Farmer's socio-economic characteristics and financial feasibility analysis of three pepper (*Piper nigrum* L.) farming patterns in Southeast Sulawesi

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Abstract. This study aims to examine farmer's socio-economic characteristics and pepper farming analysis on several pepper management patterns. This study was conducted in Lawonua Village, South Konawe District, and Simbune Village, East Kolaka District, Southeast Sulawesi Province, in June 2014 and November 2015. Data were collected through a survey method using open-ended and semi-structured questionnaire interviews, in-depth interviews, and Focus Group Discussion (FGD). Data were analyzed using qualitative descriptive and financial analysis, such as NPV, BCR, and IRR. The results showed that most income of the community in Simbune and Lawonua Village is from pepper farming activity. The respondents were dominated by men, where most of them are Tolaki Tribe, with average age ranges from 30-50 years old. Education level was dominated by junior and senior high school, and most of the respondents have more than ten years of pepper farming experience. The analysis showed that all pepper pattern management was feasible. The results indicated that the first pattern of monoculture pepper farming provided the highest NPV IDR 379,175,999 (IDR/rotation), and the second-highest was pepper farming with cocoa, which provided the highest BCR values (2.75). While the third was agroforestry pepper patterns with pepper, cocoa, durian, and langsat that had the highest IRR value of 33%. The pepper with the cocoa farming pattern was generally carried out by farmers who have enough capital. While pepper farming in the agroforestry pattern was mostly chosen due to its consideration to provide more security for family income.

1. Introduction
Pepper is one of the leading commodities that has a major role as a source of foreign exchange and farmer's income and provide job opportunities [1]. Indonesia is one of the largest pepper exporters, third place after Vietnam and Brazil [2, 3]. However, Indonesia is also the fifth largest importer of pepper in the world [3]. This condition was caused by unstable production, which results in a decrease in its quantity and quality.

The decline in pepper production is caused by its low quality, disease and pest attack [4], there are only limited pepper growers [5], and pepper management systems in Indonesia is different from other countries. In Indonesia, farmers have some pepper plantations with variation in cultivation techniques, and they do not apply the Good Agriculture Practices (GAP) for pepper cultivation [3]. In Vietnam, as...
an example of pepper management, it was strongly supported by the government and the private sector [3]. The components of GAP based on the guidelines from the International Pepper Community include land selection, land management, water management, integrated cultivation management, pest and disease control, and harvest and post-harvest [6]. Most of the farmers in Indonesia do not apply pest and disease control in pepper management due to the high cost.

The high demand in the international market is an opportunity for the development of pepper in Indonesia [1]. Farmers have three patterns of pepper management, namely: monoculture, mixture, and agroforestry. This study aims to examine farmer's socio-economic characteristics and pepper farming analysis on several patterns of pepper management.

2. Methods
2.1. Time and research location
This study was conducted in Lawonua Village, Besulutu Subdistrict, South Konawe District and Simbune Village, Tirawuta Subdistrict, East Kolaka District, Southeast Sulawesi Province, in June 2014 and November 2015.

2.2. Methodology for data collection and analysis
Data and information were collected from a series of interviews with selected respondents. Respondents were classified into three groups, i.e. (i) farmers with monoculture pepper, (ii) farmers with pepper and cocoa, and (iii) farmers with agroforestry pepper plantations. Purposive sampling was applied to select 58 respondents (29 in Simbune Village and 29 in Lawonua Village) involving 61 plot samples. The composition of plot samples was presented in Table 1.

| Pattern              | Number of Plots |
|----------------------|-----------------|
|                      | Simbune Village | Lawonua Village | Total  |
| Monoculture pepper   | 12              | 8               | 20     |
| Pepper with cocoa    | 5               | 7               | 12     |
| Agroforestry (mix pepper) | 13              | 16              | 29     |
| Total                | 30              | 31              | 61     |

Table 1. Plot composition.

