Farmers' Perceptions of Organic Rice Farming in Cambodia: Opportunities and Challenges

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Abstract

This study documents some perceptions of Cambodian farmers towards organic rice farming, as well as the determinants of farmers' views. Three target organic cooperatives were selected from three districts located in Takeo and Kampot province. 170 out of 247 farmers that were randomly selected for interviews from March to April 2014 were used in the analysis. Results indicate that most farmers were only aware that organic rice production would yield higher market prices for their produce, along with an improved standard of health and environment. They infrequently remarked about other benefits, such as soil improvement and cost reduction. Farmers perceive that labor-intensive production and lack of organic fertilizers are the main challenges in organic farming. Moreover, farmers distinguished the opportunities and challenges differently according to their characteristics. Hence, securing better yields and a market for organic rice production through long term contracting and improved farming techniques are key factors for promoting organic farming.

Keywords: organic rice farming, farmers' perceptions, opportunities, challenges, Cambodia

1. Introduction

To help improve sustainable development in rice production, organic rice farming was introduced to Cambodian farmers in 2003. Given favorable conditions, Cambodian farmers adopted and produced organic rice with astonishing success in early years. This was due to the fact that farmers could earn a higher income with project support; as Cary and Wilkinson (1997), Musshoff and Hirschauer (2008), Sheeder and Lynne (2009), and Ponti et al. (2012), documented, financial factors are very important for farmers to adopt new farming methods.

The adoption of organic rice farming fell tremendously after project support was terminated, and many farmers abandoned organic farming. However, during the last few years, the practice has gradually been adopted again due to the increasing demand for organic rice products in the market. The adoption and diffusion of organic rice farming in Cambodia has fluctuated over the past decade, although some studies conducted in other periods, such as Taing (2008), Sa (2011), Khoy et al. (2015, 2016a), acknowledge that Cambodian farmers would obtain higher yields and profits by adopting the practice. Although organic rice farming aims to increase rice farmers' income by eliminating the use of farm chemicals and encouraging the use of farm-based inputs, many farmers still perceive the practice negatively. A number of studies (e.g., McCann et al., 1997; Niemeyer and Lombard, 2003; Suresh and Reddy, 2010) have focused on factors influencing farmers' decisions to adopt organic farming.

They suggest that various economic, technical and institutional factors are influential determinants. The acceptance of new technologies can result from farmers' concerns, so farmers may view a farming system differently, based on their preferences, resources, and constraints (Bellon, 2001). Therefore, a farmer's perspective towards new technology is a critical tool in developing an effective strategy.

While there are many studies that have tried to access the impacts as well as the determinants of adoption of organic rice farming in Cambodia, none examines farmers' perception towards it. Hence, this article aims to identify Cambodian farmers' perception of opportunities and challenges with respect to organic rice farming and its determinants.

2. Methodology

2.1. Study sites

Three districts were targeted as study sites: Chum Kiri, Chhuk, and Tram Kak; the first two are located in Kampot province and the third in Takeo province. The above areas, which border each other, were selected because they have similar characteristics in terms of social and economic backgrounds, and organic rice cooperatives had been previously established in them. Those cooperatives were Srer Cheng Organic Agriculture Development Cooperative, Chhuk Organic Agriculture Development Cooperative, and Trapaing Sronger Agriculture Development Cooperative located in Chum Kiri, Chhuk, and Tram Kak districts, respectively.

2.2. Sampling and data collection

Organic and conventional farmers were randomly selected from each study area for face-to-face interviews using a specially-designed questionnaire. Farmers were asked to give opinions about organic rice farming with respect to its opportunities and challenges. We provided a list of opportunities and challenges of organic rice farming, and asked farmers to select as many of them as possible (Table 1). We conducted a field survey on 247 farmers during March and April 2014, but only 170 responses were used in the analysis, of which 150 respondents (84 organic farmers; 66 conventional farmers) provided their opinions about opportunities, and 154 respondents (84 organic farmers and 70 conventional farmers), about challenges.

