

論文要旨と審査結果

An Investigation into the Possibility of a Rice Green Revolution in Sub Saharan Africa: Lessons from the Mwea Irrigation Scheme in Kenya

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I. 論文要旨

Rice has emerged as an important cereal crop in Sub-Saharan Africa (SSA) mainly as a result of urbanization and population growth. However, rice production in SSA continues to lag behind demand and, hence, creates the widening gap between production and consumption in recent years. One strategy to boost rice production is to invest in irrigation development, disseminate high-yielding modern varieties, and enhance the utilization of fertilizers among farmers as higher modern varieties of rice respond to both the availability of water and application of fertilizer. However, investments in irrigation have remained low in SSA importantly because the past performance of large-scale irrigation projects in SSA has been poor. Additionally, farmers in SSA use small amounts of chemical fertilizers because of the high prices of fertilizer and limited access to credit for farmers. Therefore, it is of paramount importance to identify the conditions for successful rice farming in large-scale irrigation schemes in this region.

Based on this background, this study developed two objectives. First, the applicant investigated the conditions for successful rice farming in large-scale irrigation schemes based on the Asian Green Revolution experience. Second, he investigated the role of access to credit on rice farming in a large-scale irrigation scheme in SSA. He conducted an empirical analysis using two datasets: the first is a unique dataset collected by the author in Mwea irrigation scheme, and the second dataset is extracted from data reported by David and Otsuka (1994) and Nakano et al. (2011).

In order to identify the conditions for successful rice farming in large-scale irrigation schemes, the study compares large-scale irrigation scheme in SSA with irrigated areas in Asia. His findings confirm some basic laws of economic theory regarding diminishing marginal product of fertilizer application and declining demand for fertilizer with increases in its price. He finds that although farmers in SSA used smaller amounts of fertilizer in comparison to farmers in Asia, the relationship between rice yield and

fertilizer use was positive and similar between irrigated areas in Asia and SSA. In addition, the relationship between the price of fertilizer relative to output price and fertilizer use was negative in both regions. The relationship between the wage rate relative to output and labor used was also negative in both regions. However, farmers in SSA used a lot more of labor in comparison to farmers in Asia. The differences in the amounts of labor used per ha could be explained by labor-capital substitution in Asia where farmers adopted labor-saving technologies -which was suited for irrigated ecologies- as a result of high cost of labor.

Mwea irrigation scheme stood out from other schemes in SSA because the price of fertilizer compared to output price was low, even without fertilizer subsidies, and fertilizer use was the highest in SSA. The applicant investigated the determinants of input use in Mwea irrigation scheme and find no evidence of the effect of the distance of the farmer's plot from the intake of the feeder canal on input use, although the water rotation groups affected use of family labor per ha. He also finds no evidence of the effect of the wealth variables on fertilizer application, and this suggests that the access to credit in Mwea is favorable. An important finding is that the rental value of land, a proxy for the quality of land, was positively and significantly correlated with input application, suggesting that farmers were aware of their land quality, and those with good quality of land applied more inputs.

He investigated the role of access to credit on farm performance measured in terms of value of output, income and residual profit per ha for different categories of borrowers; (1) those who borrow from a farmer's cooperative (MRGM), (2) those who borrow from traders, (3) those who borrow from both the MRGM and traders, and (4) those who did not borrow (non-borrowers). He found that farmers who could not borrow from the MRGM were able to access credit from rice traders, thereby easing their credit constraints. Farmers who borrow from traders were found to be not disadvantaged in farm performance outcomes, even though they pay high interest rates.

The cost of fertilizer and rental cost of capital were cheaper for farmers who accessed credit from MRGM, and farmers who borrow from traders incurred higher interest costs. However, the differences in costs decline considerably when we assumed a hypothetical case where the interest rate charged by traders and that offered by banks for deposits was equal to the social cost of capital. In both the observed case, and in the hypothetical case, the value of output, income and residual profit was not significantly different among the four categories of farmers. This suggests that farmers, who had access to credit from traders, were able to apply amounts of inputs similar to farmers who had access to credit from MRGM as well as non-borrowers. As a result, the value of output,

income and residual profit from rice farming were not significantly different among these categories of farmers.

In sum his study shows that farmers in Mwea irrigation scheme were able to attain high farming performance because they applied ample amounts of inputs, particularly fertilizer. The presence of an alternative informal source of credit is important, so that farmers who are unable to access credit from formal credit sources, such as the MRGM, can borrow from informal credit sources such as rice traders. The study concludes that the conditions for successful rice farming in large-scale irrigation scheme includes improving the quality of irrigation infrastructure, enhancing fertilizer use by lowering the price of fertilizer and promotes informal credit markets.

II. 審査結果報告

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平成 24 年 11 月 5 日(月)の博士論文最終報告に引き続き、主査である大塚啓二郎教授、副査である、大山達雄教授、Jonna P. Estudillo 教授、木島陽子准教授(筑波大学)、および真野裕吉講師 (一橋大学) による審査委員会が開かれた。この際、本論文について、次のような意見が出された。

ケニアの灌漑稲作において、アジアのそれを上回るほどの高収量が実現されており、「緑の革命」がすでに起こっていることを示した研究は非常に貴重かつ有意義である。今後は、国際的学会誌への論文の掲載に大きな期待できる。

ただし以下のコメントがよせられた。

1. Re-examine the estimation results in Tables 11 and 12, as the signs of key coefficients are different.
2. Interpretation of Table 14 should be clearer.
3. Policy implications should be: (1) invest irrigation, (2) attempt to lower fertilizer price by reducing costs (see Morris), and (3) promote informal credit markets. How to implement (3) is not simple.

4. Examine the analysis including ratoon production.
5. Show the robustness of estimation results by trying alternative specifications.
6. Add discussions on the appropriateness of the exclusion restrictions.
7. Table 4.4 on the choice of credit source: Try probit and multi-nomial logit to identify who are rationed out explicitly.
8. It is better to include table showing the list of variables with definitions.
9. Implement the test of the difference in means in some descriptive tables.
10. Make main stories clearer and more appealing.

全体として、本学の博士にふさわしい内容であると全員の意見が一致し、審査員全員から上記で指摘された諸点について修正したことの承認を得、博士(Ph. D. in Development Economics)の学位を授与すべきであるという判断が下された。その後、修正された最終版が提出され、指摘された問題点が修正されたことを主査が確認した。