学位論文全文に代わる要約
Extended Summary in Lieu of Dissertation

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学位論文題目：
Title of Dissertation

Supply Chain and Risk Analysis of Indonesian Tea: A Case Study in Central Java Province
(インドネシア茶のサプライチェーンおよびリスク分析：
中部ジャワ省を事例に)

学位論文要約：
Dissertation Summary

Introduction

The dynamic change in business environment has resulted on many uncertainties and increased the vulnerability of tea agribusiness in Indonesia. These uncertainties are profoundly expanded due to the interdependency on the unpredictable climate condition, i.e. heavy rainfall and long drought, and fierce competition in the global market. The recent gap between supply and demand has also been weakening the competitiveness of Indonesian tea in the global market and threatening the sustainability of tea agribusiness. Moreover, tea (*Camellia sinensis*) industry is a labor-intensive business and contributes to the livelihood of approximately 85,000 labors, 110,000 household farmers, and 1 million of Indonesian people. Smallholders play a vital role in food security and sustainable agriculture, but they are also the most vulnerable actors toward the implementation of pricing policy and profit distribution within the supply chain (SC). In the midst of these challenges, understanding the vulnerability of each actor in the SC helps to recognize their ability to efficiently response on the changing condition. Therefore, the evaluation of the current tea SC and understanding the risk event that may occur and disrupt the SC are eventually required to build the resilience of SC, to improve the sustainability of tea agribusiness and to improve the livelihood sustainability of smallholder. Accordingly, the main objective of this study is to analyze and evaluate the SC of tea in Central Java Province to improve its practice and to build the resilience of its SC. To accommodate these aims, several studies are performed on the scope of tea SC in Central Java Province. The study on logistics activity, risk assessment and evaluation of pricing policy are implemented in this study.

Methodology of study

This study mainly focused on the main tea-producing regency in Central Java Province, Indonesia. There are three main reasons to focus on tea SC in Central Java: 1) around 18,000 smallholders (households head) depend on tea agribusiness for their livelihood; 2) lack of support and intervention on tea trade governance from local government agencies; and 3) limited number of previous studies focusing on tea SC development in Central Java. Four regencies were chosen to represent tea SC actors in Central Java: Batang, Pekalongan, Banjarnegara and Brebes regency. Batang and Banjarnegara regency were contributed to the 65.2% of tea production in Central Java, while tea smallholder plantation is mainly located in Pekalongan regency. In this case study, Brebes regency

represented the area under a state-owned plantation company named PT[1] Y. Additional data is also collected in Kulonprogo regency, Special Region of Yogyakarta Province to enrich the information regarding tea SC under a private-owned plantation company, i.e. PT Pagilaran. Furthermore, the surveys were conducted in two periods: October to December 2019 and September to December 2020. The in-depth interview using interview guideline and semi-structured questionnaire were used to enrich the information about the current situation of tea SC. By using convenience and snowball sampling, a total of 224 respondents have been observed in this study, including smallholder (or farmer), middleman (or collector), private-owned plantation company (PPC), state-owned plantation company (SPC), tea processing unit (TPU) and/or trader and/or tea packer, government officer, and tea expert. The demographic data gathered from the questionnaire were then analyzed using IBM SPSS Statistics version 27. The Kruskal-Wallis test for nonparametric data was carried out to assess whether there was a significant difference in the variables among group of populations.

Results and implication of study

The SC of tea in Central Java Province is presented in Figure 1. Eight main actors are identified including tea smallholder, middleman (i.e. independent collector, designated collector and farmer association), commercial tea plantation (i.e. PPC and SPC), TPU, tea auction center, trader (i.e. exporter and tea packer), government and market or customer. Based on the evaluation of current tea SC, the incoherent connection between demand from global market and supply of tea from smallholder, and dissatisfaction of smallholders toward tea selling price and delayed payment are two issues that hindering the sustainability of tea agribusiness. On the other hand, smallholder is highly depending on tea farming and agribusiness, as about 77% of their monthly income come from tea farming and agribusiness. The further analysis also found that smallholders' farm size and the availability of additional non-tea farming activities may contribute to lessen the vulnerability of smallholder. To reinforce the exploration, the logistics cost analysis using activity-based costing (ABC) method were performed in smallholder and middleman tier to help identify which logistics activity incurs the highest cost, and thus the recommendation action can be more practical and precise. Five main logistics activities are involved in this analysis, i.e. material handling, transportation, maintenance, inventory and information. In smallholder tier, three main logistics activities contributed substantially on their logistics cost (Case A), i.e. material handling, maintenance, and communication. It generated the total logistics cost of IDR 821.7/kg[2]. Meanwhile the supplementary logistics activities (Case B) eventually added the logistics cost of smallholder up to 30.8% into IDR 1,075/kg.