2.3. Data analysis

We used descriptive statistics to summarize the results of opportunities and challenges facing organic rice farmers. To assess the determinants of farmers' perceptions, we employed a multivariate probit regression using the simulated maximum likelihood method proposed by Cappellari and Jenkins (2003). Because Stata is not able to accurately estimate tri-variate and higher-dimensional normal distributions, and the computations were based on standard linear numerical approximations, the results could be subject to inefficient or poor estimation (Hajivassiliou and Ruud, 1994). Simulation-based methods are thus regarded as better approach (Stern, 1997; Gourieroux and Monfont, 1996; Greene, 2003).

Consider the M-equation multivariate probit model, specified as:

$y_{im}^{*} = \beta_m X_{im} + \varepsilon_{im}$; $m = 1,\ldots,M$

$y_{im} = 1$ *if* $y_{im}^{*} > 0$ *and 0 otherwise*

Where

y is the dependent variable for the ith farmer (when choosing opportunities and challenges),

X is independent variables (listed in table 2),

β is the regression coefficient to be estimated,

ε_{im}, $m = 1, \ldots, M$ are error terms, normally-distributed as multivariate, with a mean of 0, and variance–covariance matrix V, where V has a value of 1 on the leading diagonal and correlations $\rho_{jk} = \rho_{kj}$ as off-diagonal elements. For details of the estimation simulated under maximum likelihood, refer to Cappellari and Jenkins (2003).

2.4. Data variables and their definition

Many studies have documented the benefits and challenges of organic farming (Morgera et al., 2012; Kristiansen et al., 2006; Schneeberger et al., 2002; Niemeyer and Lombard, 2003). Specifically, COrAA (2011), Sa (2008) and Taing (2008) have proposed the potential and challenges of organic rice farming in Cambodia.

Based on the literature reviewed, we created a list of opportunities and challenges for organic rice farming to ask for farmers' perceptions (Table 1).

Table 1. List of opportunities and challenges for organic rice farming

All variables used in the multivariate probit regression are shown in Table 2. The details of the name, definition, and unit for each variable are indicated. In the analysis, farmers' perceptions of opportunities and challenges are regarded as a dependent variable. We included 10 independent variables. *Adopter* is included to assess the different perceptions of the two groups. *Age*, *gender* and *education* are regarded as farmers' characteristics; *farming labor*, *rice field* and *other farming* are included as farm characteristics; and *house size*, *off farm* and *own-tractor* pertain to economic situations.

Table 2. Description of variables included in the regression analysis

3. Results and Discussion

3.1. Descriptive results

Table 3 presents farmers' socio-economic characteristics and the comparison between organic and conventional farmers. The results show that sample farmers belong to the middle-aged group (average age 46 years old), and 90.6 percent of farms sampled were male-headed. They have low education levels, with an average of six years of schooling—a fact that imposes a challenge for researchers when introducing them to modern technology. However, by comparison, organic farmers have more years of schooling compared to conventional farmers. Hence, educational level played an important role influencing farmers' decisions on organic farming adoption.

The average active laborers in each household is 2.8 people, suggesting that most households lack adequate labor for rice farming, which is regarded as being labor intensive. With an average rice field size of 1.06 hectares per household, it is difficult to introduce organic farming to farmers since organic farmers tend to own larger fields. This factor influences whether farmers choose to conduct organic farming because they are able to allocate some parcels to organic farming if they own more land. Results also show that only 28.8 percent of farmers cultivated other crops besides rice, and organic farmers have a significantly higher percentage than conventional farmers (44 percent compared to 14 percent). It can be a challenge for farmers who only produce rice to adopt organic farming since other cropping systems may provide them more sources of organic matter to apply in their organic field.

The average square meters of a farmer's house, which is used as an indicator of farmers' wealth, is 38.7 square meters, and there is no significant size difference between organic and conventional farmers. Results indicate that 21.2 percent of farmers engaged in off-farm activities, with 26.2 percent and 16.3 percent pertaining to organic and conventional farmers, respectively. Only 20 percent of farmers have a tractor. Since organic farming requires a good level of land preparation, a tractor is very useful for organic farming. However, the results indicate that there is no difference between organic and conventional farmers. Descriptive results suggest that organic farmers face better conditions, which are favorable for conducting organic farming.

