the 4th year, while the net benefit value of more than one obtained since the 3rd year. In particular, farmers with private land tenure and HKm members become a topic in this discussion. Information on economic benefits in the long term for the two management right holders illustrates that both the private sector having independent management decisions in choosing agroforestry practices and HKm members obliged to manage agroforestry in their coffee fields show positive performance in carrying out sustainable agroforestry coffee production practices.

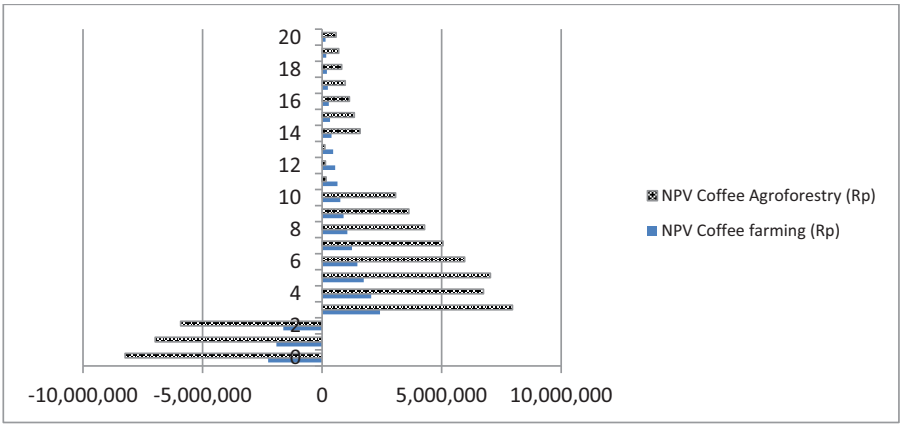

Figure 5.Net Present Value coffee monoculture and coffee agroforestry (HKm)

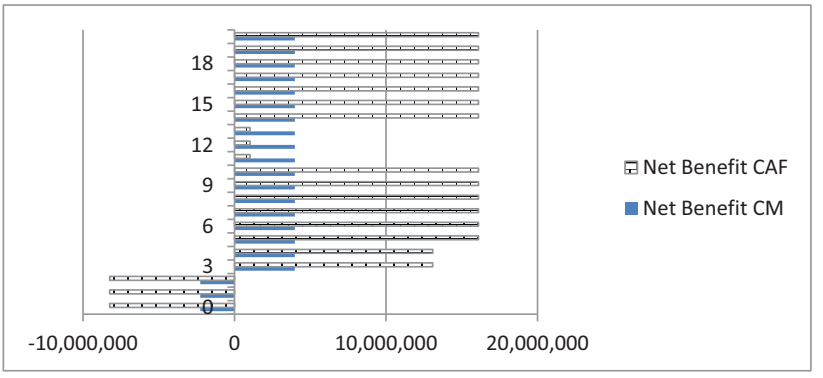

Figure 6.*Net Benefit* Value coffee monoculture and coffee agroforestry (HKm)

Table 2 presents information on the result of analysis on economic sustainability for coffee farmers with different land management rights.

Table 2.*Cost- Benefit Analysis* based on land tenure

Cost-Benefit Analysis	Land tenure	
	Private	HKm
Coffee farming		
NPV (IDR)	7,281,054	7,868,662
EIRR	35%	40%
Net Benefit	2.20	2.60
PBP (year)	3.09	4.1
Coffee agroforestry (coffee + multiple cropping + shade trees/MPTS)		
NPV (IDR)	81,310,494	25,577,759
EIRR	57%	39%
Net Benefit	3.92	2.43
PBP (year)	9.05	3.34

Based on the result of data analysis as shown in Table 2, the EIRR values of both coffee agroforestry and coffee monoculture farming are higher than the capital interest rate (18%). NPV value of all coffee farmers, with property rights, HKm, and non-HKm, is higher than zero. Net Benefit value is also greater than one on all planting systems and land management rights. Otherwise, the Payback Period (PBP) value is shorter than 20 years of the program period. The productivity of farmers' land cultivated using the agroforestry coffee system is adequate for the farmer's welfare. It means that economically the coffee agroforestry will be sustainable in the next 20 years. The application of coffee agroforestry is a strategic option to increase the productivity of farmers' land by increasing productivity beyond the productivity of coffee monoculture plantation (Figure 7). The productivity of coffee monoculture in Indonesia generally reaches only 1,000 kg.ha^{-1}.