Moreover, material handling activity accounted for the highest portion (IDR 804.8/kg) in smallholder tier, which contributed at least 75% to their total logistics cost. Additionally, the labor cost for plucking (harvesting) activity contributed about 76% to this material handling cost. Meanwhile, in the middleman tier, transportation activity accounted for the highest (50%). This is in accordance with the main role of the middleman to organize pick-up service from smallholders' farm and deliver their fresh tea leaves (FTL) to the buyer. However, inefficiency of pick-up and delivery activity contributes to this transportation cost. This transportation costs at the smallholder and middleman can be optimized by improving coordination on harvesting and transportation activities within group of farmer and middleman to meet full-capacity truckload. In this study, the profit of smallholder was varied between IDR 559.7 – 709.7 per kg, which depending on the location, quality of FTL and smallholder-middleman partnership. Meanwhile, the profit of independent and designated collector was IDR 78.2/kg and IDR 198.8/kg,

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[1] Perseroan Terbatas (PT) is Indonesian legal business entity that equivalent to Limited Liability Company (LLC)

[2] The value represents IDR per kg of fresh tea leaves

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respectively. The profit scheme presents that smallholder plays the dominant role on the profit distribution compare with middleman, i.e. independent and designated collector.

Notes: --→ flow of fresh tea leaves ——→ flow of made-tea ←··→ flow of information
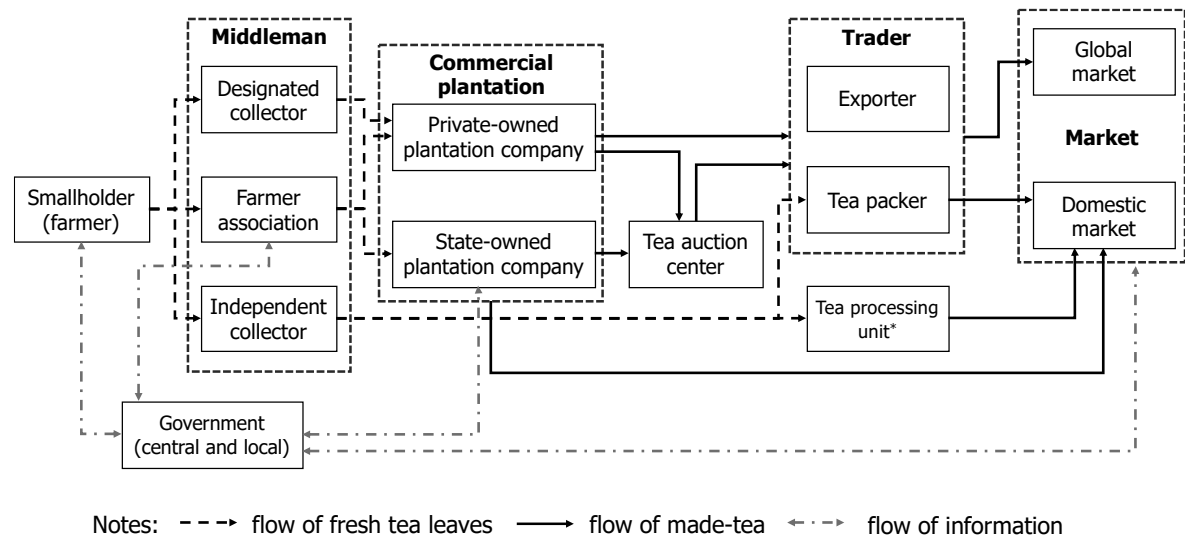
Fig. 1 The supply chain of tea in Central Java Province, Indonesia
Source: Primary data (2019, 2020)

