The Role of Smallholder Human Resources on the Performance of the Supply Chain of Cocoa Beans in Central Sulawesi Indonesia: A Structural Equation Modeling Analysis

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The Role of Smallholder Human Resources on the Performance of the Supply Chain of Cocoa Beans in Central Sulawesi Indonesia: A Structural Equation Modeling Analysis

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Abstract

This study aimed to analyze the role of smallholder human resource skills in cocoa farming on the cocoa bean supply chain performance in Indonesia and uses structural equation modeling (SEM) for this purpose. Data were collected from 320 farms in Sigi Regency and Parigi Moutong Regency. The results of the study showed that smallholder resource skills directly and indirectly have significant and positive...
effects on agility, flexibility, and economic performance in the cocoa bean supply chain. Thus, collaboration between universities, government, and the private sector is needed to support smallholders in developing education, skills, and capabilities. Increasing education and skills would lead smallholders to adopt the technologies recommended by universities, government and the private sector so that they could carry out efficient production processes to produce a high output of high quality and cocoa beans. High output and high quality cocoa beans would provide a large economic benefit to smallholders.

**Keywords:** cocoa farming, smallholder human resources, supply chain of cocoa beans.

1. Introduction

Worldwide chocolate sales are approximately US $112 billion, but the market value of cocoa beans at the farmer's level is estimated at US $9 billion in 2015. Cocoa farmers contributed approximately 95% of the output, with revenues of less than US $1 per capita per day (Anga, 2016). Indonesia is the fifth largest cocoa producer in the world (Effendy et al., 2019), but the income of cocoa farmers is still less than US $1 per capita per day. This is because Indonesia is generally only a producer of raw materials (Effendy, 2018a).

In Asia, Indonesia ranked first as a producer of cocoa with a production of 240,000 tons per year, followed by Papua New Guinea 40,000 tons per year (ICCO, 2019). This production was very low when compared to Côte d'Ivoire and Ghana which reached 2,220,000 tons per year and 830,000 tons per year (ICCO, 2019).
Cocoa plantations in Indonesia are dominated by smallholder plantations, which are characterized by the very minimal application of cultivation and postharvest technology (Effendy, Hanani, Setiawan, & Muhaimin, 2013; Effendy & Antara, 2015; Effendy, 2018a). This means that productivity is very low as is the quality of the cocoa beans; thus it is a limiting factor in the development of Indonesian cocoa (Effendy & Antara, 2015; Effendy, 2018b). This condition is exacerbated by the weak bargaining position of farmers in the market system (Hasibuan et al., 2015).

The dominant position in the cocoa market is traders. Traders are parties who enjoy very high margins in the cocoa market system, so prices at the farmer’s level become very low (Sisfahyuni, Saleh, & Yantu, 2011; Abubakar, Yantu, & Asih, 2013). Traders became able to dictate to farmers because farmers were characterized by weak mastery of information and little financial strength (Hasibuan et al., 2015).

The dominance of traders in the cocoa marketing system in Indonesia means that the cocoa supply chain, in general, is not optimized (Hasibuan et al., 2015; Herawati, Rifin, & Tinaprilla, 2015). Improved supply chain management could provide benefits to producers and consumers in terms of price, time, food security, and market access (Wong, 2007).

Supply chains capture the life cycle of a product, ranging from design to compilation, distribution, and consumption (Chopra & Meindl, 2004; Blanchard, 2010). These activities include the procurement of inputs, production processes, product storage, distribution, and commercialization (Garcia-Alcaraz et al., 2017), and there are several factors that influence these activities. Although there are factors that play a key role in the supply chain, the literature has not succeeded in fully determining how they affect the performance of various companies and farms (Soin 2004; Li, Kramer,
Beulens, & van der Vorst, 2010; Zhao, Feng, & Wang, 2015; Garcia-Alcaraz et al., 2017).

Soin (2004) and Alfalla-Luque et al. (2015) identified more than 13 factors in supply chain performance, including labor, flexibility, agility, communication, and regional infrastructure. These factors were independent variables and were considered to increase supply chain performance. They considered supply chain performance as the dependent variable. The identification results showed these factors influenced the performance of the supply chain. Labors in farming were smallholders, so their human resources needed to be considered.

