Sustainability improvement in cacao supply chain agro-industry

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Abstract: One of the problems in the cocoa agro-industry supply chain is the low income of farmers, causing the land conversion which leads to its sustainability. The purpose of this study was to improve the critical attributes of each sustainability dimension which causes continuous decrease. The methods used were multidimensional scaling (MDS), interpretive structural modelling (ISM) to describe the attributes' connection, SWOT matrix strategy and the House Model to design a strategy formulation for the institutional model. The results showed that the sustainability index was 43.07% (less sustainable). The sustainability improvement proposed were the efficient use of fertilisers and pesticides, the usage of waste for fertiliser also for other income and institutional design. The efficiency achieved was 709 Indonesian rupiah (IDR) per kg of fertilised and 60 IDR per kg of pesticides. Institutional designed in this study was able to facilitate the fulfilment of knowledge and financial requirement of facilities and infrastructure for cocoa processing from plantations up to post-harvest.

Keywords: multidimensional scaling; MDS; interpretive structural modelling; ISM; SWOT analysis; cacao agro-industry.

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1 Introduction

Indonesia is the third biggest cacao producers in the world, but this achievement is not balanced with the welfare of the farmers, therefore, there are so many farmers undertake a land conversion. The low welfare of farmers is supported by White and Lee (2009) and

Pipitone (2013) who state that the farmers' income is still below the poverty line. Srivastava (2008) says that the farmers' income does not fulfil the needs of the farmers' life and it is insufficient for the plant treatment. Haynes et al. (2012) also states that cacao farming management system is often characterised by the low profit, while farmers play an important role in the sustainability of the cacao agro-industry. This is an indicator of the decreasing sustainability index of the cacao agro-industry as according to Van Rennen (2010), one of the key elements for a sustainable cacao agro-industry is the increase income of the farmer.

Based on the observation, it is found that farmers do not have a good financial condition to cultivate their land, so they often make loans to collectors and the loan is refunded by selling their cacao to the collectors at a cheap price and this is stated also by Arsyad and Kawamura (2010). Another problem is the difficulty to get the access of price information and the absence of price guarantee from government because of the fluctuating price. This is worsened by many actors of supply chain who lengthen the chain, as proposed by Haynes et al. (2012) and White and Lee (2009) who stated that the cacao agro-industrial supply chain is a complex activity because it needs to go through a lot of actors before becoming the final product. This leads to the low profit received by farmers as farmers occupy the bottom position in the supply chain and they do not have the power to set prices (Suharjito et al., 2012). Massusungan (2013) also stated that the farmers are in the weak bargaining position.

Bolarinwa and Fakoya (2011) said that one of the weak bargaining of farmer position is caused by farming and business institution which have not been self-sufficient and optimal. Dulcire (2012) stated that the institutions of farmer were one of the major factors in the development of Indonesian cacao. Independence and farmers' institutional strengthening were very important as it was the power to remove the *ijon* system and it encouraged farmers to be able to interact with banks and markets, as well as open farmer's opportunity to determine the price.

According to Khan (2015), the importance of institutional farms in agricultural development is recognised in both industrial countries and develop countries such as Indonesia, but reality show that institution of farm in developing countries is still weak, as well as the magnitude of growing institutional barriers in farming communities. Institutional farm is expected to be able to help farmers out of the issue of farmer's economic inequality. Arimbawa (2013) stated that the institutional problem is becoming an important matter in cacao farming.

This study aims to better the sustainability chain of cocoa agro-industry supply by improving the critical element that occurs in every economic, environmental, and social dimension. The main output that is generated in this study is an institutional design done using a combination of *soft systems* and *hard system methodology*, so by forming this institution, can solve the existing problems in every dimension. *Hard systems* used in this study are *interpretive structural modelling* (ISM) and the *house models*.

2 Literature review

Based on the cocoa sustainability partnership (CSP), the sustainability of cacao agro-industry supply chain in this study is analysed based on three dimensions, namely economic, environmental and social dimensions. This is supported by the opinion of Khan (2015) and Hesterberg et al. (2012) who say that the three pillars of sustainability

consist of economic, environmental and social. Some other studies analysing the sustainability based on the economic, social and environmental are Jaya et al. (2014) who research on the analysis of the sustainability of Gayo coffee supply chain in Aceh, Immawan et al. (2015) who does a research on sustainability of batik industry supply chain and Teniwut and Marimin (2013) who does a research on sustainability of fishery agro-industry supply chain.

Analysis of the attribute relevancy is carried out by using ISM as according to Attri et al. (2013), ISM is processes that can help understand the relevancy of attributes so that the hierarchy of importance of these attributes can be seen. Bag and Anand (2015) stated that the ISM is a method to identify the relationship between each item and use the ISM to identify the contextual barriers which affect the network design of the sustainable supply chain. Mahajan (2013) also use the ISM to determine the most important attribute in deciding the JIT supply chain. Shahabadkar et al. (2012) identify the supply chain variables to improve the supply chain performance. Astuti et al., (2013) using ISM to reduce risk in the mangosteen supply chain.

The formulation of strategy in this research is carried out by using the SWOT analysis as per Nawaz et al. (2015), SWOT is a mean employed to analyse evaluation and able to plan the strategic planning. Menga et al. (2015) state that if used appropriately, SWOT is a good strategic formulation and decision making. Anna (2015) observed 91 companies and it is found that more than 50% companies employ SWOT to plan their management strategy. Slamet et al. (2012) also uses the SWOT analysis to formulate the strategy to improve performance of the supply chain and the strategy proposed are:

1 using hydroponic technology and reducing the use of pesticide

2 optimising the planting and harvest schedule by considering the climate

3 increasing the flexibility in order fulfilment

4 applying the standard of quality control to guarantee the consistency of the product's quality and the acceptance of product by consumers.