In this study, the role of commercial plantations cannot be detached in supporting the sustainability of tea agribusiness and rural development. The field survey found that the prominent role of commercial plantation is described as an effort to support poverty alleviation and farmer empowerment. The three main roles of commercial tea plantations, i.e. PT Pagilaran, are 1) creating job opportunities, 2) giving particular educational support, and 3) supporting self-development of smallholder through training and assistance. These roles of commercial plantation should be supported by government to support the poverty alleviation. In addition, tea farming is typically family-based farm. Costly and limited availability of hired labor in the rural area underlies this family-based farm. However, this organizational system has been put smallholder at an increasing disadvantage in terms of their ability to bargain with up- and downstream trading partners, as also stated by Valentinov (2007). Despite the role of commercial plantation, the role of farmer association thus also contributes to the farmer empowerment and strengthening farmer bargaining power. Currently the role of each farmer association is very limited and it is deemed necessary for improvement. Farmer empowerment in terms of decision-making power and organizational strengthening can be continuously improved with the collaboration from other SC actors as well as support from the government.

The elaboration and assessment between Integration Definition for Function (IDEF0) model and sustainable livelihood framework (SLF) were further conducted to understand and assess the contribution of existing SC system to the livelihood sustainability of tea smallholders in the rural area of Central Java Province. Among nine vulnerability factors that have identified, climate change as the natural shock and tea production are the most influential factors toward the livelihood sustainability of tea smallholder. This assessment also found that tea smallholders in Central Java Province are still in the level of achieving basic livelihood outcomes for supporting their basic household needs. It implies that the current situation of tea smallholders has not yet accomplished economic sustainability. This also confirm that the livelihood of smallholder is highly vulnerable toward the dynamic condition of tea agribusiness. In addition, special emphasis on risk management practice at the smallholder is needed because shock, trend and seasonality may enhance their resilience on livelihood.

