Department of International Studies
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Master's Thesis

Do fertilizer and seed subsidies strengthen farmers' market participation? - The impact of Tanzania NAIVS on farmers' purchase of agricultural inputs and their maize-selling activities -

化学肥料・改良種の農業補助金は農家の市場参加を促進するか？
- 農業投入財の購入およびトウモロコシの売却活動に対するタンザニア補助金（NAIVS）の影響 -

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(Motivation)

Realizing the African Green Revolution has been a critical issue to achieve high agricultural production in Sub-Saharan Africa (SSA). Of the world fertilizer consumption in 2013, the SSA region just accounts for less than two percent in nitrogen, phosphate, and potash (FAO 2015). Some SSA governments and development partners have endeavored to raise the smallholders' use of modern agricultural inputs such as fertilizer and improved seed. One practice is a large-scale input subsidy program for smallholders, which was introduced in some SSA countries such as Kenya, Malawi, Rwanda, Tanzania, Zambia in East Africa and Burkina Faso, Senegal, Mali, Nigeria, Ghana in West Africa (Druilhe and Barreiro-Hurl 2012).

By comprehensively analyzing farmers' activities, this thesis provides new insights to previous literature that has focused on specific aspects of subsidy impacts. A representative topic of previous literature is on revealing whether a subsidy enables farmers to adopt subsidized inputs and achieve high agricultural production (Chibwana et al. 2010). Another representative topic is whether a subsidy crowds out farmers' commercial purchases of subsidized inputs (Ricker-Gilbert et al. 2011). The analyses of these previous works are insufficient to evaluate the efficiency and sustainability of SSA subsidies. The overuse of subsidized inputs may decrease the consumption of non-subsidized inputs and deteriorate agricultural productivity, which may ruin the fruits of subsidies. In particular, selling activities of subsidized farmers has not been examined in previous works, despite its obvious importance for farmers' sustainable development. Therefore, this thesis aims to evaluate the effectiveness and sustainability of SSA subsidies in broader perspectives.

This thesis deals with the subsidy program for inorganic fertilizer and improved seed in Tanzania since 2008, or the National Agricultural Input Voucher Scheme (NAIVS). This program aims to promote small-scale farmers to adopt modern agricultural technologies by providing them with a voucher. Subsidized farmers who receive a voucher purchase inorganic fertilizer and improved seed at half the price at a local retail shop.

The purpose of this thesis is to examine whether the NAIVS program strengthened farmers activities in both agricultural input and grain markets. The dataset in the thesis comes from two waves of the Tanzanian National Panel Survey, which collects socioeconomic and agronomic information at household and plot levels nationwide in Tanzania. I first evaluate the subsidy impacts on farmers' participation in agricultural input markets by examining their expenditure on all types of agricultural inputs such as inorganic fertilizer,

improved seed, organic fertilizer, traditional seed, pesticide/herbicide, labor, capital. Estimating the increase of expenditure on subsidized inputs (inorganic fertilizer and improved seed) is insufficient to evaluate farmers' market participation. Subsidized farmers may sacrifice the consumption of non-subsidized inputs by excessively investing in cheap subsidized inputs whose prices halved with the subsidy. This offsets farmers' participation in agricultural input markets as a whole. To evaluate the subsidy impacts on farmers' participation in grain markets, on the other hand, I examine the probability for farmers to sell maize and their maize sales. Maize is the most popular staple food in Tanzania and its improved seed is a main subsidized input in the NAIVS program. For the estimations above, I adopt the Correlated Random Effects Tobit and Probit models. This method enables us to address the potential endogeneity of subsidy programs by controlling for farmers' time-constant heterogeneity.

Though I attempt to evaluate the NAIVS program by using a comprehensive set of inputs, we still have the following question: does the overuse of cheap subsidized inputs lower agricultural productivity? Subsidized farmers may use subsidized inputs beyond the appropriate application level relative to non-subsidized inputs. To answer this question, I finally use a Stochastic Frontier (SF) model to test whether the NAIVS program affected the efficiency of farmers' maize production. The SF model offers an econometric method to directly measure production inefficiency. This approach also measures the response of harvested maize to production factors, which is beneficial to investigate whether the subsidy is effective to raise farmers' agricultural production.

(Importance)

My findings will be beneficial in designing an efficient subsidy program. Obviously, improving farmers' participation in agricultural markets is inevitable for sustainable development of agricultural production. Selling activities in grain markets enables farmers to independently use agricultural inputs after the subsidy graduation and to raise their production level in the long run. To achieve the higher level of production for sales, we must confirm the subsidy increases the use of subsidized inputs without sacrificing demands for non-subsidized inputs. We also must confirm subsidized farmers produce outputs without alleviating production efficiency by excessive use of subsidized inputs.

(Results)

The results in the thesis show that the average beneficiary farmer at least tripled the expenditure on inorganic fertilizer and improved seed. This considerably increased expenditure can be explained by the increased probability for beneficiaries to purchase subsidized inputs. Despite the large increase above, the expenditure on non-subsidized inputs is not significantly increased nor decreased. Furthermore, I do not find evidence the NAIVS program affected the production efficiency of beneficiaries. Therefore, the NAIVS program promoted farmers' participation in agricultural input markets as a whole, with production efficiency maintained. Nevertheless, neither the probability of selling maize nor the amount of maize sales did not increase significantly for beneficiaries. Hence, the subsidy program did not strengthen farmers' activities in maize markets. This insignificant result is attributed to the endogenous process of selecting subsidized farmers. The NAIVS may have selected farmers who were selling crops to markets to ensure these farmers could afford half the payments of subsidized inputs. In addition, SF results reveal that using subsidized inputs contributes to significant but small increases in maize production. These findings indicate the NAIVS program is unsustainable because maize selling activities are a main income source for most smallholders to purchase agricultural inputs. These findings also indicate the subsidy is inefficient because low output responses to subsidized inputs generate insufficient profits for continuous agricultural investments. These pessimistic implications cannot be obtained by previous works that focused on specific aspects of subsidies.

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