The influence of these factors and their interactions deserves study in the supply chain of cocoa beans in Indonesia because a better understanding could have an impact on the sustainability of cocoa farming. This study adopted a model from Garcia-Alcaraz et al. (2017) and adjusted the model to the conditions of the cocoa beans supply chain in Indonesia. This study aimed to analyze the role of smallholder human resource skills in cocoa farming on the performance of the cocoa beans supply chain in Indonesia.

2. Materials and Methods

2.1 Study areas and sample design

The study was conducted in Central Sulawesi, which was chosen purposively because it is the center of cocoa production in Indonesia (BPS, 2018a). Central Sulawesi has 13 regencies that produce cocoa crops, and there are 5 regencies with production above 10,000 tons: the Regencies of Banggai, Poso, Donggala, Parigi Moutong, and Sigi (BPS, 2018b).
Two regencies were used as the location of the study, selected randomly from among the five regencies: Sigi Regency and Parigi Moutong Regency were chosen as the research locations. Sigi Regency was represented by the villages of Berdikari and Rahmat, while Parigi Moutong Regency was represented by the villages of Sidole and Tanampedagi. We randomly selected 320 farms from all cocoa farms that were already in production. Data on smallholder human resource skills, supply chain agility, supply chain flexibility, and supply chain economic performance and information on the household characteristics of cocoa farms were collected from March to May 2019.

2.2 Theoretical and research model

2.2.1 Human resources in the supply chain

Human resources are key indicators of a company's success because human factors are considered to be a critical aspect of the supply chain (Lengnick-Hall, Lengnick-Hall, & Rigsbee, 2013; Garcia-Alcaraz et al., 2017). Alfalla-Luque, Marin-Garcia, & Medina-Lopez (2015) discussed 28 factors that affect supply chain integration, and the most significant of them were managerial commitment and human resources. The most recent study discussing the element of human resources in the supply chain (Garcia-Alcaraz et al., 2017) introduced 4 factors that affected wine supply chain integration, and the most significant factor was the influence of human resource skills on supply chain flexibility. Cocoa has its own supply chain and needs to be studied. Another important aspect of smallholder human resources that needs to be considered for cocoa farming is the farmers' qualifications because the level of education, skills, and experience add flexibility to the supply chain. Farmers who are
highly educated and trained are able to make the right production decisions to increase output (Effendy et al., 2013; Effendy, 2018b; Garcia-Alcaraz et al., 2017).

2.2.2 Supply chain agility

Agility in the supply chain is the ability to respond quickly to changes in demand from customers or end consumers and will affect product prices (Sherehiy, Karwowski, & Layer, 2007). Garcia-Alcaraz et al. (2017) discussed the importance of agility in the wine supply chain, where supply chain agility has a significant effect on supply chain economic performance. In the case of cocoa farming, agility is important because agricultural products require special treatment and storage to ensure their quality (Garcia-Alcaraz et al., 2017). Such activities are also the result of human resource skills (Lin, Chiu, & Tseng, 2006). Agility is also important in the supply chain for cocoa beans because farmers need to adapt to changes in consumer demand related to the amount and quality of cocoa beans. Farmers must also be agile in marketing cocoa beans. Farmers who succeed in these activities will certainly benefit from a competitive advantage and improved performance, which would bring them greater economic benefits (Garcia-Alcaraz et al., 2017). Based on the discussion we proposed the following hypothesis.

Ha1: Smallholder resource skills for cocoa farming have a direct and positive effect on the agility of the supply chains of cocoa beans.

2.2.3 Supply chain flexibility

Flexibility is the speed with which an adaptable supply chain supports market changes or product modification. One factor that can help achieve supply chain
flexibility is human resources. For example, some researchers have studied the impact of human resources on supply chain flexibility (Das 2011; Lengnick-Hall et al. 2013; Jin, Vonderembse, Ragu-Nathan, & Smith, 2014; Blome, Schoenherr, & Eckstein, 2014), for example (Garcia-Alcaraz et al., 2017), the effect of human resources on the flexibility of the wine supply chain. These authors find that supply chain flexibility greatly affected the agility of the wine supply chain. Managers and administrators built flexible organizations so that they could accelerate design changes and meet customer demand. In this case, they relied on trained and multifunctional workers to perform activities in the supply chain and maintained material flow throughout the production process. It is important to identify flexibility in the cocoa supply chain where farmers can adapt to changes in world cocoa prices. Farmers can also take action to increase cocoa productivity, such as rejuvenating old cocoa crops, using and pruning protective trees, and taking advantage of extension services and training to improve the efficiency with which they use production inputs. Farmers who succeed in these activities obtain greater economic benefits. Based on the thing, the following hypothesis is proposed.