To accommodate the previous findings, the inherent risk in tea smallholder, middleman and commercial plantation were identified and assessed to develop the comprehensive analysis for building the resilience of tea SC. The risk management process from ISO 31000: 2018 and Rapid Agricultural Supply Chain Risk Assessment (RapAgRisk) concept are elaborated in this study. Nineteen risks have been identified in tea SC, including risk of blister blight disease (R1), risk of tea leaf roller disease (R2), risk of low quality of FTL (R3), risk of delayed payment (R4), risk of short-time buyer (R5), risk of fluctuated global price of tea (R6), risk of fluctuated supply and demand of tea (R7), risk of prolonged period of dry season (R8), risk of various quality of tea from supplier (R9), loss during storage (R10), loss during transportation (R11), risk of changing on buyer policy (R12), risk of changing on government policy (R13), risk of substandard of smallholder's FTL (R14), lack of tea smallholder regeneration (R15), pressure from peer competition (R16), pressure from tea smallholder (R17), pressure from buyer (R18), and technology risk (R19). The inherent risks in smallholder, middleman and commercial plantation are presented on the risk mapping in Figure 2. The inherent risks in PT Pagilaran and PT Y is possibly different due to the different business characteristics of both commercial tea plantations.
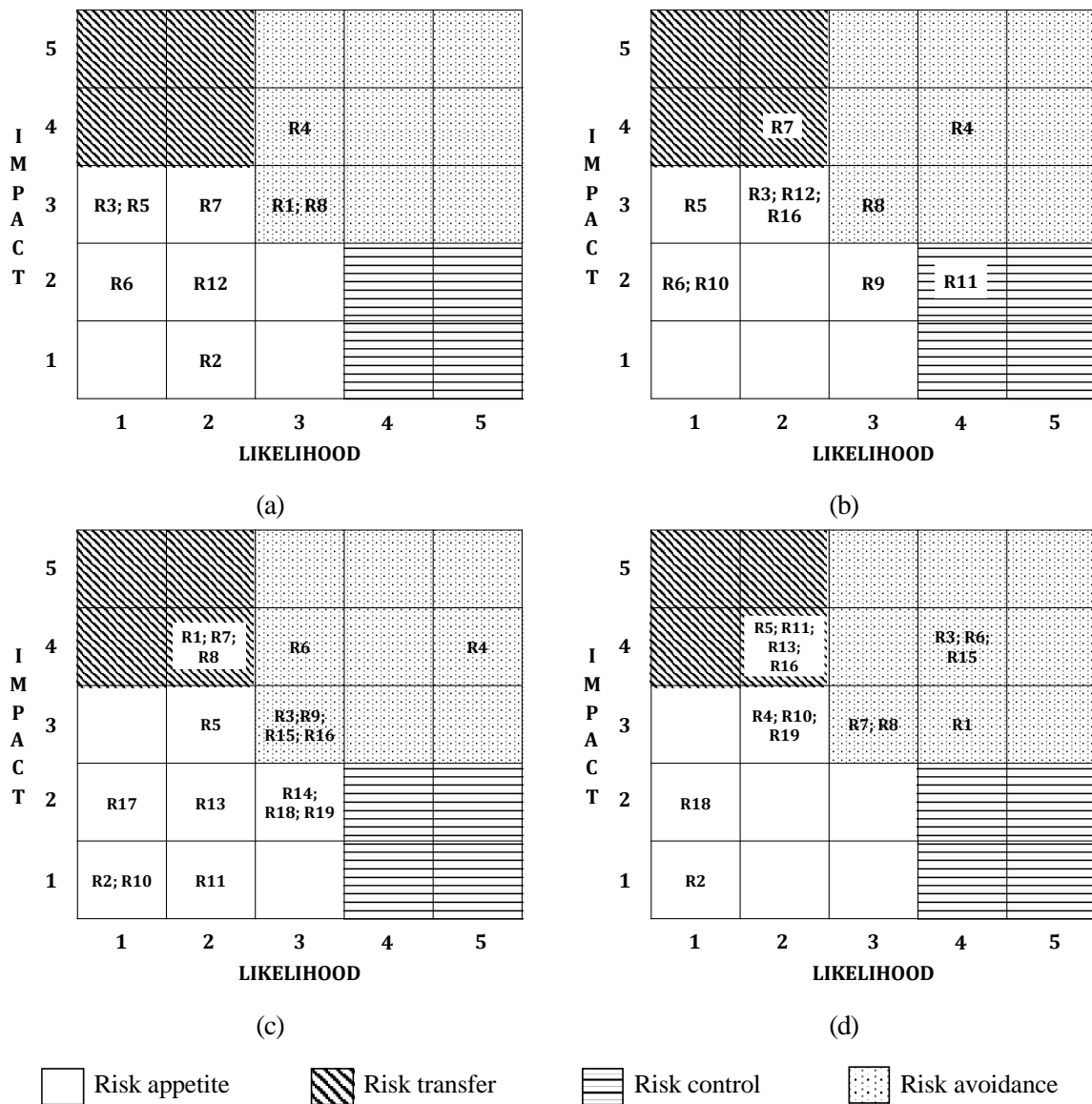

Fig. 2 The risk mapping in (a) smallholder tier; (b) middleman tier, (c) PT Pagilaran, and (d) PT Y
Source: Primary data (2019, 2020)

This study classifies the risk into four categories: risk avoidance, risk transfer, risk control and risk appetite, from the highly prioritized to least prioritized of risk. This risk assessment results the following findings: First, the risk of prolonged dry season (R8) has high expected loss on each stakeholder in tea SC. Second, this study presents that smallholder should anticipate blister blight disease (R1) because it reduces the production by 40-60% and disrupts the supply of tea leaves to middlemen and commercial plantations. This definitely results on imbalance supply and demand of tea leaves in the upstream part of the SC. Moreover, the biological and environmental risk, weather-related risk, and financial risk are the common key risks faced by the smallholder and influence greatly to their resilience in the SC. The market risk (R7) begins to perceive at the middleman tier, while the risk of fluctuated global price (R6) initially perceives in commercial plantation tier. The role of local government in tea trade system is highlighted due to their insignificant contributions through the existing regulations, policies and interventions. The participation and support from the government in establishing profitable trade governance for commercial plantation, middleman and smallholders should therefore be immediately undertaken.