Table 3. Characteristics and comparison between organic and conventional farmers

3.2. Farmers' perception of organic rice farming

This section presents farmers' perceptions towards organic rice farming. As mentioned in the methodology section, a list of opportunities and challenges was provided to farmers to select among based on their perception. Figure 1 shows the perception of farmers towards the advantages of conducting organic rice farming, which we used to categorize farmers into three groups: pool sample, organic farmers, and conventional farmers. In the pool sample, farmers believed that price premiums, health and environmental benefits, and market opportunities, comprising 82.7 percent, 50 percent, and 29.3 percent, respectively, provided the greatest benefits. Over 80 percent of farmers responded that they would obtain higher prices from organic products, consistent with the finding of Cary and Wilkinson (1997), Sheeder and Lynne (2009), and Ponti et al. (2012). They documented that economic factors are very important to farmers in developing countries when considering whether to adopt organic farming.

On the other hand, fewer farmers perceive soil improvement, cost reduction, and yield premium as opportunities arising from organic farming (Figure 1). Even some empirical studies such as Sa (2011) and Khoy et al. (2016a) suggested that farmers could obtain higher yield and reduce production cost by shifting to organic farming; yet most farmers unable to realize such opportunities. This is due to the poorer yield performance during the three-year transaction period, and the deficiency of farm records. This result is in contrast to Piadozo et al. (2014), who suggested that lower cost and improved soil fertility were the most important advantages perceived by Filipino rice farmers.

To distinguish the perception between organic and conventional farmers, separated results are also shown in Figure 1. They indicate that there are some perception differences between organic and conventional farmers. Akin to the pool sample, conventional farmers acknowledge price premium, market opportunities, and health or environmental benefits as organic farming opportunities, while soil improvement, cost reduction, and yield premium receive a lower percentage of recognition. Price premiums and health or environmental benefits are still the most important benefits perceived by organic farmers. Interestingly, organic farmers perceive soil improvement and cost reduction in shares as high as 32.1 percent and 36.9 percent, respectively, suggesting that organic farmers could realize significant advantages in these terms by adopting organic farming. Surprisingly, few organic farmers believe that yield premium and market opportunities are among the advantages of organic farming, since they experience yearly yield and market fluctuations.

Figure 1. Farmers' perception of opportunities towards organic rice farming

Figure 2 presents the perception of farmers regarding the challenges of organic rice farming. Results indicate that intensive labor (46.8%), lack of organic fertilizer (44.2%), and market instability (40.3%) are the most important challenges perceived by farmers in the pool sample. This finding is in line with Khaledi et al. (2011), who revealed that Canadian farmers were not adopting organic farming due to a lack of market opportunity and additional labor requirements for organic products. Njeru (2015) also suggested that labor intensity and inadequate market incentives were among the most important challenges of organic farming in Kenya. Hossain (2012) documented that lower availability of organic fertilizer was one of the main problems for farmers in conducting organic farming. Nevertheless, farmers do not perceive weeds, yield, and documentation as problems associated with organic farming. Although weeds are generally believed to be one of the most important issues for organic farming, farmers in study areas are able to control them effectively. Conversely, Hall and Rhoades (2009) documented that Ohio grain farmers regarded higher weed infestation, lower yield, and higher pest infestation as the main barriers to growing organic crops. Moreover, Piadozo et al. (2014), Conrado (2010), and Malab (2011) suggested that dealing with documentation limited the adoption of organic vegetable farming in the Philippines, which is inconsistent with our findings.

While organic farmers acknowledge that labor-intensive practice (52.4%), lack of organic fertilizer (41.7%) and insect/disease issues (34.5%) were the key issues in organic rice farming, conventional farmers believe that market instability (62.9%), lack of organic fertilizer (47.1%), and labor-intensive requirements (40%) were the greatest obstacles. The different perceptions of market instability between organic and conventional farmers suggest that conventional farmers have a negative opinion toward the organic market because there is no long-term contract for organic produce. Although organic contract farming has existed, the contract is only written on a one-year basis. Since there is a limited supply of family labor, mainly due to broad immigration to urban areas for better job opportunities, lack of a domestic market, and lack of sources for organic matter, farmers find it hard to conduct organic rice farming.