Immawan et al. (2015) and Arkeman et al. (2015) also employ the I-SWOT analysis to implement the good food production in small and middle scale companies in Bogor and produced five alternative strategies to improve food safety through the application of GMP by considering each limitation. To implement the strategy, SWOT matrix strategy was used, by dividing the quadrant as stated by Pearce and Robinson (1997).

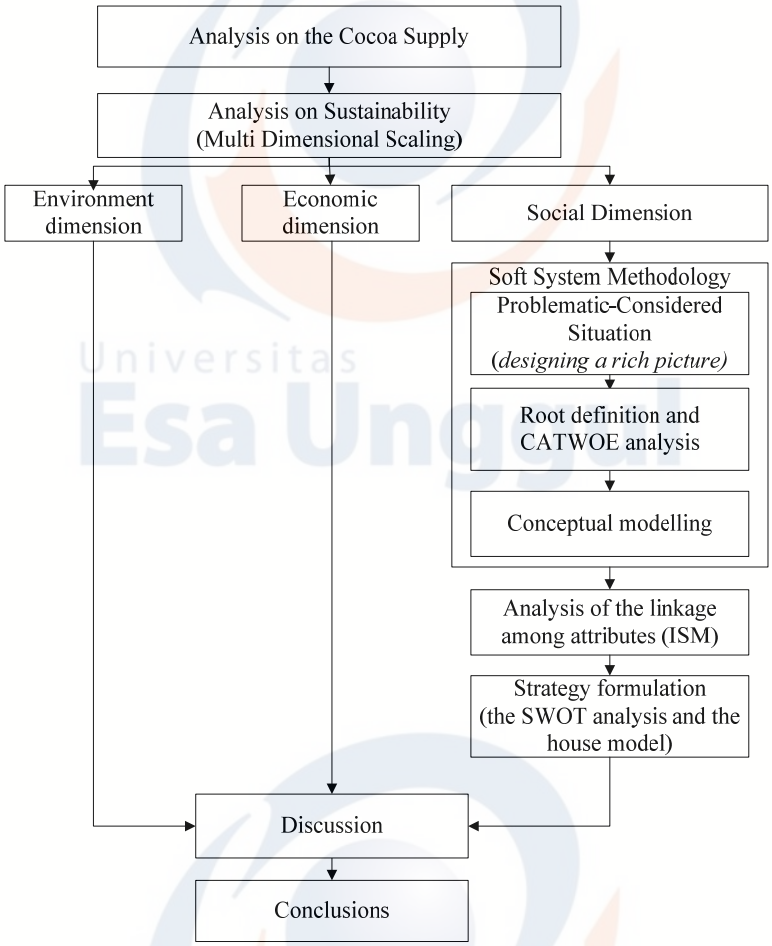
According to Checkland and Poulter (2010), SSM is an approach to solve various issues-oriented process where users learn to know about the situation that occurs then take corrective action. Morcos and Henshaw (2009) also states that the SSM is an approach for modelling that is difficult to comprehend and according to Hindle (2011), SSM adopts part participative approach to solve the problems and using system modelling structure discussion among stakeholders.

Kartika and Muzayanah (2015) stated that the House Model is a tool used to describe wishes to become an action. The House Model consisted of the roof, pillars and foundation. The vision of this study is to improve the sustainability of cocoa agro-industry supply chain. The vision would be the roof of the house models. Furthermore, the determination of the pillars formulated based on SWOT analysis.

3 Research design and method

This research is carried out in Luwu district, Larompong sub districts, South Sulawesi in Indonesia. It was conducted in seven steps. The first step was analysing the cacao agro-industry supply chain and actors involved in the chain. The second step was analysing the sustainability by using rapid appraisal for cacao (Rap-Cacao) ordination technique by using the method of multidimensional scaling (MDS). MDS was employed because according to Allahyari (2009), MDS was able to visualise every dimension and aggregate, so it could improve the understanding of the ongoing status of each dimension. The third step was analysing the critical elements appeared in the social, economic and environmental dimensions whose index value was less sustainable (below 50%). The fourth was designing a rich picture to illustrate the problems that occur, the fifth stage was designing the root definition and CATWOE. The sixth step was analysing the linkage attributes (ISM). The ISM stage conducted was referred to (Shahabadkar et al., 2012). The seventh step used the SWOT analysis and the House Models to design a strategy formulation. The research steps are displayed in Figure 1.

Figure 1 The research steps

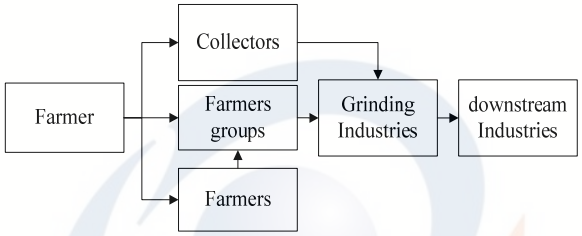


4 Results and discussion

4.1 Analysis of the cocoa agro-industry supply chain

The cacao agro-industry supply chain in this study was a series of activities using cocoa as a raw material to be processed into candies and the actors of the cocoa agro-industry supply chain in Luwu District, Larompong Sub-district, in South Sulawesi Indonesia, consisted of farmers, farmer groups, association of farmer groups, collectors, grinding industry and downstream industries. The cocoa agro-industry supply chain network in the Luwu district Larompong Sub-district, in South Sulawesi Indonesia can be seen in Figure 2.

Figure 2 The cacao agro-industry supply chain network

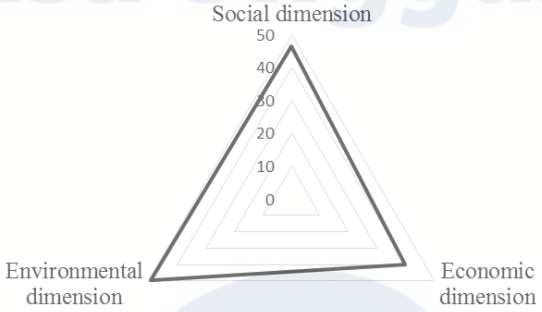


Based on Figure 2, it was known that farmers were the head of the chain supply actors, so they played the main role in the sustainability of the cocoa agro-industry supply chain.