Primary and secondary data were collected in this research. Primary data was collected through household surveys using open-ended and semi-structured questionnaires (farmers' socio-economic conditions, costs, and benefits of managing pepper gardens), in-depth interviews, and Focus Group Discussion (FGD). Meanwhile, secondary data collected includes data about the general condition of the village/research location. Data were analyzed using financial analysis such as NPV, BCR, and IRR and descriptive analysis. Data analysis was conducted as follows:

1. Qualitative descriptive analysis to find out the respondents' socio-economic conditions and farming activities.
2. Analysis of pepper farming, which is based on costs and benefits data obtained from the interviews in accordance with the business cycle (20 years) and various farming patterns that have been found in the research area. Investment criteria used for financial analysis are Net Present Value (NPV), Benefit-Cost Ratio (BCR), and Internal Rate of Return (IRR). The formulas used in financial analysis are as follows [7]:

\[
NPV = \sum_{t=1}^{n} \frac{B_t - C_t}{(1+i)^t},
\]

Where: \(B_t\) is a gross benefit in the t-year; \(C_t\) is the gross cost in the t-year; \(n\) is the economic life of the business, and \(i\) is the prevailing discount rate.
\[
BCR = \frac{PV_{Benefit}}{PV_{Cost}}
\]

\[
IRR = (i_2 - i_1)(\frac{NPV_1}{NPV_1 - NPV_2}) + i_1
\]

The discount rate used is 11.02%, which is the average interest rate between 2010 - 2015.

3. Result and Discussion

3.1. Socio-economic characteristics of farmers in Simbune and Lawonua

Characteristics of farmers in this study include gender, tribe, age, education level, number of dependants, and farming experiences. The results of the household survey were presented in Table 2.

| No | Characteristics of Respondents | Number (person) | Percentage (%) |
|----|--------------------------------|-----------------|----------------|
| 1. | Gender                        |                 |                |
|    | Male                           | 46              | 79.31          |
|    | Female                         | 12              | 20.69          |
|    | Total                          | 58              | 100            |
| 2. | Tribe                          |                 |                |
|    | Bugis                          | 25              | 43.10          |
|    | Tolaki                         | 30              | 51.72          |
|    | Toraja                         | 2               | 3.45           |
|    | Selayar                        | 1               | 1.72           |
|    | Total                          | 58              | 100            |
| 3. | Age                            |                 |                |
|    | < 30                           | 4               | 6.89           |
|    | 30-50                          | 42              | 72.41          |
|    | > 50                           | 12              | 20.69          |
|    | Total                          | 58              | 100            |
| 4. | Education Level                |                 |                |
|    | Up to Elementary               | 27              | 46.55          |
|    | Junior and Senior High School  | 29              | 50             |
|    | Dipl/Bachelor                  | 2               | 3.44           |
|    | Total                          | 58              | 100            |
| 5. | Number of Dependants (person)  |                 |                |
|    | 1 – 3                          | 39              | 67.24          |
|    | 4 – 5                          | 11              | 18.97          |
|    | >5                             | 8               | 13.79          |
|    | Total                          | 58              | 100            |
| 6. | Farming experience (year)      |                 |                |
|    | Up to 5                        | 4               | 6.89           |
|    | 6 -10                          | 8               | 13.79          |
|    | >10                            | 46              | 79.31          |
|    | Total                          | 58              | 100            |

In Simbune and Lawonua Village, education level was dominated by junior and senior high school (50%). Ideally, the level of education shows farmers' insight, knowledge, and rationality in acting. The number of family dependents is mostly one to three persons (67.24%). The number of family dependents will determine the amount of expenditure. Most of the respondents (79.31%) have more...
than ten years of farming experience, including planting pepper. Hence, it was expected that farmers could solve problems related to farming techniques. The sex of the respondents was dominated by men (79.31%) where 51.72% of respondents were from Tolaki Tribe, and 43.10% were from Bugis Tribe. In line with [8], the Community of Simbune Village was dominated by Tolaki, while the community in the Lawonua Village was dominated by Tolaki and Bugis (migrants). Simbune village was identified as a local village while Lawonua Village was a local and migrant village.