Figure 2. Farmers' perceptions of challenges towards organic rice farming

3.3. Determinants of farmers' perceptions

The relationship between farmers' characteristics and their perceptions is revealed in this section. Table 4 shows the determinants of farmers' perceptions of opportunities from organic rice farming. Results indicate that organic farmers are more likely to recognize the importance price premium, soil improvement, cost reduction, and health or environmental benefits, but less likely to consider market opportunities to be the main advantage of organic farming. As mentioned earlier, organic farmers are highly aware of the advantages of conducting organic farming, and they realize that market opportunities from organic farming are low due to yearly market demand fluctuations.

Older farmers tend to select soil improvement and health or environmental benefits as outcomes from organic farming opportunities, while they are less likely to select yield premium. Older farmers have longer experience in farming, so they may be aware of the benefit of conducting organic farming in terms of soil and health or environmental improvement. However, they still have a negative opinion about the yield from organic farming because older farmers are risk averse and always hold negative views of new farming ideas (Khanna, 2001). More educated farmers are likely to select soil improvement as a main benefit of organic farming, but they are less likely to accept that organic farming can provide a yield premium. Certainly, more educated farmers are usually able to obtain a general knowledge about organic farming through various sources of information, which always mention soil improvement and yield problems associated with organic farming. However, even if they have a negative opinion about yield premium, they are able to realize other benefits, which many studies (e.g., Azam, 2015; Koesling et al., 2008; Mzoughi, 2011) document, suggesting that more education might lead farmers to adopt new farming practices.

The size of the rice field is negatively associated with the selection of soil improvement, indicating that farmers who own larger rice fields face difficulties in maintaining their soil nutrients when conducting organic farming. Khoy et al. (2016b), and Islam et al. (2011) acknowledged that rice farmers are not able to obtain higher efficiency scores when the fields are larger, perhaps leading them to generate some negative opinions about organic farming. In addition, farmers that grow other crops, have a negative view about cost reduction and market opportunity from organic rice farming. Undoubtedly, organic farming would reduce cost of chemical inputs used, but it would also increase the farmers' labor inputs. This would be less favorable to farmers who engage in many agricultural activities, since they would have to manage their labor resources, increasing the cost of labor. Yearly market demand fluctuations might also lead them to have a negative perception of market opportunity.

House size is positively correlated with the recognition of health or environmental benefits. Since house size is a wealth indicator, the result implies that richer farmers are likely to care about their health and environment. Chouichom and Yamao (2010) explained that farmers in developed countries adopt organic farming because of their concern for health and environmental problems. This may be applicable to richer farmers in developing countries, too. Farmers who have off-farm jobs view soil improvement positively, but cost reduction negatively. As mentioned earlier, farmers who engage in many activities will face difficulties in managing labor resources; hence, it would increase labor costs. However, they would gain knowledge about soil improvement of organic farming through various sources of information. Farmers who have a tractor are likely to recognize the market opportunity since they are able to manage organic farming effectively to avail of it. As Mariano et al. (2012) noted, machinery adds intensity to organic farming.

Table 4. Determinants of the opportunities of organic rice farming

Table 5 presents the correlation matrix of error terms for equations pertaining to opportunities. These results explain how farmers' choices of perception relate to each other. The resulting likelihood ratio test of error terms suggests the rejection of the null hypothesis. There are significant correlations between some farmers' choices of perception. Results show that farmers' recognition of price premium versus soil improvement, and price premium versus yield premium are negatively correlated. This fact suggests that if farmers select price premium as a benefit of organic farming, they are less likely to care about production benefits (soil and yield). However, production benefits, particularly soil improvement and yield premium, have a positive correlation. Farmers believe that if soil quality improves, yield will increase. Health or environment benefits are negatively correlated with yield premium and any market opportunity indicating that farmers that are more concerned about health or environment are less likely to benefit financially.

Table 5. Correlation matrix of the error terms for equations on opportunities

Determinants of farmers' perceptions towards the challenges of organic farming are shown in Table 6. Because farmers selected only four challenges among the choices, we regressed only those choices on farmers' characteristics. Results show that if farmers conduct organic farming, they are more likely to face insect/disease problems and labor shortages as their main challenges, but less likely to have market problems.