4.2 Analysis of sustainability (multidimensional scaling/MDS)

Based on the calculation, it was found that the sustainable index for all dimensions were below 50% or less sustainable. The index of social dimension sustainability was 46.42%, the economic dimension was 39.85% and 49.19% was the environmental dimension. The results of the analysis can be seen in Figure 3.

Figure 3 The kite diagrams of cocoa agro-industry's sustainability index



Next steps in the analysis of sustainability were to weigh in by using *pairwise comparison*. Data for weigh in gained using questionnaire for experts where the selection of experts is done purposely (purposive sampling). Then the weigh in value is used to calculate the multi-dimensional sustainability index was 43.07%. According to Hidayanto

and Supiandi (2009), a value less than 50% was categorised as less sustainable, so the critical attribute causing the low sustainability had to be improved. The result of multidimensional sustainability analysis can be seen in Table 1.

Table 1 The multi-dimensional sustainability index

Sustainability dimensions	*Index*	*Weight*	*Index * weight*
Economic dimension	39.85	0.60	23.91
Social dimension	46.62	0.20	9.32
Environmental dimension	49.19	0.20	9.84
Multi-dimensional index			43.07

Rap-Cacao was validated by comparing the results of MDS with Monte Carlo. The mean difference was 1.64, so it could be concluded that the value of sustainability index of cocoa agro-industry was quite appropriate, because according to Kavanagh and Pitcher (2004), the range of indicator values was considered quite appropriate when the difference between the sustainable MDS index with Monte Carlo analysis was relatively small (less than 5%). The complete results can be seen in Table 2.

Table 2 MDS Rap-Cocoa using a Monte Carlo analysis

Sustainability dimensions	*Sustainability index (%)*		*Deviation*
	MDS	*Monte Carlo*	
Economic dimension	49.19	46.42	2.77
Social dimension	39.85	40.05	0.20
Environmental dimension	46.62	48.58	1.96

The low sustainability index for each dimension indicated that cocoa agro-industry supply chain needed to be improved in its each dimension. The improvement was started from the economical dimension, followed by the environmental dimension and then the social dimension.

4.3 Analysing the critical elements

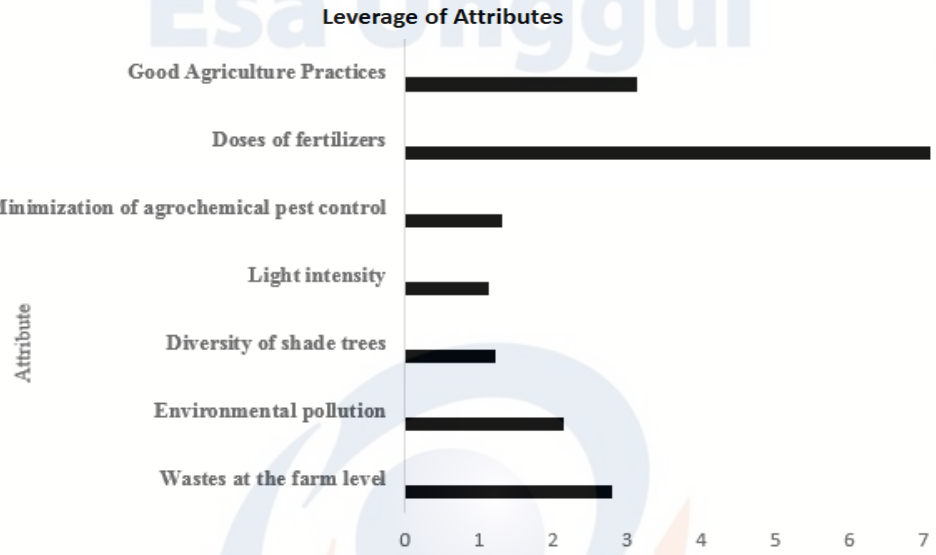
4.3.1 Critical element analysis of environmental dimensions

Based on the discussions conducted with experts, attributes of the environmental dimension consisted of seven attributes, namely Good Agriculture Practices (GAP), the dose of fertilisers, integrated pest management, sunlight intensity, diversity of shade trees, environmental pollution and waste at the farmer level. Based on the results of data processing using MDS, it was found that the most sensitive attribute was the dose of fertiliser, followed by the good agricultural practices (GAP), as it was seen in Figure 4.

Based on the leverage analysis of environmental dimension in Figure 4, it was displayed that the most influential indicator in the environmental dimension was the dose of fertiliser followed by GAP. The environmental pollution and waste at the farmer level was other highly influential indicators, while controlling pests, sunlight intensity and diversity of shade trees were indicators that possessed low influence on the environmental dimension. The dose of fertiliser was included in one of the attributes of

environmental dimension due to their excessive dose, which led to the decreasing number of soil nutrient.

Figure 4 Leverage analysis of environmental dimension



Note: Root mean square change in ordination when selected attribute removed (on sustainability scale 0 to 100).

Haynes et al. (2012) stated that waste mostly occurred in the upstream (in the farmer level) as well as along the supply. One of the wastes was in the fertiliser or pesticide used. This happened in Luwu district, which the farmers scattered the fertiliser; this way of fertilising led to 70% of wasted fertiliser as the Urea fertiliser was easy to evaporate and dissolve with water. Another wasteful action was using hand sprayer to spread the pesticide (the hand sprayer capacity was 15 L). The spray of pesticide was supposed to reach 125 trees, but as the farmers wished to wet the leaves, therefore the 15 L of pesticide could only be used for about 60 trees.