Building resilience of SC should be undertaken by all stakeholders because failure of one stakeholder to deal with their vulnerability will affect the other stakeholders. Theoretically, vulnerability can be foreseen from three elements: exposure to the disruptions, sensitivity to the disruptions, and the capacity of the system or entity to cope with the disruptions. The combination of those three elements may determine the degree to which an entity, community or stakeholder is vulnerable to the changing conditions. Therefore, the integrated framework to build the resilience of tea SC under this case study considers those elements and is performed in Figure 3.
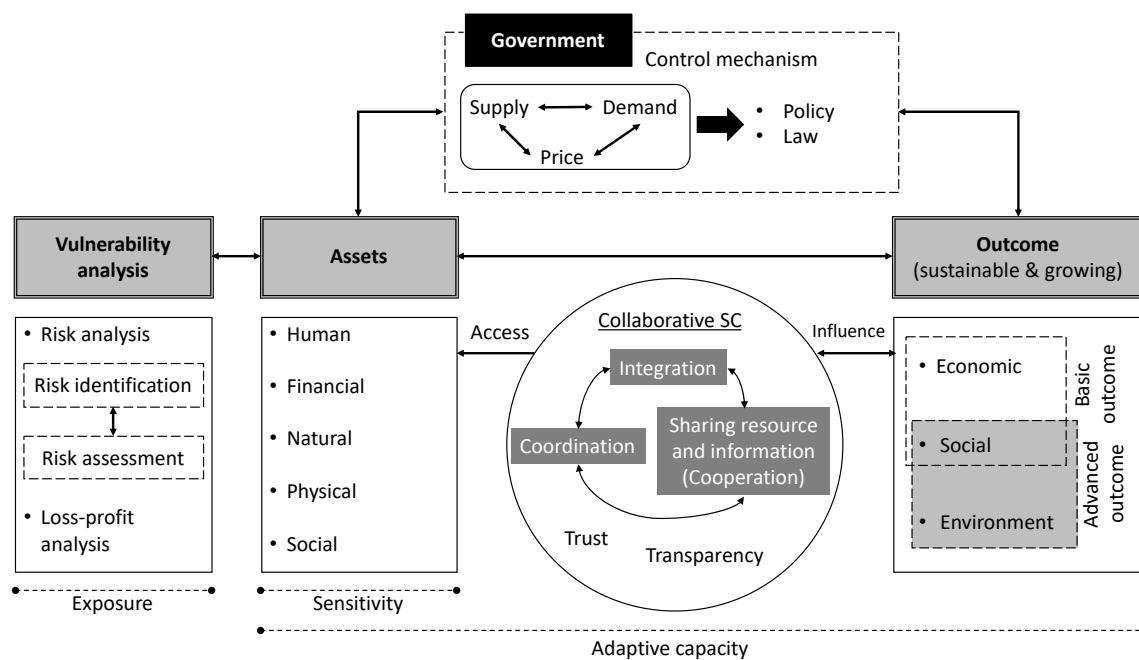

Fig. 3 The conceptual framework to build resilience of supply chain: A case of Javanese tea supply chain
Source: partly adapted from Department for International Development (1999)

To build the resilience of SC, vulnerability analysis should be performed to recognize the disruption that might occurs, including the internal and external environment that influence the stakeholder resilience. The combination of risk analysis and loss-profit analysis can be used to assessed the exposure in each stakeholder. Further, the sensitivity of stakeholders in tea SC to the disruption should be performed through the assessment of assets. This comprehensive analysis on vulnerability, assets and related-outcome may help the stakeholders to response on changing condition and develop the strategies. To efficiently achieve the outcomes, collaborative SC should be involved in the system. However, the collaboration can also either foster or devastate the outcomes of stakeholders. Three degree of collaboration can be considered in tea SC: integration, cooperation and coordination (Figure 3). The degree of collaboration is specific in each case and each stakeholder. To support the collaborative tea SC, trust and transparency are also required with a certain level, as both factors are important antecedents of knowledge sharing among the stakeholders in tea supply chain. Additionally, the government support is also required in this system through control mechanism between supply, demand and pricing system. Adaptive capacity or the capacity to response the disruption, further, can be done by changing the level or combination of assets and changing the outcomes.