



Determinants of Farmers' Agricultural Diversification: The Case of Cambodia

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Abstract

A Heckman sample selection approach is employed with the data on Cambodia Socio-Economic Survey CSES-2007 to explore price and non-price factors determining farmers' crop diversification decision, and consequently affecting diversification intensity. The findings suggest that high relative price discourages farmers from diversifying crops. Irrigation, agricultural equipment ownership and farming expenditure have significantly positive effects on the decision, and sequentially increasing the intensity. Arable land size per household member, agricultural and transportation equipments have positive correlation with the diversification decision. Small scale of farming is a major hindrance to the decision, and consequently reducing the intensity. Land dispute, one of the main institutional matters in Cambodia, is found to have significantly negative marginal-effect on farmers' decision on crop diversification.

Keywords: Agricultural diversification, sample selection model, Cambodia

Introduction

In the process of economic development, agriculture serves as a food producer and factors-of-production supplier to industrial sector. It is also a major income generator for rural households in less developed economies. The well developing sector makes tremendous contribution to poverty and inequality reduction in out-of-the-way areas. Agricultural diversification has been considered one of the most likely avenues to promote the development of agriculture. The diversification is the adjustment of farming, which combines various and complimentary agricultural activities and moves agricultural resources from low to higher value (Meerta *et al.*, 2005; Joshi *et al.*, 2003; McCulloch and Ota, 2002; Delgado and Siamwalla, 1999). In sub-Saharan Africa, the movement of resources to high-value produce is the most likely way to better the agricultural productivity within a context of growing

urbanization and global integration (IFPRI, 2007).

The importance of agriculture has attracted researchers' attention to the factors determining the agricultural production pattern. In Thailand, land title induces higher farming investment; farmers with legally-titled land make more investment in farming, use more inputs, and produce more outputs (Feder *et al.*, 1988a; 1988b). Regarding crop diversification in Kanartaka, irrigation, fertilizers, physical infrastructure, markets structure and transportation are the main determinants (Saraswati *et al.*, 2011). In Kenya, agricultural assets, amount of hired labor, occupation of household head, contractual arrangements, farm size, and distance to output market are a major factor affecting the farmer's decision to diversify into horticulture (Mwangi *et al.*, 2013). Moreover, in Sudan the degree of crop diversification has positive correlation with the household size and income level (Abdalla *et al.*, 2013). Meanwhile, in India, Assam plains' diversification of agriculture

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is a mechanism adopted to respond to ecological risk from flood (Mandal and Bezbaruah, 2013).

In Cambodia, more than 80 percent of the population lives in the countryside, earning their living by farming dependently upon rain-fed condition. The farming is dominated by rice production either for subsistence or small-scale commercial purpose. Over the past decades, the agricultural outputs have increased by 4.4 percent, driven mainly by rice, livestock and fisheries. Paddy covered around 2.63 million hectares during 2007-2011 (up to 90 percent of the cultivated land), and the production increased from 4 million tons in 2000 to 6 million tons in 2007 (MAFF, 2011; and MAFF & MWRM, 2010). However, the paddy yield remains relatively low vis-à-vis the neighboring countries'. The yield averaged around two tons per hectare in Cambodia, compared to 2.65 - 4.95 tons in the neighbors (EIC, 2006). The agricultural productivity is constrained by the shortage of capital investment for such inputs as seeds, fertilizers, and irrigation. Given price instability and relatively low productivity of agriculture, coupled with poor connection between rural economies and the rest of the economy, the rural population has not been much better off. However, a full employment of agricultural resources makes it more possible to shore up the rural struggling economies. But, only 0.9 percent of total land areas are now permanently-farmed (Hem, 2012). This reflects that the agricultural resources are not fully used, causing the agricultural output level to stay far below what it otherwise would be.

Transforming monoculture into diversified agriculture can not only promote the full employment of resources, but also bridge the market efficiency gap. The diversified agriculture has been equally considered a major strategy to conquer many challenges faced by farmers and to respond to opportunities. It improves farmers' nutrition; and more dynamic farmers can diversify agricultural products to meet changing consumption patterns as consumers become rich and urbanization develops rapidly. The diversification can also allow farmers to

increase revenue by supplying products to potential export market. In Cambodia, the diversification of agriculture is, however, low and probably constrained by price factors and many non-price factors. Cambodian farmers' rice double-cropping is mainly determined by the water availability and cultivable land (Tong *et al.*, 2011). The unfamiliarity with and limited knowledge of non-rice crops, and unpredictable rainfall causes Cambodian farmers to perceive that diversifying paddy field puts them at high stakes (ACIAR, 2011). Concerning land right issue, some of the farmers are landless or lost their land, as a result of the government's economic land concession, insecure land rights and tenure, limited access to information, and land grabbing. In 2008, 150, 000 Cambodians nationwide were intimidated into getting forcibly evicted (Amnesty International, 2008); and 21.1% of 2,235 households sampled were landless, and 26.3% held less than half a hectare of land (Chan, 2008).