Simbune village was founded in the 1930s – 1950s by Tolaki Tribe, who lived from shifting cultivation activities. In the 1970s, people in the village began to plant coffee and cloves. In 1993, the Organization for Economic Cooperation and Development (the Government of Japan) and PT. Hasfarm provided a cocoa seed (F1) in a joint support program. This program also provided extension services and production support for farmers [8]. Lawonua village was founded in the 1930s when the community still settled on the riverbank of Konawe-Eha River, and they planted corn and other crops for their living. The first households (Tolaki) came from Amosilu Village. When the Bugis from Bone arrived, then they became local partners. The community gradually cleared forests for shifting cultivation activities to plant rice, local coffee, sago, coconut, and corn [8].

Based on the community land-use perspective in Simbune Village, it covers forests (32%), cocoa agroforestry (21%), shrubs (20%), swamps (9%), settlements (9%) and pepper gardens (9%). While in Lawonua Village, it covers agro-cocoa plantation (38%), oil palm plantations (17%), 24% shrubs, 8% settlements, 4% sago, 9% maize and other crops [8].

In Simbune Village, the pepper garden is usually far from farmer's house, while in Lawonua Village, the pepper garden is mostly located near their house, although there is also some pepper garden located far from farmer's house.

| No. | Description                                      | Simbune Village                      | Lawonua Village                      |
|-----|-------------------------------------------------|--------------------------------------|--------------------------------------|
| 1.  | Farming land location                           | Private in the village (91%)         | Private in the village (91%)         |
| 2.  | Distance from home to farmer's garden (by foot) | <15 minutes (40%)                    | <15 minutes (56%)                    |
| 3.  | Slope level                                     | Flat land: 59-74%                    | Flat land: 28%                       |
|     |                                                | Slope land: 26-41%                   | More slope land: 72%                 |
| 4.  | Land cultivation                                | Owned and Worked on its own          | Owned and worked on its own          |
| 5.  | Ownership                                       | Inheritance (66-70%), purchase (9-32%)| Inheritance (33%), purchase (59%)    |
| 6.  | Land source                                     | Secondary forest (62%)                | Other people (57%)                   |
| 7.  | Land tenure (year)                              | After 1990                           | After 1990                           |
| 8.  | Ownership status                                | Husband's land (62%)                 | Share land (husband and wife (49%)   |
| 9.  | Land use (before)                               | Cocoa agroforestry (46%)             | Mixed garden (25%)                   |
| 10. | Land use (before and one year after cultivated) | Shrubs (69%)                         | Shrubs (71%)                         |

Source: summarized from [8] and [9]

Most of the community in Simbune and Lawonua are farmers. The land ownership of the farmers in Simbune Village is extensive, with the average area of cocoa agroforestry is 1.11 ha and shrubs 1.09 ha per family. While in Lawonua Village, the average area of cocoa agroforestry is 0.9 ha and mixed gardens 0.79 ha [8]. In Lawonua Village, many local people do not have land because most of it has been sold to migrants.
Pepper farming management can affect the success of pepper management. There is a tendency in both villages that farmers do not carry out intensive maintenance of pepper compared with cocoa. There is an assumption that pepper can still grow well even without intensive maintenance. It is different from cocoa that needs intensive maintenance. In practice, if pepper farming is not intensively maintained, it will not grow well and provide optimal productivity.

Pepper management was carried out in a simple way: using local seeds in the form of worm tendrils (shrubs) and climbing tendrils, with *Gliricidia* sp (Gamal) as a climbing tree. Climbing tree planting is done simultaneously with pepper, or one month before pepper. A hole for planting pepper is made with a 40 cm depth near the climbing tree. Most farmers directly planted pepper, although there were also farmers who planted pepper 1-3 days after making holes.

Pepper maintenance activities were carried out by farmers, including binding of pepper when it is propagating, weeding, and pruning. Fertilizing activities and pests eradication were not carried out by most farmers due to limitations in ability and capital. As a result, pepper attacked by pest/disease was mostly left to die. Some farmers tried to anticipate pest attacks by giving herbicide (*furadan* or *bordo*) before planting.