The use of fertiliser in Luwu district was varied depends on the farmers' habit. Some farmers still used the mixed of chemical fertiliser and others have already used the organic fertiliser. A kind of the chemical fertiliser usually used by the farmers were compound chemical fertiliser in which the needs of the fertiliser was 500 g to 750 g for one tree, three times of application in one year and 250 g for one tree in one year, once of application. The price for NPK phonska or NPK Rainbow is for 50 kg was 120,000 IDR, meanwhile the needs of Petro Organic was 2 kg to 5 kg for one tree in one year. The price for Organic Petro for 40 kg was 22,000 IDR. The price of organic fertiliser was cheaper than the chemical one, but the farmers did not want to use it because according to them, its reaction to the plant growth was relatively slow. The difference from the chemical fertiliser use was 500 IDR for 1 tree or 62,500 IDR for 125 trees. The chemical fertiliser was more expensive than the organic fertiliser and wasted more, as the farmers needed to scatter the fertiliser and it wasted up to 70%.

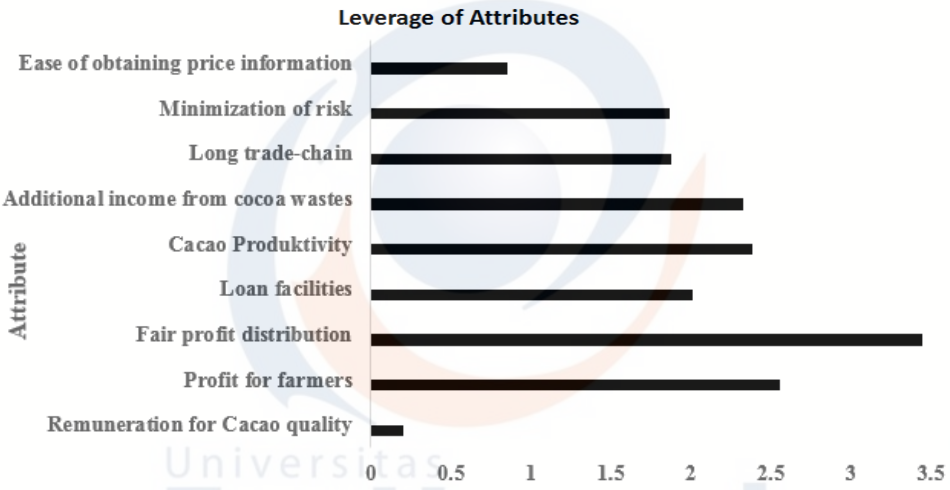
Another efficiency gained from the spraying pesticide technique was 50% of the pesticide costs for 15 L. As theoretically, 15 L of pesticide was supposed to reach

125 trees, but as the farmers often wanted their leaves to be wet, so it could only reach 60 trees. Assuming the price was 55,000 IDR, therefore the efficiency cost to purchase the pesticide was 396,000 IDR per spray, while the spraying activity was undertaken every two weeks or 10,692,000 IDR in one year.

4.3.2 Critical element analysis of economic dimension

Attributes analysed in the economic dimension consisted of nine attributes, namely market access and pricing information, minimising risk, the long trade chains, the additional income from the cocoa waste, productivity of cocoa, access to credit, a fair profit for all cocoa agro-industrial supply chain actors, the benefits for farmers and remuneration for the quality of cocoa. The analysis of leverage for the economic dimension can be seen in Figure 5.

Figure 5 Leverage analysis of economic dimension



Note: Root mean square change in ordination when selected attribute removed (on sustainability scale 0 to 100).

Based on the analysis of economic leverage dimensions in Figure 5, it is known that some of the most influential indicator on the economic dimension is fair profit for of the supply chain agents, benefit farmers, cocoa productivity and income from cocoa waste. Fair profit for the agents of the cocoa agro-industry supply chain showed that all actors existed in the cocoa agro-industry supply chain have to have a fair profit especially farmers' profit because farmer is the first chain to manage the farm and produced cocoa. As for the three other attributes (farmers' benefit, the productivity of cocoa and income from cocoa waste), influence each other that is when farmers earn high profits, it can increase the motivation of farmers to cultivate their farm well (GAPs) as to increase cocoa productivity.

To obtain high profits, in addition to efficiency as explained in the environmental dimension discussion, farmers have already started to take advantage of cacao waste to replace chemical fertilisers as well as for side income. The benefit of cacao is not exclusively its seed, the pulp and the skin could also be utilised. Widyotomo and Mulato

(2008) stated that The waste utilisation of cacao can be more beneficial and economically high valued so that can provide an increase in income and business opportunity in mass cacao farming sector, where one of the example explained was the utilisation of cacao pulp waste transformed into nata de cacao, alcohol and cacao pulp juice.

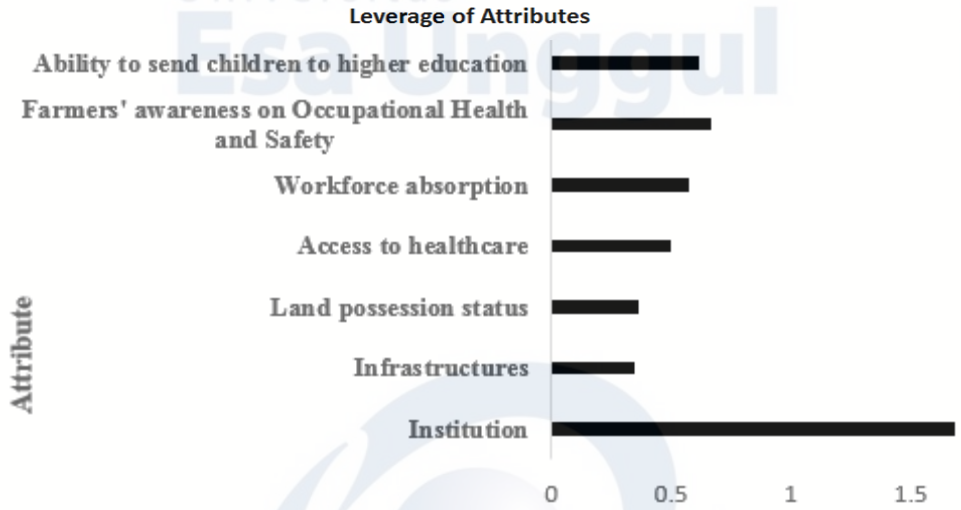
In addition to pulp, another utilisation of cacao waste was stated by Yunus et al. (2013) saying that the cacao skin could be used to feed animals, natural dye, charcoal materials, teobromin, pectin and polyphenols. Based on the explanation, the additional income from cacao waste could be obtained as a lot of waste produced but the utilisation was very little. The advantage gained from the utilisation of cacao waste was it could help to reduce the fertiliser costs as the cacao waste could be used as an organic fertiliser, so the plant nutrients could be maintained and the fertiliser costs reduced.