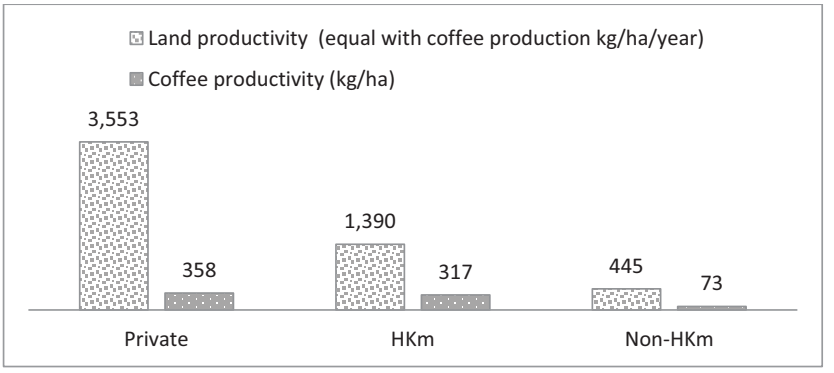

Figure 7. The productivity of farmer's land with coffee agroforestry system

Furthermore, the sensitivity analysis on the changes affecting the economic sustainability of agroforestry coffee system is carried out under the condition of decreased coffee price. It was conducted recalling that the price level affects the determination of the farmers' profit rate. The changes in coffee production and price are the factors most affecting the feasibility of coffee agroforestry (Premono and Lestari 2018). From Figure 8 showing Indonesian coffee export prices during 2003-2017, it can see that the trend of world coffee prices is fluctuating very dynamically. This external situation can not be avoided by coffee farmers. Price in Japan is very volatile and has a more extreme downward trend compared to markets in the USA and Germany. The changes in global coffee price threaten the sustainability of domestic coffee production. Furthermore, the results of sensitivity analysis on coffee farming in the condition of lowered coffee price presented in Table 3.

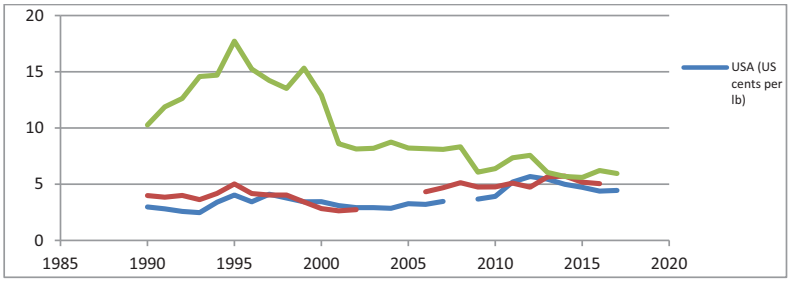

Figure 8. Indonesian coffee price export by destinations during 2003-2017 (ICO 2018)

Table 3.The sensitivity of sustainable coffee production under the coffee price changing

Indicator	Coffee Price Changing					
	Private			HKm		
Criteria	10%	30%	50%	10%	30%	50%
NPV (Rp)	8,436,934	5,989,259	1,538,939	23,575,254	5,749,723	5,749,723
EIRR	47%	40%	24%	38%	73%	28%
Net B/C	3.18	2.55	1.40	2.32	0.14	0.16
Decision	Sustain	Sustain	Sustain	Sustain	un-sustain	un-sustain