Simbune and Lawonua Village have three types of pepper management, namely: monoculture (only planted with pepper using *gamal* as a climbing tree), a mixture of pepper and cocoa, and agroforestry pepper (with various types of plants) [9]. The differences between the three types of pepper farming management are summarized in Table 4.

| No. | Description                        | Pepper monoculture | Pepper with cocoa | Pepper in agroforestry |
|-----|----------------------------------|--------------------|-------------------|------------------------|
| 1   | Fruit production                 | More               | More              | Less 50%               | Less 50%                | Reduced          |
| 2   | Growth                           | Faster             | Faster            | Faster                 | Faster                 | Fastest and healthier |
| 3   | Maintenance                       | Easy but not economical | Easy    | More economical       | Easy                   | Easier           |
| 4   | The intensity of pest and disease attacks | Bigger and simultaneous | Faster spreads | The same bit slowly spread | More resistant        | More resistant lower and slowly spread |

Pepper commonly was planted during the rainy season (February - August), but in recent years there were frequent shifts in the rainy season and dry season where the rainy season could be longer or shorter. During the dry season, generally, farmers who will plant pepper have prepared climbing tree, which will become a pillar for pepper. Although the percentage of pepper gardens in the two villages is small, nowadays pepper is a quite attractive choice to increase household income. Research results of [8] stated that the average income from pepper farms in Simbune Village was IDR 3,824,400 (12% of total income), and in Lawonua Village was IDR 2,152,100 (6.8% of total income). In both villages, the most significant contribution was from cocoa agroforestry and mixed-garden (agroforestry). The contribution of cocoa agroforestry to total income in Simbune Village was 38%, and in Lawonua Village was 19.9%. In comparison, the contribution of agroforestry to total income in Simbune Village was 6.7% and 18.4% in Lawonua Village.

3.2. Pepper farming financial feasibility
The financial feasibility analysis of pepper farming in this study aims to determine the financial feasibility of the existing patterns: monoculture pepper, pepper with cocoa, and pepper agroforestry. Agroforestry-managed pepper is usually planted with a variety of fruit trees, but in this analysis, it is limited to the dominant fruit trees found in farmers' land. Pepper cropping patterns in the research site are presented in Table 5.
Table 5. Pepper cropping patterns in the study site.

| No | Pattern                  | Plant          | Average of land (ha) |
|----|--------------------------|----------------|---------------------|
| 1  | Monoculture pepper       | Pepper         | 0.59                |
| 2  | Pepper with cocoa        | Pepper, cocoa  | 1.38                |
| 3  | Agroforestry Type 1      | Pepper, cocoa, patchouli, durian, langsat | 1.32 |
| 4  | Agroforestry Type 2      | Pepper, cocoa, durian, langsat | 1.53 |

The calculation of pepper farming analysis uses several assumptions, namely: 1) pepper farm area is converted into 1 hectare, 2) the cycle used is 20 years, 3) types of pepper produced is white pepper. The selling price used is the average price in 2015 from Southeast Sulawesi (pepper: IDR 105,000 per kg, cocoa: IDR 20,000 per kg), 4) prices of fertilizers, pesticides, insecticides, equipment, and labor are based on the average price in 2015, 5) The seeds used are local seeds (climbing tendrils or worm tendrils), 6) climbing tree is gamal (Gliricidae sp).

The results of the interviews showed that income from agricultural activities is the primary source of income, but agricultural activities in both locations used simple techniques. They have not applied Good Agriculture Practices (GAP). Plant maintenance was not intensive due to capital constraints, and some pepper gardens are located far from the farmers' residence (housing). According to [10], fertilization is absolutely necessary for pepper plants. For optimal pepper shrub, fertilization should be provided four times a year. If adjusting to GAP, the costs incurred for all pepper farming patterns are enormous, but farmers in Simbune and Lawonua village usually only pay for fertilizers and pesticides if needed. Most seeds are obtained without buying.