According to Wahyudi et al. (2009), organic fertiliser could be obtained from shredding the cacao or embedding the cacao skin, placenta, rotten fruit and all the rest of the harvest into holes on the day of harvest and then covered it with 20 cm thick soil in order to kill the PBK larva in the cacao skin. This was very efficient but the use of manure fertiliser from the cacao skin has not been implemented yet as the process was quite long before it really could be used as fertiliser. The opportunity was rarely taken by farmers due to their limited knowledge, so it was needed to design a program to educate farmers about processing and utilising the cacao waste.

4.3.3 Critical element analysis of social dimension

The attributes of social dimension consisted of seven attributes, namely the establishment of institutions, the availability of infrastructure, the farmers' awareness towards the aspects of occupational, health and safety, the easy access on health, the financial condition to send their children to a higher level of education, land possession status, and employment. Based on the results of data processing using MDS, the leverage analysis of the social dimension could be seen in Figure 6.

Figure 6 Leverage analysis of social dimension

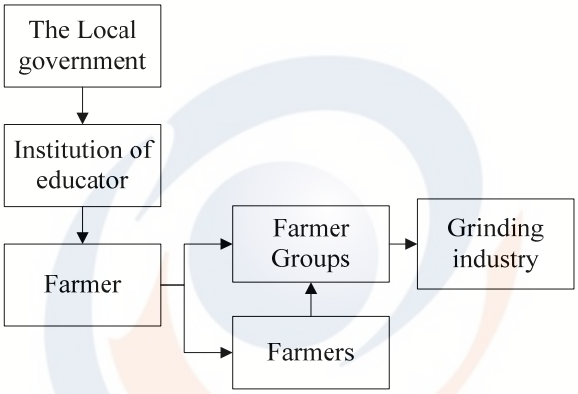


Note: Root mean square change in ordination when selected attribute removed (on sustainability scale 0 to 100).

Based on leverage analysis of the social dimensions in Figure 6, one of the most sensitive attributes was the institutional. The institution played an important role in the sustainability of the cacao agro-industry as the existence of institutions made the relationship between the actors of the cacao agro-industry supply chain strong and the information flow on the network was maintained.

The established institution in Luwu district was the farmer groups and association of farmer groups. In Luwu, there have been 16 farmer groups and an association of farmer groups. They only undertook the fermentation process of wet cacao beans. The saving and loans system also has not worked well, so lots of problems related to the funding to employ the crops have not been solved yet. The established partnership could be seen in Figure 7.

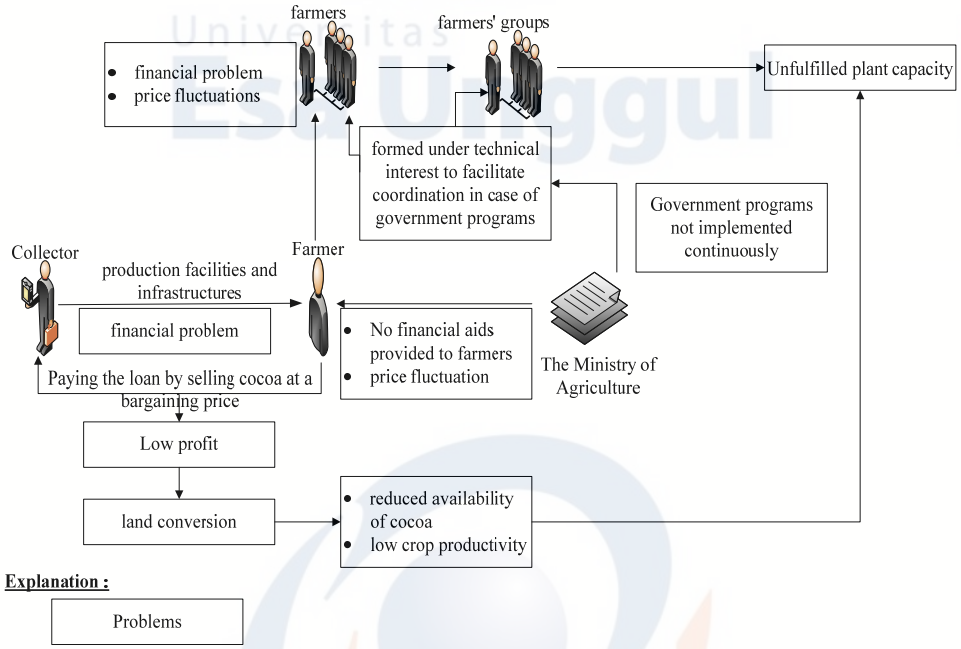
Figure 7 Current institutional structure



4.4 Designing an institutional using SSM

To provide institutional proposals, so this study was designed by using the soft systems methodology (SSM) start with describing a condition that occurs at this point for later will be illustrated in rich picture. Image of issues starts from farmers as actors who are in the upstream. Farmers have financial problem to meet the needs of production facilities and infrastructure so that farmers have to borrow from collectors and pay the loan by selling it to a collector in cheaper price. Another problem is that cocoa prices are always fluctuating and there is no fund support for farmers. Based on this problem, causing land conversion, reduced availability of cacao, low crop productivity and factory's capacity was not met. Institutions that have been established such as farmer groups and union groups are not able to help reducing the problems that occur because the agency was formed based on the technical interest to facilitate the coordination if there is a government program, while the government programs are still not yet implemented continuously. There are not many activities that can be done by the groups because they have difficulty in financial beside price is not stable. Description of these problems in the form of rich picture can be seen in Figure 8.