Ha2: Smallholder resources skills for cocoa farming have a direct and positive effect on the flexibility of the cocoa beans supply chains.

Ha3: The flexibility of supply chains in making changes in production processes has a direct and positive effect on SCA.

2.2.4 Supply chain economic performance

Supply chain performance in this study was measured using economic units because the economic performance of supply chains reflects the ultimate goal of the company (Searcy, McCartney, & Karapetrovic, 2007). Supply chain economic
performance captures a company's economic output, such as sales growth, profitability, and cash flow (Garcia-Alcaraz et al., 2017). According to Gunasekaran, Patel, & McGaughey (2004), supply chain performance must be measured by elements of financial performance. Every company must measure the economic effectiveness of its supply chain if it is to be aware of the economic situation and implement plans for future improvement. Such measurements may depend on several aspects, such as human resource skills (Garcia-Alcaraz et al., 2017). Another source of successful supply chain economic performance is agility, where organizations adjust to demand uncertainty (Garcia-Alcaraz et al., 2017). The same study also finds that companies that are able to adapt quickly to change are also likely to benefit from a larger group of customers. In addition to supply chain agility, it is also necessary to analyze supply chain flexibility. Flexibility must be monitored in the supply chain design phase. According to Seebacher & Winkler (2015), the easiest way to measure flexibility in the supply chain is through an economic approach. Therefore we considered the following hypothesis.

Ha4: Smallholder resource skills in cocoa farming have a direct and positive effect on the economic performance of the supply chain of cocoa beans.

Ha5: The agility of the supply chain has a direct and positive effect on the economic performance of the cocoa beans supply chain.

Ha6: The flexibility of the supply chain has a direct and positive effect on the economic performance of the cocoa beans supply chain.

Based on this relationship, we propose a cocoa bean supply chain performance model, as shown in Figure 1.
Figure 1 adopts the supply chain model proposed by Garcia-Alcaraz et al. (2017), adjusted to reflect the supply chain of cocoa beans. The model in this study consisted of 4 latent variables and 12 manifest variables, as shown in Table 1.

### 2.3 Data collection

Data collection in this study used a structured questionnaire. The questionnaire was designed to identify the research variables listed in Table 1. Data measurements were carried out using a Likert scale. Lower values (1) indicated that activities have no benefits, and the highest value (5) meant that activities are very useful in cocoa farming. Questionnaires were given to managers who were active in cocoa farming. The collected data were then analyzed using structural equation modeling (SEM).

### 2.4 Structural equation modeling

The SEM technique is used to test the hypothesis of the proposed model. Lisrel software is used to analyze the model in Figure 1, and five indexes of model suitability are calculated: chi-square test ($\chi^2$), root mean square error of approximation (RMSEA), comparative fit index (CFI), goodness-of-fit index (GFI), and adjusted goodness-of-fit index (AGFI), as summarized from Fan & Sivo (2005), Barrett (2007), Ryu (2011) and Byrne (2013). The model is said to have good fit if it meets the following conditions (Table 2).

A chi-square test was used to test $H_0$. $H_0$ states that there is no difference between the covariance of the population and the covariance of cocoa farming samples; if $H_0$ is accepted, then the model fits (Curran, Bollen, Paxton, Kirby, & Chen, 2002; Fan et al., 2016). However, authors argue that the Chi-square test is very sensitive to sample
size. RMSEA was the used to compensate for this weakness in the Chi-square test: if RMSE > 0.06, it indicates the lack of suitability of the model. According to Fan et al. (2016), the comparative fit index is a model feasibility test that is not sensitive to sample size or the complexity of the model; if CFI < 0.95, then the model has poor fit. GFI is analogous to the determinant coefficient in a regression; if GFI ≤ 0.90, then the model does not fit. GFI is affected by sample size (Sharma, Mukherjee, Kumar, & Dillon, 2005), this weakness was compensated for by using AGFI.