Because land title and land conflicts are a main issue in Cambodia, they may have significant effects on Cambodian farmers' diversification of agriculture. Moreover, price factors seem to be overlooked in the previous studies. Also, the impact of such institutional factors and price factors on the diversification has yet to be explored in the case of Cambodia in particular. The current study is, as a part of growing branch of literature on agricultural economics, conducted to bridge this gap and to offer further empirical evidence.

The attempt in this paper is therefore to provide new insights into a question of why the agricultural diversification is low in Cambodia, based on data on Cambodia Socio-Economic Survey 2007. In so doing, the paper has twin objectives: (i) to explore factors determining farmers' behavior towards agricultural diversification, with a focus on price factors and issues of rights to land, (ii) and consequently investigate their influences on the diversification intensity. The finding is crucial to the government's policies at micro and macro level in reducing poverty and inequality through rejuvenating

agricultural market favorable to the market-oriented diversification.

Analytical framework

The agricultural diversification is a production of additional crops to existing ones at farm level (Dorjee *et al.*, 2003). The agricultural activities are, with the availability of production technology, changed in response to the signals of markets. More specifically, it is a change in product (or enterprise) choice and input use decisions forced by market principle and profit maximization (Pingali and Rosegrant, 1995). At farm level, the diversification represents a change in the underlying characteristics of the farm system such that farming and products are more aligned with the social, environmental, and economic contexts (Barghouti *et al.*, 2004). Farmers make such a change in response to both opportunities (changing consumer demand and demographics, export potential, changing marketing opportunity, and improving nutrition) and threats (risk, external and domestic policy threats, and climate change).

To theoretically identify price and non-price factors affecting the farmers’ decision, let assume that farmer *i* has, with the available agricultural resources, two strategic choices to produce commodities: either to diversify crop portfolio or produce a specific crop. He prefers any production strategy that can generate the highest profit. The model is solved as follow:

Crop diversification choice

As a producer, farmer *i* is to maximize the profit subject to the production technology constraint. The production technology is characterized by a combination of land K_i and other agricultural inputs X_i such as seeds, fertilizers...etc. Farmer *i*’s profit optimization problem can be written and solved as follow:

$$\begin{aligned} \text{Max}_{K_i, X_i} \pi &= pQ_i - rK_i - p_X X_i \\ \text{S.t: } Q_i &= Q(K_i, X_i; Z_q), \\ \text{production technology constraint} \\ Q_i, K_i, X_i &\geq 0 \end{aligned} \quad \dots\dots\dots (1)$$

Where Q, p, r and p_x are output of diversified crops, average price of output, cost of land renting and price of agricultural inputs respectively; and Z_q is production’s characteristics, including access to irrigation and production techniques, shifting the production technology. The problem can be solved with the FOC for inputs as follow:

$$\begin{aligned} \frac{\partial \pi}{\partial K_i} &= p \frac{\partial Q_i}{\partial X_i} - r = 0 \Rightarrow \frac{\partial Q_i}{\partial K_i} = \frac{r}{p} \\ \frac{\partial \pi}{\partial X_i} &= p \frac{\partial Q_i}{\partial X_i} - p_X = 0 \Rightarrow \frac{\partial Q_i}{\partial X_i} = \frac{p_X}{p} \dots (2) \end{aligned}$$

From these equations, the optimal level of input X and the optimal land size to be used in the production, as well as the optimal output are obtained as follow:

$$K_i^* = K(p, r, p_x, Z_q)$$

$$X_i^* = X(p, r, p_x; Z_q) \quad \dots\dots\dots (3)$$

$$Q_i^* = Q(p, r, p_x; Z_q) \quad \dots\dots\dots (4)$$

The maximized profit from the diversification choice, called the indirect profit function, can be obtained:

$$\pi_D^* = pQ_i^* - rK_i^* - p_x X_i^* \text{ or } \pi_D^* = \pi(p, r, p_x; Z_q) \quad \dots\dots\dots (5)$$

Crop specialization choice

Like the crop diversification choice, but here farmer *i* produces a specific crop with the available agricultural resources. The production technology is characterized by a combination of land K_i and input X_i . The farmer maximizes the profit subject to the production technology constraint. Farmer *i*’s profit maximization problem can be written as follow:

$$\begin{aligned} \text{Max}_{K_i, X_i} \pi &= p_s Q_{si} - rK_i - p_x X_i \\ \text{S.t: } Q_{si} &= Q(K_i, X_i; Z_q), \\ Q_{si}, K_i, X_i &\geq 0 \end{aligned} \quad \dots\dots\dots (6)$$

Where Q_s, p_s and p_x are output of specialized crop, specialized crop output price and price of input X respectively.