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Original Article

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 effects 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 show 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 enable smallholders to adopt technologies recommended by universities, government and the private sector, so that they could carry out efficient production with a high output of high quality cocoa beans. High output and high quality cocoa beans would provide a large economic benefit to the smallholders.

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

1. Introduction

Worldwide chocolate sales are approximately US $112 billion annually, but the market value of cocoa beans at the farmer's level was 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).

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In Asia, Indonesia ranked first as a producer of cocoa with a production of 240,000 tons per year, followed by Papua New Guinea at 40,000 tons per year (International Cocoa Organization [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 only very minimal application of cultivation and postharvest technologies (Effendy, 2018a; Effendy & Antara, 2015; Effendy, Hanani, Setiawan, & Muhaimin, 2013). This means that productivity is very low, as is the quality of the cocoa beans; thus these conditions limit developments in Indonesian cocoa production (Effendy, 2018b; Effendy & Antara, 2015). This is further exacerbated by the weak bargaining position of farmers in the market system (Hasibuan *et al.*, 2015).

The dominant position in the cocoa market is held by the traders. Traders are parties who enjoy very high margins in the cocoa market system, while prices at the farmer's level remain very low (Abubakar, Yantu, & Asih, 2013; Sisfahyuni, Saleh, & Yantu, 2011). Traders are able to dictate condition to the farmers, because the latter possess only a 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 (Blanchard, 2010; Chopra & Meindl, 2004). 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 (Garcia-Alcaraz *et al.*, 2017; Li, Kramer, Beulens, & van der Vorst, 2010; Soin 2004; Zhao, Feng, & Wang, 2015).

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, considered as the dependent variable. The model identification showed these factors indeed influenced the performance of the supply chain. Labor in the 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 bean supply chain in Indonesia. This study aimed to analyze the effects of smallholder human resource skills in cocoa farming on the performance of the cocoa bean 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 sampling locations 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 the cocoa farms that were already in production. Data on smallholder human resource skills, supply chain agility, supply chain flexibility, and supply chain economic performance, as well as information on the household characteristics of cocoa farms were collected from March to May 2019.

2.2 Theory and the 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 (Garcia-Alcaraz *et al.*, 2017; Lengnick-Hall, Lengnick-Hall, & Rigsbee, 2013). 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 pose 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 (Blome, Schoenherr, & Eckstein, 2014; Das 2011; Jin, Vonderembse, Ragu-Nathan, & Smith, 2014; Lengnick-Hall *et al.* 2013), and (Garcia-Alcaraz *et al.*, 2017) report on the effects 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 actions 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. So, the following hypotheses are posed.

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 changes 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 hypotheses.

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 these tentative relationships, we propose a cocoa bean supply chain performance model 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. The lowest value (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 hypotheses using the proposed model. Lisrel software was used to analyze the model in Figure 1, and five indexes of model suitability were calculated: chi-square test (λ^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 a good fit if it meets the conditions in 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

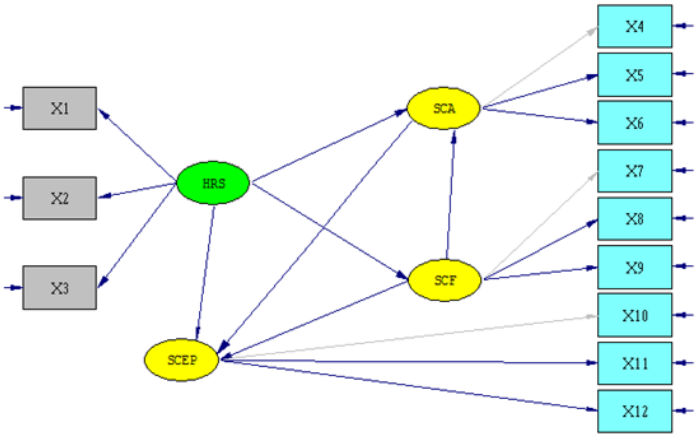

Figure 1. Supply chain model of cocoa beans

Table 1. Research variables

Latent variable	Manifest variable	Symbol
Human resources of smallholder (HRS)	1. Education of smallholder	X1
	2. Skills of smallholder	X2
	3. Cocoa farming experience	X3
Supply chain agility (SCA)	1. Cocoa marketing efficiency	X4
	2. Level of technology adoption	X5
	3. Rapid change in improving the quality of cocoa beans	X6
Supply chain flexibility (SCF)	1. Rejuvenation of old cocoa crops	X7
	2. Using and pruning of protective trees	X8
	3. Frequency of using extension services and training for cocoa farming	X9
Supply chain economic performance (SCEP)	1. Increased sales / level of cocoa production	X10
	2. Cash flow (availability of cocoa production inputs)	X11
	3. Income level	X12

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

Goodness-of-fit	Cut-off Value
Chi-square test (λ^2)	p-value > 0.05
Root mean square error of approximation (RMSEA)	RMSEA < 0.06
Comparative fit index (CFI)	CFI > 0.94
Goodness-of-fit index (GFI)	GFI > 0.90
AGFI	AGFI > 0.90

Source: Manurung, Basir-Cyio, Basri, & Effendy, 2019.