3. Results and Discussion

3.1 Testing goodness-of-fit with structural equation modeling (SEM)

SEM is a statistical method that carries out confirmatory factor analysis (CFA) and simultaneously estimates a series of multiple regression equations that assess the direct and indirect effects of the variables tested (Brown, 2015; Kline, 2016). The CFA procedure was carried out to verify the validity of the four latent variables and 12 manifest variables in this study. The results of the structural model evaluation described earlier are shown in Figure 2 and Table 3.

Figure 2 is the standard coefficient obtained from the CFA, which shows the relationship between the manifest variables and the factor items that measure it through modeling. Figure 2 shows that all factor items that measure the manifest variable were between 0.69 and 0.99, which exceeds the limit of 0.5, so it meets the requirements for each measurement equation (Hair, Black, Babin, & Anderson, 2010).

Table 3 shows that the SEM model of the supply chain performance of cocoa beans overall has a good ability to match the sample data (goodness-of-fit). The structural model is said to have good fit if it meets the requirements, as shown in Table
2. The structural model described previously had an estimation covariance matrix that was not significantly different from the covariance matrix of the sample data (Chen, Curran, Bollen, Kirby, & Paxton, 2008; Fan et al., 2016; Ribeiro et al., 2017).

3.2 Direct effects

The direct effects between constructs in this study can be seen in Table 4.

Table 4 shows the direct effects between constructs and can be used to prove the hypothesis stated earlier:

Ha1: Statistically, there is enough evidence to state that smallholder resource skills in cocoa farming have a direct and positive effect on the SCA of cocoa beans. This is in accordance with previous theory, which stated that human resource skills had a positive effect on SCA (Lin et al., 2006; Garcia-Alcaraz et al., 2017).

Ha2: Statistically, there is enough evidence to state that smallholder resource skills in cocoa farming have a direct and positive effect on the flexibility of the cocoa beans supply chain. This is in accordance with the previous hypothesis, which stated that human resource skills had a positive effect on supply chain flexibility (SCF) (Das, 2011; Lengnick-Hall et al. 2013; Jin et al. 2014; Blome et al. 2014; Garcia-Alcaraz et al., 2017).

Ha3: Statistically, there is enough evidence to state that SCF in terms of making changes in the production process had a direct and positive effect on SCA for cocoa farming. This result was in accordance with the previous theory, which stated that SCF had a positive effect on SCA (Das, 2011; Garcia-Alcaraz et al., 2017). The SCF of cocoa beans had a significant effect on supply chain speed. Thus, cocoa farm managers...
are required to build flexible organizations to increase the production and quality of cocoa beans to meet consumer demand.

Ha4: Statistically, there is enough evidence to state that smallholder resource skills in cocoa farming have a direct and positive effect on the economic performance of the cocoa beans supply chain. This is in accordance with the previous hypothesis stating that human resource skills had a positive effect on SCEP (Alfalla-Luque et al., 2015). Smallholder human resources were the key indicator of success in cocoa farming because human factors play a key role in the supply chains (Lengnick-Hall et al. 2013; Alfalla-Luque et al., 2015; Garcia-Alcaraz et al., 2017). The important aspects to consider are education level qualifications, skills, and farming experience because these will increase the speed, flexibility, and financial performance of the cocoa beans supply chain.

Ha5: Statistically, there is enough evidence to state that SCA had a direct and positive effect on the SCEP of cocoa beans. This was in accordance with the previous theory, which stated that SCA had a positive effect on SCEP (Garcia-Alcaraz et al., 2017). SCA is important in cocoa farming because agricultural products require special treatment and storage to ensure their quality (Garcia-Alcaraz et al., 2017). Cocoa farmers could adapt to changes in consumer demand in terms of the quantity and quality of cocoa beans by adopting technologies recommended by the government, such as using superior seeds and fermenting cocoa beans (Effendy & Antara, 2015; Effendy et al., 2019). In addition, farmers could also market cocoa beans more efficiently. Farmers who succeed in these activities would obtain greater economic benefits (Effendy et al., 2019).
Ha6: Statistically, there is enough evidence to state that SCF had a direct and positive effect on the economic performance of the cocoa bean supply chain. This is in accordance with the previous theory, which stated that SCF had a positive effect on SCEP (Blome et al. 2014; Seebacher & Winkler 2015; Garcia-Alcaraz et al., 2017). Flexibility must be monitored by the supply chain design phase. SCF could be the result of several elements, such as rejuvenating old cocoa crops, using and pruning protective trees, and utilizing extension services and training in the cocoa fields (Effendy, 2015; Effendy, 2018b).