Farming costs are all inputs used to finance farming activities [11]. Determining the cost of inputs, both technically and economically in agroforestry gardens, uses the principle of joint cost [12]. These costs include: 1) Investment costs consist of land rent, payment of taxes and equipment costs, and 2) Operational costs consist of land processing, purchase of seeds, fishing, planting, fertilizing, maintenance, and harvesting. However, the cost of harvesting fruit trees is not always taken into account because farmers sometimes sell on trees (farming land).

Of all the operational patterns, the costs for cocoa are higher than for other crops, and the highest costs are for workers, although, in reality, the labor used is unpaid family labor. This is in line with [13], who stated that variable costs, including the costs of seeds, labor, and transportation to the market of the cocoa product, provided a percentage of 90.03%. The wage component of labor plays a dominant role in the structure of production costs. Table 6 presents the NPV, BCR, and IRR values of three pepper management patterns.

Table 6. NPV, BCR, and IRR values of pepper farming in several management patterns.

| No | Pattern                  | Discounted income (IDR/rotation) | Discounted cost (IDR/rotation) | NPV (IDR/rotation) | BCR  | IRR  |
|----|--------------------------|---------------------------------|--------------------------------|--------------------|------|------|
| 1  | Monoculture pepper       | 621,425,620                     | 242,249,620                    | 379,175,999        | 2.57 | 31%  |
| 2  | Pepper with cocoa        | 388,376,570                     | 141,062,507                    | 247,314,064        | 2.75 | 31%  |
| 3  | Agroforestry Type 1      | 410,813,446                     | 225,754,255                    | 185,059,191        | 1.82 | 25%  |
| 4  | Agroforestry Type 2      | 369,047,542                     | 152,048,729                    | 216,998,814        | 2.43 | 33%  |

NPV calculation was conducted to determine the present value of the net benefits obtained during the period of pepper cultivation. Based on the calculation (Table 6), pepper farming activities in all
management patterns are feasible because they produce NPV more than zero (NPV > 0). The highest NPV value is the pepper monoculture pattern. The differences in the benefits of the value obtained from each pattern were caused by technology in managing the pepper farming land, size of landholding, education level, and labor productivity level.

The size of landholding can affect the pattern of pepper management. Farmers who have vast land tends to apply monoculture or cocoa pepper farming. In contrast, farmers with limited land tend to apply with agroforestry system, because the land is the main source of income. However, the size of the landholding does not always relate to income. According to [10], although extensive land ownership supports pepper management, farmers do not always get high income, and otherwise. Many factors are affecting the management of pepper, such as decreasing land fertility, unpredictable weather changes, and also the condition of old/unproductive pepper. [14] stated that production factors that affect pepper productivity are the size of landholding and the use of fertilizer and labor, while the factors of production that do not affect the productivity of pepper are seeds, pesticides, and type of pepper.

Education is one factor that can determine the motivation of farmers in conducting pepper farming [11]. There is a tendency of farmers with higher education will choose commodities with higher economic value to cultivate the land. The pepper cocoa pattern is more preferred because both of them have high economic value, but when faced with limited capital, farmers will choose the monoculture pepper or agroforestry pattern because the costs are less than the pepper cocoa pattern.

Differences in the economic value of agroforestry can be caused by labor productivity, differences in cropping patterns, types of commodities, and size of landholding [12]. In the agroforestry pattern, more labor is used because there are many planting activities with several commodities. Therefore, agroforestry patterns have socio-cultural values compared with others.

