博士論文（要約）

A study on the impact of private rice grading system on production and market transaction in Sub-Saharan Africa

- A case study of the Northern region, Ghana -

（サブサハラアフリカにおける米の民間品質基準の導入が生産及び市場取引に
及ぼす影響に関する研究－ガーナ北部州の事例分析－）

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Abstract

This dissertation aims to evaluate the impact of the private rice grading system in the Northern region of Ghana. The Green Revolution in SSA has been considered a key solution to overcome the agricultural problem in SSA. The Green Revolution in SSA's main idea is that the growth of agricultural productivity is possible if SSA countries learn the innovations and experiences of the Green Revolution in Asian countries. Thus, the research about the Green Revolution in SSA has focused on improving agricultural productivity and production quantity. However, the literature less focused on quality improvement of agriculture, especially rice quality. Since some SSA countries face income increases, urban consumers in SSA prefer higher-quality food products. Therefore, the research and policy discussions should examine the agricultural production that considers urban consumers' preference for high quality.

This dissertation studies the case of rice production and transaction in Ghana. Ghana is one example of SSA countries that face income increases and urban consumer preferences for high-quality rice. Also, a private company in the northern region of Ghana has introduced a quality-based rice grading system. This system is rarely available in SSA countries' rice markets. Thus, quantitatively examing this grading system's impact contributes to expanding the research frontier and policy discussion of the Green Revolution in SSA. This dissertation applied causal inference methods and quantitatively evaluated the impact of introducing the quality-based rice grading system on rice production and transaction in the study area. The empirical results showed that

introducing the quality-based grading system changed rice production and transaction towards quality consideration and improvement in the study area. The summary of this dissertation is as follows.

Chapter 1 discusses the rice market situation in SSA and specifies the research question based on the related literature. Globalization integrated developing countries with developed countries through international trade. This integration provided access for people in developing countries to many new products from developed countries. Imported agricultural products are crucial examples because they have changed domestic markets of agriculture and food. With the increasing income of urban consumers, they prefer high-quality agricultural products: milled rice is the newly available staple food for people in Sub-Saharan African (SSA) countries. Despite this trend, the quality of local rice is still lower than the imported rice. The gaps between consumers and producers are a source of economic inefficiency in consumer and producer welfare. Why this gap remains, and how can we solve the problem? This dissertation hypothesized that the quality certification system would be an incentive to upgrade producers' rice quality if the system provides a quality premium on price.

Chapter 2 summarizes the qualitative survey in the Northern region of Ghana. The survey's critical finding is that the large-scale rice milling plant has introduced the quality-based rice grading system, which differentiates purchase price based on quality parameters with objective measurements at the laboratory. This quality-based rice grading system is a unique system for purchasing paddy in SSA. The expectation is that this system works as a quality certification system to upgrade rice quality in SSA. Next, the chapter examines the impact of adopting a new aromatic rice variety on rice farmers' outcomes before the large-scale rice milling plant introduced the grading system. The

region has introduced the new aromatic variety in response to the urban consumer demand. Thus, the analysis for the impact of adopting the new aromatic variety provides an assessment of how much the consumer demand affects the rice farmers' productions before the milling plant introduced the grading system. The analysis applies the endogenous treatment effect models to account for the endogeneity of adopting the new aromatic variety. The results show that farmers who adopt the new local aromatic rice varieties obtain higher rice yields. Still, the higher yields are far from the potential yield of the new local aromatic rice variety. The impact on revenue and profits is negligible (positive, but not statistically insignificant), possibly due to the non-existence of quality-price premium, which suggests why local rice quality is not higher in SSA.

Chapter 3 explains the data sets used in the quantitative analysis of introducing the grading system on rice production and transaction. A representative household survey randomly draws the rice farmers in the area around the large-scale rice milling plant's location. The survey also collects harvested paddy from all sample farmers. The agricultural research institute's laboratory in this region measures the quality parameters of paddy collected to explore the grading system's effect on paddy's objective quality. In addition to the data collection, the research team conducts the training meeting teaching the grading system's existence of the randomly selected sample farmers to generate an exogenous variation in exposures to the system. Thus, these originally collected data sets allow this dissertation to quantitatively investigate the system's impact on rice quality upgrading in the study area.

Chapter 4 examines the indirect impact of introducing the quality-based rice grading system on rice transactions between the farmers and the traders. The analysis applies an IV approach to control the endogeneity of farmers' choice of the trader. The results show

that the farmers near the large-scale rice milling plant are more likely to choose the traders who evaluate the quality contents of paddy, and in this case, the farmers obtain higher sales prices than the case that the traders do not evaluate the quality contents of paddy. An interpretation of the results is that the system's introduction has generated competition between the large-scale rice milling plant and the traders. Thus, this chapter's results provide evidence of expanding the quality-based rice transaction in the study area.

Chapter 5 examines the direct impact of introducing the quality-based rice grading system on rice farmers. The analysis applies a linear regression model with the random assignment of the training generated by Randomized Controlled Trial (RCT). The results show that the farmers realize the grading system introduced as a new quality-based rice sales opportunity. The farmers who understand the system are more likely to sell paddy through the grading system, although they do not obtain statistically significantly higher sales prices than to sell through other local traders. The results on the farmers' paddy quality show that some farmers who notice the grading system are more likely to get the higher hypothetical grade in the grade imposed by the system and the higher incidence of quality accepted scores. They are also more likely to adopt quality-upgrading practices such as adopting the local rice aromatic variety, the combine harvester for harvesting paddy, and the sheet/tarpaulin for threshing harvested rice. However, the average rice quality is lower, especially in contents of red rice, discoloration, and crack of paddy. These findings suggest that the quality-based rice grading system has induced rice farmers to upgrade rice productions toward quality.

Chapter 6 summarizes the findings and discusses the limitations of this dissertation. Overall, this dissertation's analysis shows supporting evidence that the quality certification system can be an incentive to upgrade producers' rice quality in the study

area.

The implications of the findings are as follows. First, the processing sector is the key to bridge the farmers and consumers. Thus, establishing a similar-scale rice milling plant in other SSA countries will upgrade local rice quality in SSA. The quality-based grading system will be the basis of the plants' operation. Second, among the contents of rice quality, red rice, discolor, and crack is low on average in the study area. Then, the effort to upgrade rice quality should focus on these factors. Third, many farmers still do not sell rice through the grading system. The main reason is that the farmers do not trust the grading system, transportation cost is high, and the amount of rice sales per transaction is small. Therefore, the well-functioning of the grading system requires overcoming these constraints.

There are limitations of this dissertation. The dissertation could not analyze some crucial contents of considering the potential of the grading system. These contents are the cost and benefit of producing the upgraded rice for farmers, the plant's survival, optimal contract mechanism, consumer response to the upgraded local rice, and the results' external validity. Applying and extending the rice grading system in the study area to other regions should examine these contents. It means that further investigation should consider what technologies are complements to rice quality improvement. These researches leave future works.