Older farmers are less likely to select labor problems as a challenge of conducting organic farming due to the fact that older households tend to have an older child, leading to more farm labor availability. However, older farmers are more likely to choose market problems as the challenge for organic farming, suggesting that older heads of households that have more farming labor require a secure market to meet household expenditure needs. Compared to female household heads, male farmers are less likely to have labor challenges in organic farming. With more education, farmers are more concerned about insect/disease and market problems since they have garnered some information regarding the actual problems of conducting organic farming.

Farmers with more labor at their disposal are more likely to perceive that lack of fertilizer is a challenge for organic farming. Even if farmers have enough labor supply, which is favorable for conducting organic farming, the limited sources of organic fertilizer remain a key challenge. Results point out that farmers who engage in other farming activities are less likely to select insect/disease and labor problems as challenges since they already have sufficient capabilities, as a result of their experience from many farming activities, to manage these. Wealthier farmers (as indicated by larger house size) are less likely to regard lack of fertilizer as a challenge since they can procure organic fertilizer from various sources. Moreover, farmers who have off-farm jobs are less likely to perceive insect/disease problems as a challenge because they often have better farming knowledge compared to those without an off-farm job. Farmers with their own tractor view the labor-intensive nature of organic farming as the main challenge, but they are less likely to select market fluctuation as a challenge.

Table 6. Determinants of the challenges of organic rice farming

Table 7 presents the correlation matrix of error terms for the equations pertaining to challenges. The result of the likelihood ratio test of error terms suggests the rejection of the null hypothesis. Results show that farmers' selection of lack of fertilizer is negatively correlated with that of insect/ disease problems and labor-intensive practices. Moreover, the correlation between intensive labor and market fluctuation is also negative. However, only insect/disease problems and market fluctuation are positively correlated. The results suggest that farmers are likely to select only one main challenge in organic rice farming. They are not able to specify less important potential challenges due to their limited knowledge and skills.

Table 7. Correlation matrix of the error terms for equations on challenges

4. Conclusion and Recommendations

This study documented some important points about the perceptions of Cambodian farmers regarding organic rice farming, as well as the determinants of those farmers' perceptions. On the one hand, results show that farmers, in the pool sample, believe that price premiums, and health or environmental benefits are among the highest benefits of organic rice farming. On the other hand, fewer farmers view soil improvement, cost reduction and yield premium as important issues. When examined separately, conventional farmers acknowledge price premium, market opportunities and health or environmental benefits as organic farming opportunities. While organic farmers identify price premium and health or environmental benefits as the opportunities, they assign more importance to soil improvement and cost reduction in shares as high as 32.1 percent and 36.9 percent, respectively, suggesting that organic farmers could realize significant gains in these respects from organic farming adoption. Surprisingly, fewer organic farmers believe that yield premium and market opportunities are the advantages of organic farming since they have experienced yearly yield and market fluctuations.

Labor-intensive requirements, lack of organic fertilizer, and market instability are the most important challenges perceived by farmers in the pool sample. In contrast, organic farmers acknowledge that intensive labor, lack of organic fertilizer, and insect/disease problems are key issues facing organic rice farmers. Conventional farmers believe that market instability, lack of organic fertilizer and labor-intensive production are the main obstacles. The difference in perception of market instability between organic and conventional farmers suggests that conventional farmers hold negative opinions about the organic market because there are no long-term contracts for organic farming. Organic farmers are more likely to recognize most of the opportunities (other than market opportunities); this result indicates that they are highly aware of the advantages of conducting organic farming. Older and better-educated farmers tend to accept the benefits accrued from soil and health or environment improvements, while they are less likely to view yield premium as significant.

With larger rice fields, farmers have a negative view towards soil improvement as being a benefit. Farmers growing other crops negatively view cost reduction and the market opportunities generated by organic rice farming. Since house size is a wealth indicator, it can be concluded that richer farmers are more likely to care about their health and environment. Farmers who have off-farm jobs perceive soil improvement positively, but cost reduction negatively. With a tractor, farmers are likely to perceive market opportunities since they can manage organic farming effectively to avail of them.