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 coefficient of determination in linear regression; if GFI ≤ 0.90, then the model does not fit. GFI is affected by sample size (Sharma, Mukherjee, Kumar, & Dillon, 2005), and 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 as measured through modeling. Figure 2 shows that all factor items that measure the manifest variable were between 0.69 and 0.99, which exceeds the threshold 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 shown in Table 2. The structural model described previously had an estimated 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

Table 4 shows the direct effects between constructs and can be used to assess the hypotheses stated earlier.

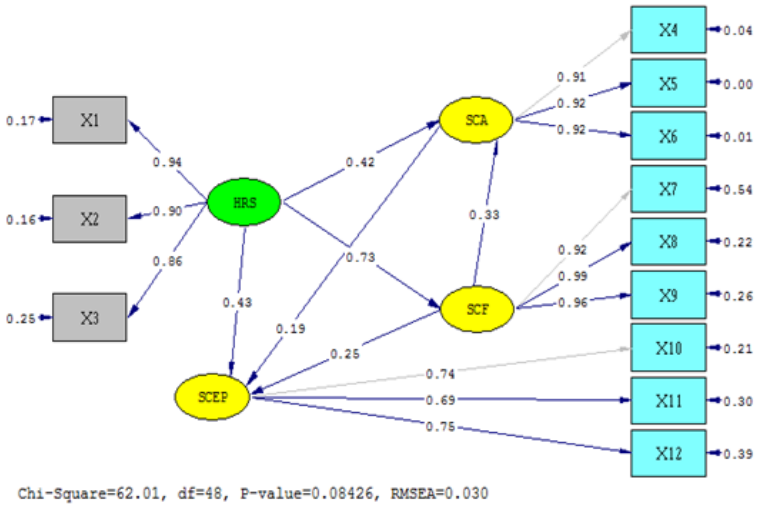

Figure 2. Structural model estimation of the supply chain performance of cocoa beans

Table 3. Goodness-of-fit of the structural model

Parameter	Value	Cut-off value	Model compatibility with data
Chi-square test (λ^2)	62.01	p=0.084 > 0.05	Yes
Root mean square error of approximation (RMSEA)	0.03	0.03 < 0.06	Yes
Goodness-of-fit index (GFI)	0.97	0.97 > 0.90	Yes
Adjusted goodness-of-fit index (AGFI)	0.95	0.95 > 0.90	Yes
Comparative fit index (CFI)	1.00	1.00 > 0.94	Yes

Table 4. Direct effects between constructs

To	From		
	HRS	SCA	SCF
SCA	0.42*		0.33*
SCF	0.73*		
SCEP	0.43*	0.19*	0.25*

* p < 0.05

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 (Garcia-Alcaraz *et al.*, 2017; Lin *et al.*, 2006).

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) (Blome *et al.* 2014; Das 2011; Garcia-Alcaraz *et al.*, 2017Jin *et al.* 2014; Lengnick-Hall *et al.* 2013).

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 (Alfalla-Luque *et al.*, 2015; Garcia-Alcaraz *et al.*, 2017; Lengnick-Hall *et al.* 2013). 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; Garcia-Alcaraz *et al.*, 2017; Seebacher & Winkler 2015). 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 indirect effects on other latent variables, which are summarized in Table 5.

Table 5 shows that all indirect effects between the 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).

Table 5. Indirect effects

To	From	
	HRS	SCF
SCA	0.24*	
SCEP	0.31*	0.06*

* $p < 0.05$

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 larger than 0.5 indicates that HRS has the dominant effect on the economic performance of the cocoa bean supply chain, so that smallholder resources need to be improved through extension services and training to increase the income of cocoa farmers (Effendy *et al.*, 2019).

Table 6. Total effects

To	From		
	SCA	HRS	SCF
SCA		0.66*	0.33*
SCEP	0.19*	0.74*	0.31*
SCF		0.73*	

* $p < 0.05$

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 largest, at 0.73, which means that most SCF on cocoa farming was attributable to education, skills, and smallholder resource capabilities. HRS also affects SCEP and SCA, even though with smaller effect sizes (0.43 and 0.42), because HRS is the basis of SCA, SCF, and SCEP.

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