The results of sensitivity analysis on the long-term economic sustainability in the condition of coffee price decreasing to 50% indicate that proprietary agroforestry coffee farming continues to provide economic benefits in the long run. Agroecology practices can benefit small farms and help generate income with the volatility of coffee prices and provide positive returns even in the condition of falling prices (Pronti 2018). However, HKm members can reach economic sustainability with a price reduction of up to 30%. When the simulation of coffee prices decreasing by 50% from the base price in 2016, HKm members show that the performance is not sustainable economically. The rating indicator (NPV) shows negative value and net benefit value is less than one. In these conditions, the

HKm license holders should unnecessarily worry recalling an assumption about an actual average production of coffee with unproductive age (coffee plant age <4 years with the production average 75 kg.ha^{-1}). The situation became different when the analysis was carried out by assuming that the HKm farmers' coffee production was at least the same as the production of non-HKM farmers (317 kg.ha^{-1}), and produced possible economic benefits in the long run.

4. DISCUSSION AND CONCLUSION

The application of the Cost-Benefit Analysis (CBA) instrument is needed to find out whether or not the sustainability assessment of coffee agroforestry system in upper Sekampung watershed is essential to provide long-term economic benefits and the environment. Financial sustainability in the coffee production system not only pertains to maintaining productive economic activities but more broadly also involves taking care of the livelihoods, environment and social needs of rural communities often having little opportunity of getting income other sources (Giovannucci and Potts 2008). The coffee farmers' diverse household income source is a strategic option to minimize the impact of production failure risk. The threat of agricultural production failure is very high as extreme microclimate changes occur.

Other studies also found that agroforestry systems still reach economic sustainability despite the decreases of coffee production by 30%, and timber production by 30% (Premono and Lestari 2018). The fruit tree-based agroforestry system that is more attractive financially can be labor- and investment-saving, thereby less risky than the monocropping system (Kassa 2015). The financial feasibility analysis of agroforestry businesses can guarantee the process of internalizing water and carbon services together (Ramadhan 2012).

The coffee planting system with shade plant is very acceptable as a mechanism that can provide sustainable financial and environmental benefits. This mechanism explicitly strengthens the farmers' choice to implement sustainable coffee production (Noordwijk et al., 2004). Small-scale coffee production with agroforestry system functions equally well or better than the monoculture plantation does with high input levels. Agroforestry contributes to the farmer's income in either the short or long term (Indrajaya and Siarudin 2015). The performance of coffee farming with agroforestry can provide a more sustainable income level (Fitriani et al., 2018).

Developing a coffee production business, farmers also grow intercropping plants, especially pepper and banana. Banana is a substitute for household income in the short term. Agroforestry system combining coffee and banana generates monthly income from banana production that can balance the cost of coffee production, generate positive cash flows, and demonstrate economic feasibility. Economically this system is feasible, even with the variations of ± 20% in production costs and the changing product selling prices (Alves et al., 2015).

There is no difference in net farm profit between the shade plant classifications. Extra income coming from timber increases the farmer's income and economic performance of coffee agroforestry in the future (E Rosalien et al., 2017; Jezeer et al., 2018). The study on land for the farmers holding forest management license (HKm) on the Pematang Neba Register 28 and Register 32 of Mt.

RindinganTanggamus showed that planting essential commodities (coffee, pepper, coconut, cocoa, bananas) provides long-term economic benefits (Mardliyah and Berliana 2014).