Organic farmers are more likely to face insect/disease problems and labor shortages as their main challenges, but less likely to have market problems. However, older farmers are less likely to view labor problems, but they are more likely to see market problems. Compared to female-headed farms, male-headed ones are less likely to have labor challenges for organic farming. More educated farmers are more concerned about insect/disease and market problems. Furthermore, farmers with access to a higher supply of labor are more likely to perceive the lack of fertilizer as the main challenge of organic farming. Farmers who engage in other farming activities are less likely to select insect/disease and labor problems as the key challenges of organic farming. However, wealthier farmers are less likely to regard lack of fertilizer as an important challenge of organic farming. Moreover, farmers who have off-farm jobs are less likely to view the insect/disease problem as a main challenge. Farmers with tractors perceive the labor-intensive atmosphere of organic farming as a challenge, but they are less likely to select market fluctuation in the survey.

Since most farmers are only aware that producing organic rice would provide higher prices and better health or environment, they miss the other benefits it brings, including soil improvement and cost reduction. Hence, to increase the adoption level and productivity of organic rice farming, its benefits should be extended to farmers through various kinds of training programs that farmers suggest. Securing yields and markets for organic rice by providing long-term contracts and improving farming techniques should also be a key promoter. Labor-intensive production and lack of organic fertilizer are the main challenges for organic farming. Therefore, smaller, local tools and mechanisms, which are suitable for small-scale production, should be invented and their use encouraged. To deal with the organic fertilizer problem, farmers should encourage using organic substances effectively, as well as creating cropping systems that help increase organic matter. Implementing our suggestions would hopefully contribute to improving organic rice farming in Cambodia.

References:

Azam, M.S. (2015). The Influence of socio-demographic factors in adopting organic farming practices. International Journal of Interdisciplinary and Multidisciplinary Studies, 2(5), 8-17.

Bellon, R. M. (2001). Participatory research methods for technology evaluation: a manual for scientists working with farmers. Mexico, D.F.: CIMMYT.

Cambodian Organic Agriculture Association (COrAA). (2011). Organic agriculture and food processing in Cambodia: status and potentials. Phnom Penh: COrAA. Retrieved from: http://www.coraa.org/page.php?id=8

Cappellari, L., & Jenkins, S.P. (2003). Multivariate probit regression using simulated maximum likelihood. The Stata Journal, 3(3), 278-294.

Cary, J., & Wilkinson, R. (1997). Perceived profitability and farmers' conservation behavior. Journal of Agricultural Economics, 48(1), 13–21.

Chouichom, S., & Yamao, M. (2010). Comparing opinions and attitudes of organic and non-organic farmers towards organic rice farming system in North-eastern Thailand. Journal of Organic Systems, 5(1), 25-35.

Conrado, V.D. (2010). Documentation of organic vegetable production in Region 2. Research Terminal Report.

Gourieroux, C., & Monfont. A. (1996). Simulation-Based Econometric Methods. Oxford: Oxford University Press.

Greene, W.H. (2003). Econometric Analysis. 5th ed. Upper Saddle River, NJ: Prentice–Hall.

Hajivassiliou, V., & Ruud, P. (1994). Classical estimation methods for LDV models using simulation. In Handbook of Econometrics, eds. R. Engle and D. McFadden, vol. IV, 2383–2441. Amsterdam: North-Holland.

Hall, K., & Rhoades, E. (2009, February). Ohio grain farmers' attitudes toward organic and non-organic farming methods. Paper presented at the Southern Association of Agricultural Scientists Agricultural Communication Session, Atlanta, GA.

Hossain, S.T. (2012). Organic farming in populated area: Bangladesh – an example of case study. Organic Eprints, pp. 105-113. Retrieved from: http://orgprints.org/29203/

Islam, Z.K.M., Sipilainen, T., & Sumelius, J. (2011). Access to microfinance: does it matter for profit efficiency among small scale rice farmers in Bangladesh? Middle-East Journal of Scientific Research, 9(3), 311-323.

Khaledi, M., Liaghati, H., Mohammadamini, M., & Weseen, S. (2011). Assessing the barriers to conversion to organic farming in Canada. Environmental Sciences, 8(2), 109-126.