IRR value is more than the opportunity cost of capital (OCC) value, which is 11.02% (IRR in all management > 11.02 %). Thus, it can be concluded that farming in all management is feasible. There is a relationship between IRR and NPV. IRR is a discount rate (DR) that produces NPV equal to 0. This means that when the discount rate of 31% for monoculture pepper and pepper with cocoa, 25% for pepper agroforestry type 1, and 33% pepper agroforestry type 2, it will produce NPV equal to zero. Net B/C ratio obtained from monoculture was 2.57, pepper with cocoa was 2.75, pepper agroforestry type 1 was 1.82, and pepper agroforestry type 2 was 2.43. This shows that every additional fee of IDR 1.00 will result in an additional benefit of IDR 2.57 for monoculture, an additional benefit of IDR 2.75 for the pepper and cocoa, an additional benefit of IDR 1.82 for pepper agroforestry type 1, and additional benefit of IDR 2.43 for pepper agroforestry type 2. Net B/C Ratio value produced by all management patterns is more than one, so pepper farming in all management is feasible. When compared to all existing patterns, agroforestry type 2 (pepper, cocoa, durian and langsat) is the most suitable pattern to cultivate, with the assumption that there are no pest attacks on a large scale. If there is a pest attack on pepper, agroforestry patterns are considered by farmers to be safer because farmers can still get income from other crops. Some plants such as patchouli also provide shorter-term income, and fruit trees can be sold or be consumed directly.

Some research results show that monoculture pepper is feasible, primarily if it is cultivated with the procedure (GAP). [15] stated that pepper farming in Lampung could obtain NPV of IDR 235,881,319 ha⁻¹ cycle⁻¹ with IRR 53%, B/C ratio 2.5, and payback period 2.8 years. Still in Lampung, [16] stated that pepper farming could obtain NPV of IDR 270,000 ha⁻¹ cycle⁻¹ with IRR 24.63 on interest rate 24%. In Lahat South Sumatra, [17] stated that pepper farming could produce an NPV of IDR 46,311,720, a BCR of 1.5, and an IRR of 37.5%.

Furthermore, [18] stated that in Pesawaran District, Lampung Province, the main combination of cocoa and banana cropping patterns on state forest produces NPV of IDR 17,452,336.56; BCR of 1.32; an IRR of 23%. A combination of cocoa and parkia produced NPV, BCR, and IRR values of IDR 41,860,069.85; 1.77; and 27%, respectively. Then, a combination of cocoa and durian resulted in NPV of IDR 42,864,090.38, BCR of 1.79, and IRR of 28%. These three patterns are feasible. The pattern of planting cocoa + durian and cocoa + parkia is more profitable than the pattern of cocoa +
banana, but farmers who plant on state forest prefer the pattern of cocoa + banana because there is no security of land tenure in the state forest.

The high current prices caused the positive value of pepper farming feasibility. Based on farmer information until December 2015, the price of dried pepper was IDR 120,000 per kg, even though in the previous year, the price of dried pepper was IDR 30,000 to IDR 40,000 per kg. Pepper and cocoa marketing did not face any problem. Whereas for fruit plants such as rambutan or langsat, when there is a big harvest, there are no buyers for them; consequently, they are only consumed by family members. The marketing conditions of pepper and other products are presented in Table 7.

| No. | Plant species | Form of sale | Place of sale | Buyer | Transaction system | Type of marketing | Buyer status |
|-----|---------------|--------------|---------------|-------|-------------------|-------------------|--------------|
| 1.  | Pepper        | Dried fruit  | House         | In/out Village | Cash              | Temporary        | Trader       |
| 2.  | Cocoa         | Dried fruit  | House         | Village outside | Cash              | Temporary        | Trader       |
| 3.  | Patchouli     | Wet/dry leaves | House      | In/out village | Cash              | Temporary        | Trader       |
| 4.  | Durian        | Fruit        | On-Farm       | Village outside | Cash              | Temporary        | Consumer     |
| 5.  | Langsat       | Fruit        | On-Farm       | Village outside | Cash              | Temporary        | Consumer/Trader |

4. Conclusion
Most of the community in Simbune and Lawonua Village are farmers having experience in pepper farming. Most of the respondents from Tolaki Tribe are men with average ages ranges from 30-50 years old. The education level was dominated by junior and senior high school. The size of landholding and limited capital influenced farmers to choose to apply the agroforestry pattern in pepper management. Pepper management was carried out in a simple technique, using local seeds, and plant maintenance was not intensive. Pepper farming activities in all management (monoculture pepper, pepper with cocoa, and agroforestry pattern) are feasible. However, pepper in the agroforestry pattern is mostly chosen because it provides more security for family income and more resistant to pests and diseases attack. Monoculture pepper provides the highest NPV and costs less, but it is not resistant to pests and diseases, while the pattern of pepper with cocoa provides the highest BCR, but it needs significant capital. In the future, pepper cultivation in Indonesia can be developed with an agroforestry pattern. Strengthening the capacity of pepper farmer and improvement of pepper technique is needed, in particular in the development of pepper quality, cocoa, and other commodities, such as high quality of seeds and technique to control diseases and pests attack.