Figure 8 Problem situation expressed using rich picture (see online version for colours)



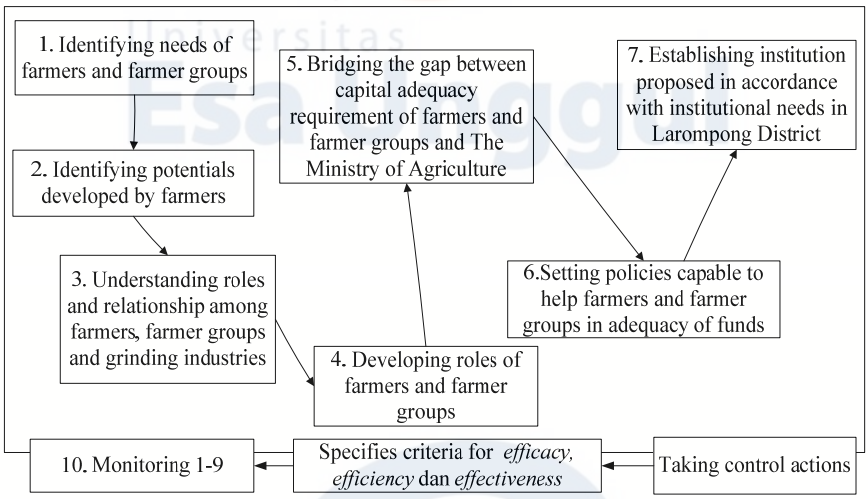
The next stage was designing the root definition and CATWOE analysis. It can be seen in Table 3.

Table 3 CATWOE and root definition

CATWOE	
C (customers):	The association of farmer groups, farmer groups, grinding industries
A (actors):	Farmers
T (transformations)"	To increase income and welfare of farmers
W (Weltanschauung):	Loan facilities, price guarantee from the Ministry of Agriculture
O (owners):	Farmers, the association of farmer groups
E (environmental constraints):	Inflation
Root definition:	
To increase income and welfare of farmers, it is necessary to establish institution able to provide loan facilities to farmers and farmer groups so that they do not owe to collectors, and to motivate them the cocoa price should be guaranteed by governments as represented by the Ministry of Agriculture. Institution formed in the near future must have expertise to guide farmers to cultivate their farms such as developing a demonstration plot that enables to be followed by farmers.	

The conceptual models can be seen in Figure 9.

Figure 9 The conceptual models

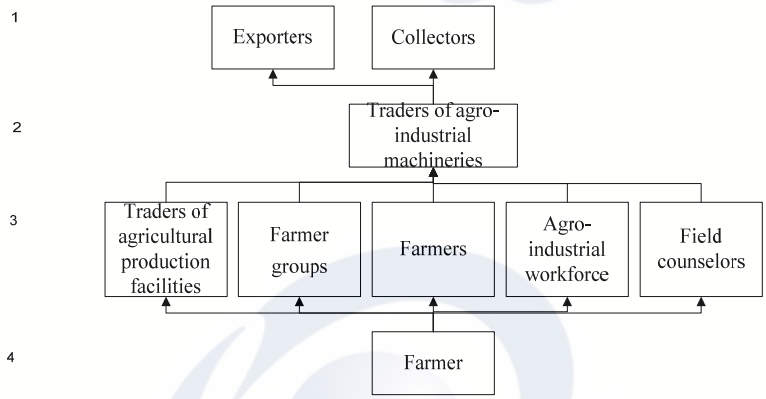


4.5 Analysis of linkage attributes

The fifth step was analysis of linkage attributes (ISM). Indicators used in ISM consisted of eight sectors, namely the sector of community affected, the needs of program, the main obstacle, the possible changes, the purpose of the program, benchmarks to assess each goal, activities to plan actions, activities to evaluate the achieved goal and institutions involved in the program implementation.

The data used was obtained from the opinion of three experts. The results of the community affected was as follows: there were nine sub elements and based on the data processing using the ISM with consistency value as much as 93%, it was found out that the sub element of farmer was in the lowest rank indicating that the sub sector of farmers was in the highest rank which meant that they were the key element in the community affected as it was shown in Figure 10.

Figure 10 Program requirements



In other sector, which was the need of programs, the consistency value was 97% with modelling and loan facilities as the key sub elements. While in the main obstacle factor, the consistency value was 100% with the low productivity, the unstable price of cocoa, the limited fund and the low guarantee of raw material continuity as the key elements. In addition, in the possible change sector, the consistency values was as much as 92% and its key element was increasing the income and welfare of the farmers. In the program purposes sector, the consistency value was 98% and its key element was improving the balance of profit distribution. The benchmark to assess the purpose sector had the consistency value as much as 90% and its key element was improving the income and welfare of the farmers. In the involved institutional which had consistency value as much as 90%, the key element was the farmer groups, banks, the local government, the association of farmer groups, and cooperation. In the activities needed sector, the consistency value was 100% and its key element was the price guarantee from the government and the clear intensive system development. This was in line with Srivastava (2008) who said that supporting policy and government regulation to support the farmers were needed, including the application of Indonesian National Standard (SNI) and quality control system. In this case, the government needed to pay attention and improve the infrastructure, as well as improve the incentive system for the farmers to improve their productivity and the quality of cacao, free the farmers from tax, retribution and other burdening taxes. The important infrastructure development was such as improving the path connecting the farmer and the market and building drainage where needed.