Khanna, M. (2001). Sequential adoption of site-specific technologies and its implications for nitrogen productivity: A double selectivity model. American Journal of Agricultural Economics, 83(1): 35-51.

Khoy, R., Nanseki, T., & Chomei, Y. (2015). Impacts of organic rice farming on production performance in Cambodia: an application of propensity score matching. Japanese Journal of Farm Management, 53(2), 85-90.

Khoy, R., Nanseki, T., & Chomei, Y. (2016a). Assessment of the premium on rice yield and rice income from adoption of organic rice farming for Cambodian farmers: an application of endogenous switching regression. Journal of Agricultural Economics and Development, 5(2), 33-44.

Khoy, R., Nanseki, T., & Chomei, Y. (2016b). Profit efficiency of rice farmers in Cambodia: the differences between organic and conventional farming. Journal of Sustainable Development, 9(6), 34-45.

Koesling, M., Flaten, O., & Lien, G. (2008). Factors influencing the conversion to organic farming in Norway. International Journal of Agricultural Resources, Governance and Ecology, 7(1/2), 78-95.

Kristiansen, P., Taji, A., & Reganold, J. (2006). Organic agriculture: A global perspective. Victoria, Australia: CSIRO Publishing. Retrieved from http://orgprints.org/14043/

Malab, B.S. (2011). Documentation of organic vegetable production in Region 1. Research Terminal Report.

Mariano, M.J., Villano, R., & Fleming, E. (2012). Factors influencing farmers' adoption of modern rice technologies and good management practices in the Philippines. Agricultural Systems, 110, 41–53.

Mccann, E., Sullivan, S., Erickson, D., & De Young, R. (1997). Environmental awareness, economic orientation, and farming practices: a comparison of organic and conventional famers. Environmental Management, 21(5), 747-758.

Morgera, E, Caro, C.B., & Durán, G.M. (2012). Organic agriculture and the law (FAO legislative study 107). Rome: FAO.

Musshoff, O., & Hirschauer, N. (2008). Adoption of organic farming in Germany and Austria: An integrative dynamic investment perspective. Agricultural Economics, 39, 135–145.

Mzoughi, N. (2011). Farmers adoption of integrated crop protection and organic farming: Do moral and social concerns matter? Ecological Economics, 70(8), 1536–1545.

Niemeyer, K., & Lombard, J. (2003). Identifying problems and potential of the conversion to organic farming in South Africa. Paper presented at the 41st annual conference of the Agricultural Economic Association of South Africa (AEASA), October 2-3, 2003, Pretoria, South Africa.

Njeru, M.K. (2015). Challenges and benefits of organic farming among farmers in Nembure Division, Embu County-Kenya. International Journal of Humanities and Social Science, 5(12), 59-69.

Piadozo, M.E.S., Lantican, F.A., Pabuayon, I.M., Quicoy, A.R., Suyat, A.M., & Maghirang, P.K.B. (2014). Rice farmers' concept and awareness of organic agriculture: implications for sustainability of Philippine organic agriculture program. Journal of the International Society for Southeast Asian Agricultural Sciences, 20(2), 142-156.

Ponti, D.T., Rijk, B., & Ittersum, M.K. (2012). The crop yield gap between organic and conventional agriculture. Agricultural Systems, 108, 1-9.

Sa, K. (2011). Organic rice farming systems in Cambodia: socio-economic impact of smallholder systems in Takeo Province. International Journal of Environmental and Rural Development, 2(1), 115-119.

Schneeberger, W., Darnhofer, I., & Eder, M. (2002). Barriers to the adoption of organic farming by cash-crop producers in Austria. American Journal of Alternative Agriculture, 17(01), 24-31.

Sheeder, R., & Lynne, G. (2009). Empathy conditioned conservation: "walking in the shoes of others" as a conservation farmer. Agricultural and Applied Economics Association's Annual Meeting, Milwaukee, WI, July 26–28.

Stern, S. (1997). Simulation-based estimation. Journal of Economic Literature 35, 2006–2039.