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References
[1] Maryadi, Sutandi A and Agusta I 2016 Analisis usaha tani lada dan arahan pengembangannya di Kabupaten Bangka J. SEP 9 23–9
[2] Rosida, Busaeri S R and IIsan M 2018 Prospek pengembangan usaha tani lada (Piper nigrum L.) (Studi kasus di Desa Pebaloran, Kecamatan Curio, Kabupaten Enrekang) Wiratani 1 78–89
[3] Kardinan A, Laba I W and Rismayani 2018 Peningkatan daya saing lada (Piper nigrum L.) melalui budidaya organik J. Perspektif 17 26–39
[4] Yanti, Syamsudin T and Saparuddin 2018 Analisis keputusan petani dalam pengelolaan hama pada tanaman lada (Piper nigrum L.) J. Saintifik 4 99–110
[5] Wahyudi A 2010 Teknologi pertanian sehat kunci sukses revitalisasi lada. *SINAR TANI*
[6] International Pepper of Community 2011 *Good Agricultural Practices of Pepper* (Jakarta: Balai Penelitian Tanaman Obat dan Aromatika Kementerian Pertanian Republik Indonesia)
[7] Gray C F and Larson E W 2007 *Manajemen Proyek Proses Manajerial* (Yogyakarta: ANDI)
[8] Janudianto, Khususiyah N, Isnurdiansyah S, Suyanto and Roshetko J M 2013 *Livelihood strategies and dynamics of land use systems in Southeast Sulawesi Working paper* (Bogor: World Agroforestry Center)
[9] Fauziyah E, Suhaendah E and Manurung G S 2016 Pengetahuan petani mengenai pemanfaatan limbah kakao untuk pupuk kompos di Desa Lawonu, Sulawesi Tenggara *Prosiding Seminar Nasional VII Masyarakat Konservasi Tanah dan Air Indonesia* (Bandung) p 209
[10] Rismunandar and Riski M H 2003 *Aquaculture and trading pepper* (Jakarta: Self Help Spreader)
[11] Awang S A, Andayani W, Affianto A, Himmah B and Widayati W T 2002 *Community Forestry Socio-Economic and Marketing* (Yogyakarta: BPFE)
[12] Andayani W 2005 *Agroforestry Economy* (Yogyakarta: Debut Press)
[13] Suripatty M P 2011 Analisis struktur biaya produksi dan kontribusi pendapatan komoditi kakao (Theobroma cacao L) di Pulau Latu *J. Agroforestri* 6 135–41
[14] Surianti, Rianse U and Abdullah W G 2018 Analisis efisiensi usaha tani lada di Desa Lalonggapu Kecamatan Landono Kabupaten Konawe Selatan *J. Agribisnis dan Ilmu Sos. Ekon. Pertan.* 3 34–9
[15] Hasibuan A M and Sudjarmako B 2008 Daya saing usahatani lada di Lampung *RISTRI Bull.* 1 1–8
[16] Nurasa T and Supriatna A 2005 Analisis kelayakan finansial lada hitam (Studi kasus di Provinsi Lampung) *J. Sos. Ekon. Pertan.* 5 1–16
[17] Sumantri B, Purnomo B S and Isronita M 2004 Analisis finansial usaha tani lada (*Piper nigrum L.*) di Desa Kunduran Kecamatan Ulu Musi Kabupaten Lahat Sumatera Utara *J. Agric. Sci.* 6 32–42
[18] Febryano I G 2009 Analisis finansial agroforestri kakao di lahan hutan negara dan di lahan milik *J. Perenn.* 4 41–7