3.3 Indirect effects

Figure 2 shows that latent variables had an indirect effect on other latent variables, which are summarized in Table 5.

Table 5 shows that all indirect effects between latent variables were statistically significant (p < 0.05). This finding indicates that the smallholder human resources of cocoa farms, in addition to having a direct effect on the economic performance of the cocoa beans supply chain, also had an indirect effect through speed and SCF. Smallholder human resources for cocoa farming were measured based on education, skills, and experience, which means that to increase economic performance in the cocoa beans supply chain, the education and skills of farmers must be increased. The education and skills of farmers could be increased through extension services and training (Effendy et al. 2019).

3.4 Total effects

The total effects of the SEM mentioned earlier are shown in Table 6.
Table 6 shows that the effects were statistically significant (p < 0.05). HRS coefficient values higher than 0.5 indicate that HRS has the highest effect on the economic performance of the cocoa bean supply chain so that smallholder resources needed to be improved through extension services and training to increase the income of cocoa farmers (Effendy et al., 2019).

4. Conclusions

The six hypotheses proposed in SEM were all accepted. Based on the effects between the latent variables, the effect of HRS on SCF was the highest, at 0.73, which means that most SCF on cocoa farming was caused by education, skills, and smallholder resource capabilities. HRS also affects SCEP and SCA, even though the value was smaller (0.43 and 0.42), because HRS is the basis of SCA, SCF, and SCEP.

Acknowledgments

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Figure 1. Supply chain model of cocoa beans

Figure 2. Structural Model Estimation of the supply chain performance of cocoa beans
### Table 1 Research Variables

<table>
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<tr>
<th>Latent variable</th>
<th>Manifest variable</th>
<th>Symbol</th>
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<tr>
<td>Human resources of smallholder (HRS)</td>
<td>1. Education of smallholder</td>
<td>X1</td>
</tr>
<tr>
<td></td>
<td>2. Skills of smallholder</td>
<td>X2</td>
</tr>
<tr>
<td></td>
<td>3. Cocoa farming experience</td>
<td>X3</td>
</tr>
<tr>
<td>Supply chain agility (SCA)</td>
<td>1. Cocoa marketing efficiency</td>
<td>X4</td>
</tr>
<tr>
<td></td>
<td>2. Level of technology adoption</td>
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<td></td>
<td>3. Rapid change in improving the quality of cocoa beans</td>
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<td>Supply chain flexibility (SCF)</td>
<td>1. Rejuvenation of old cocoa crops</td>
<td>X7</td>
</tr>
<tr>
<td></td>
<td>2. Using and pruning of protective trees</td>
<td>X8</td>
</tr>
<tr>
<td></td>
<td>3. Frequency of using extension services</td>
<td>X9</td>
</tr>
<tr>
<td></td>
<td>and training for cocoa farming</td>
<td></td>
</tr>
<tr>
<td>Supply chain economic performance (SCEP)</td>
<td>1. Increased sales / level of cocoa production</td>
<td>X10</td>
</tr>
<tr>
<td></td>
<td>2. Cash flow (availability of cocoa production inputs)</td>
<td>X11</td>
</tr>
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3. Income level

Table 2. Goodness-of-fit for model evaluation in Figure 1

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<td>Chi-square test ($\lambda^2$)</td>
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<td>Root mean square error of approximation (RMSEA)</td>
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<td>Comparative fit index (CFI)</td>
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<td>AGFI</td>
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Source: Manurung, Basir-Cyio, Basri, & Effendy, 2019.

Table 3. Goodness-of-fit structural models

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<tr>
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### Table 4. Direct effects between constructs

<table>
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<tr>
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<td>0.73*</td>
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</tr>
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<td>0.43*</td>
<td>0.19*</td>
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* p < 0.05

### Table 5. Indirect effects

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<td>SCEP</td>
<td>0.31*</td>
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<td>0.06*</td>
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* p < 0.05

### Table 6. Total effects

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<td>SCEP</td>
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<td>0.74*</td>
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<td>0.31*</td>
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<tr>
<td>SCF</td>
<td>0.73*</td>
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* p < 0.05