The analysis result for the eight elements tested by using ISM showed that farmers were the most influential sector in funding and loan facility was the most needed program. Some changes might be made was improving the income and welfare of the farmers and achieving the purpose of the program, namely improving the balance of profit distribution and welfare. Actions needed to be done in the sustainable cacao agro-industry was guaranteeing prices as well as developing clear incentive system.

In the mapping diagram of *driver power-dependence*, the result analysis was in the Sector 4 or independent sector. The elements were used as the base to determine the farmer institution as the farmers were the key elements from the community affected.

4.6 Designing a strategy formulation

The strategy formulation was conducted by using SWOT analysis and the House Models. Khalili et al. (2013) stated that to achieve the sustainability, a sustainable, effective and proactive strategy was needed which was included in the SWOT analysis (strength, weaknesses, opportunities and threats). Pearce and Robinson (2003) also mentioned that SWOT analysis was used to give pictures about efforts in need to be done to develop capability and competency of company's resources so that the strategic analysis can be established. The strategy formulation was a process to choose strategy to achieve the sustainable cacao agro-industry supply chain.

The most critical attribute from the result analysis using the MDS to each dimension was used as the weakness (W) mapped in the SWOT analysis. The result analysis of SWOT can be seen in Table 4.

Table 4 The SWOT matrix design

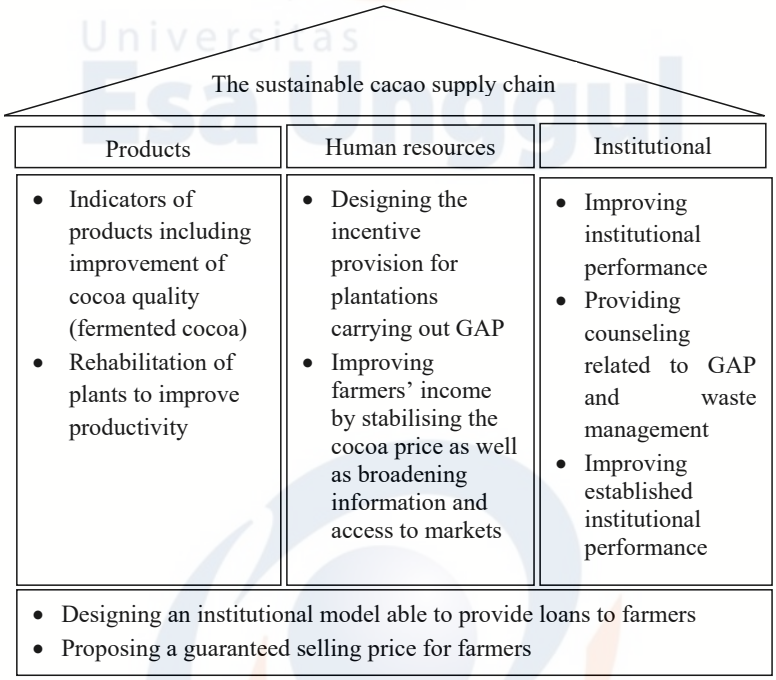
Internal factors	*Strengths (S)*	*Weaknesses (W)*
External factors	1 A major local and national commodity	1 Low profit
	2 A commodity not able to be substituted by other commodities	2 Low cocoa productivity
		3 Low additional income from cocoa wastes
		4 Unstandardised doses of fertilisers
		5 Non-productive institution
		6 Unfair profit gained
		7 No GAP carried out
Opportunities (O)	*SO strategies*	*WO strategies*
1 Potential export of fermented cocoa	1 Increasing cocoa quality (fermented) (S_1, O_1)	1 Improving institutional performance (W1, W2, W3, W4, W7, O1)
2 An increasing demand	2 Rehabilitating plants for an increase in productivity (O_2, S_2)	2 Providing counseling related to GAP and waste management (W2, W3, W4, W7, O2)
Threats (T)	*ST strategies*	*WT strategies*
1 Shortage of capital	1 Designing an institutional model that would provide loans to farmers (S_1, S_2, T_1)	1 Improving institutional performance (W1, W2, W4, W5, W7, T1)
2 A weak bargaining position		
3 A fluctuating price of cocoa	3 Proposing a guaranteed selling price for farmers (S_1, S_2, T_2, T_3)	2 Increasing farmers' income by stabilising the cocoa price as well as broadening information and access to markets (W1, W3, W5, W6, T2, T3)

Based on the results of strategy formulation by using SWOT analysis, it was found that the cocoa agro-industrial supply chain had a big opportunity to the external environment in the form of high demand and the opportunity to export, but it had the low capability to manage the crops and it resulted in poor quality of cocoa. Therefore, based on the matrix strategy SWOT, it went into quadrant III and the proposed type of strategy was alliance strategy.

Pearce and Robinson (1997) stated that the alliance strategy was a partnership strategy in which the partner contributed to the skills and experiences to achieve business excellence together and the alliance consisted of an expertise, new business, cooperative and M&A alliances. The proposed type of alliance was the alliance of skills or expertise, in which participant companies shared their expertise and gave counselling intensively to farmers regarding to GAP and waste management.