In addition to being able to streamline the farming costs on agroforestry (Binam et al., 2015; Evizal et al., 2012; Haggar et al. 2015; M. R. A. Noponen et al. 2013), it also benefits environmental services. Environmental services are a form of positive externalities that is enjoyed widely by the community. Coffee agroforestry can provide environmental services and increase the farmers' welfare (Hairiah and Ashari 2013; Suyamto and Noordwijk 2004). Coffee agroforestry is one of the sustainable adaptive management attempts to address the risk of forest ecosystem damage (Buongiorno and Zhou 2015; Eakin et al. 2014; Foran et al. 2014). Ecological restoration of agroecosystems is generally useful and can be recommended as a way of increasing biodiversity and providing support and regulation to environmental services in agricultural landscapes (Paula et al., 2015). One of the best land use strategies is agroforestry due to contribute to food security and mitigate environmental damage (Wilson and Lovell 2016). Coffee planting under the farmer group patronage on Mount Tanggamus shows the performance of multi-strata complex agroforestry with high diversity (Septiawan et al., 2017). The application of complex multi-strata of agroforestry coffee is also applied well in Panggung Island, Tanggamus (Fitriani et al., 2018; Fitriani et al., 2018).

Also, an essential option of increasing the diversity of intercropped populations and MPTS also need to be taken into account to increase the productivity of coffee farmer land. The extensive and intensive promotion of successful agroforestry coffee production patterns in the areas around the protected forest and Sekampung watershed should be developed. The establishment of coffee agroforestry system can design through agricultural extension models with an entrepreneurial approach. The critical factor of the entrepreneurial approach involved the farmers' formal education, farmers' participation in community institution, access to information, farming environment and learning process in education (Aviati et al. 2016). This is an important step to comply with the prerequisites of environmental service scheme development in upper Sekampung watersheds. Complying with the prerequisites of economically sustainable coffee agroforestry is the foundation for developing the environmental service of Payment for Environmental Service (PES), particularly the Compensating for Opportunities Skipped (COS) scheme. COS scheme is appropriate to a condition in which the opportunity legality creates a trade-off reducing environmental services as a result of improved coffee monoculture productivity. The COS scheme assumes that land management rights still become an obstacle to the actors (van Noordwijk and Leimona 2010).

Based on the result of analysis on the economic sustainability of the coffee production system in the Sekampung watershed, it can see that overall coffee can derive from the monoculture and coffee agroforestry systems in land management rights, HKm, and non-HKm fulfilling the eligibility criteria and providing economic benefits in the long run. Notably, both proprietary coffee farmers having private rights to production decisions independently and HKm members obliged to manage agroforestry in their coffee fields show positive performance in carrying out sustainable agroforestry coffee production. This condition is crucial information to minimize the effect of the trade-off between economic benefits and environmental benefits. The land productivity utilized optimally with planting intercropping plants, and MPTS. The application of coffee agroforestry is a strategic option to

increase the productivity of farmers' land by increasing productivity beyond the productivity of coffee monoculture intensification.

Long-term agroforestry coffee production is relatively resistant to the change of coffee prices despite extreme price decline. It indicates that coffee farming agroforestry with property rights and HKm schemes still can provide economic benefits in the long run. The HKm license holders need to take into account the options for increase the diversity of intercropped populations and MPTS to improve the productivity of land under their management.

Overall, it concluded that coffee farming using monoculture and agroforestry system with schemes of proprietary, HKm, and non HKm meets feasibility criteria and provides an economic benefit in the long term. Notably, the proprietary coffee farmers having independent management decisions in choosing agroforestry practices and HKm members obliged to manage agroforestry in their coffee fields show positive performance in carrying out sustainable agroforestry coffee production practices. This condition is vital information to minimize the effect of the trade-off between economic benefits and environmental benefits. The land productivity could be utilized optimally with planting intercropping plants and MPTS that provide higher economic benefits. The application of coffee agroforestry is a strategic option to increase the productivity of farmers' land by increasing productivity beyond the productivity of coffee monoculture intensification.

Agroforestry coffee production in the long term is relatively resistant to the change of coffee prices despite extreme price decline. It indicates that coffee farming agroforestry with property rights and HKm schemes still can provide economic benefits in the long run. The HKm license holders need to take into account the options for increase the diversity of intercropped populations and MPTS to improve the productivity of land under their management

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