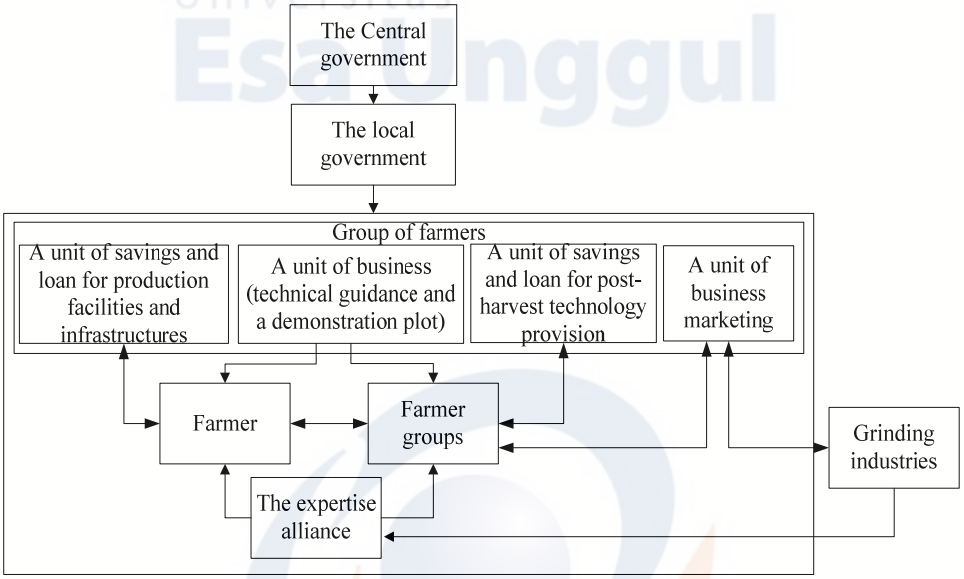
The proposed improvement model was the model used in the House Model. The SWOT analysis result showed that there were three pillars or strategic targets supporting the vision, namely products, human resources, and institutional. From the House Model, seven indicators of main performance to improve the sustainable cacao agro-industry supply chain were derived. See Figure 11.

Figure 11 The house model



Based on the results of SWOT analysis (Figure 10) and the House Model (Figure 11), there is conceptual model that design institutional model which is able to give credit to farmers and suggest a trading guaranteed price of cocoa on the government to farmers. The institutional model which is suggested can be seen in Figure 12.

Figure 12 The proposed institutional model



According to Figure 12, note that the suggested institution can be done by using the institution, which already exists but there is a function change like in group of farmers. Group of farmers which is suggested have four types of business units namely unit of savings and credit whether for savings and credit facilities and production infrastructure to farmers and providing post-harvest technology for farmers' groups, business units farmer to do the technical guidance for farmers and give a sample area that can be followed by farmers and farmers groups as well as marketing business unit that will be in contact with the grinding industry because the grinding industry will only make a purchase of cocoa in large number so that the product of cocoa that has been fermented and dried in farmer groups, sent to group of farmers then to be sent to the grinding industry. All business units of farmers groups, must be given financial support from the government, namely Regional Government Budget from regional government according to the agriculture ministry's regulations No. 82 of 2013. This was done as first help to the business units that can work well until group of farmers has really been independent and got the joint venture from all members.

In the proposed institutional forms the expert alliance which was proposed by strategy of SWOT analysis. This is done to develop the knowledge of farmers on cocoa quality criteria which is desired by the industry. Expert alliance should be able to transfer the knowledge that is useful for farmers so that farmers are able to improve the quality and productivity of cocoa. The capital which is implemented by the expert alliance comes from grinding industry CSR which is associated with group of farmers in the District.

Proposed institutional designed, can help farmers to improve the sustainability of supplying the chains of cocoa agro-industry from three critical dimensions that happen, starting from the efficiency of the use of fertilisers and pesticides at the farm level, the ways of treating cocoa waste and techniques for doing GAP which all aim to improve farmers profitability and to improve cocoa productivity due to strong institutions then such activity can be run properly and continuous evaluation so with the realisation that can increase the continuous cocoa agro-industry supply chain.

5 Managerial implication

The finding of this study was very useful to improve the index of sustainable cocoa agro-industry supply chain. The added value which could be gained from the expertise alliance was it could help the farmers to obtain knowledge related to the how to earn additional income from waste management as well as knowledge about how to carry out GAP, how to fertilise and use pesticide efficiently so that the farmers could get higher profit.

The proposed policy to give loans, incentive, as well as guaranteed price for the farmers was a proposal which could help the farmers to cultivate their crops so that the farmers could be motivated to cultivate their crops and produce high quality and productivity of cacao.

6 Conclusions

The cacao agro-industry supply chain has lots of actors, such as farmers, farmer groups, association of farmer groups, collector, grinding industry and downstream industries. The

sustainability index of cacao agro industry in Indonesia is only 43.07% (less sustainable). The initial cause of this condition is low income of farmers, causing lots of land conversion. To overcome this problem, a strategy should be designed to help increase the farmers' income.

The improvements made on the environmental dimension are to do the efficiency of the use of fertilisers and pesticides. The amount of efficiencies gained from fertilisers amount IDR 709 per kg while the pesticide efficiency is IDR 60 per kg.

Improvement that is done on the economic dimension in the acquisition of high profits can be done by making the efficient use of fertilisers, pesticides and cocoa waste because it can be used for fertiliser and quality of cocoa that produces better product than the quality of the cocoa using fertilisation with chemical fertilisers. Cocoa waste can be used as additional revenue that can be utilised to fulfil the farmer needs.

Improvement that is done in social dimension is designing institutions by proposing a change of the institutional functions. Function change is done to group of farmers, which has first function as a marketing unit, then proposed to have four other business units, namely unit of savings and credits for production facilities and infrastructure for farmers, units of micro-credit and post-harvest technology for farmers' groups, farmers' business units to technical guidance for farmers and give a sample area that can be followed by farmers and marketing business unit that will be in contact with the grinding industry. The proposed institutional alliances also require expertise that serves to provide input and knowledge transfer to farmers to obtain the conformity of quality among the industry's desire to farmers' knowledge and continuous supply.

The proposed institutional design can facilitate the fulfilment of knowledge or finance which needed to procure cacao's processing facilities and infrastructures starting from farming to post harvest in the environmental dimension, economic and social, so that sustainability of cacao supply chain agro industry business can then sustain.

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