Suresh Reddy, B. (2010). Organic farming: status, issues and prospects - a review. Agricultural Economics Research Review, 23, 343-358.

Taing, K. (2008). Economic analysis of organic-culture rice in rural household economy: case studies in Tram Kork and Chumkiri District (Master's Thesis). Available from Royal University of Agriculture, Phnom Penh, Cambodia. p. 66-72.

Figures and Tables

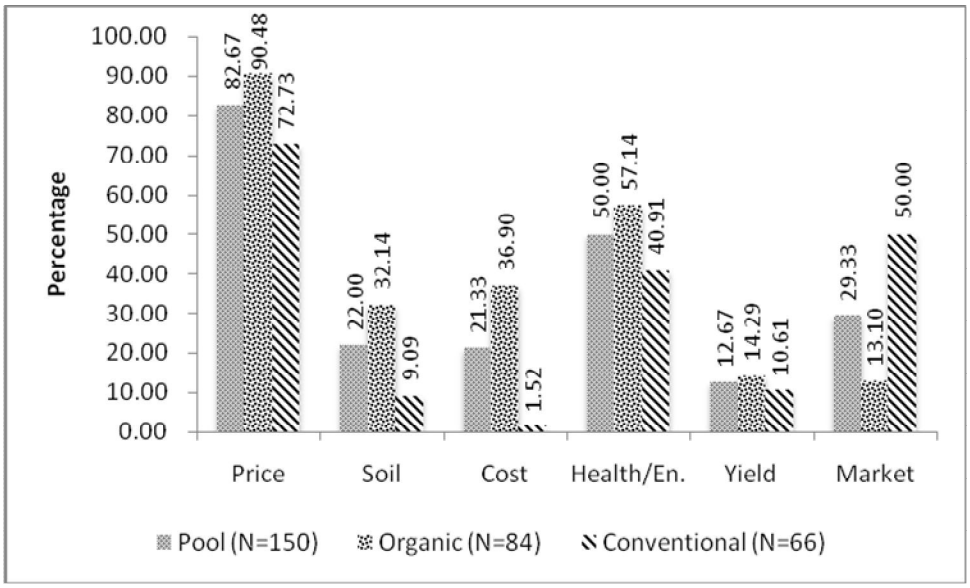

Figure 1. Farmers' perception of opportunities towards organic rice farming

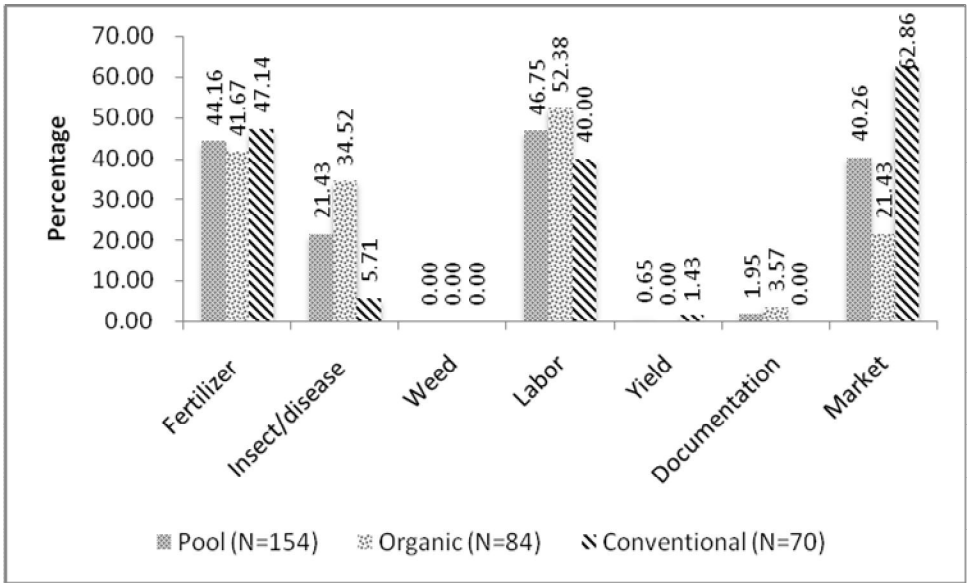

Figure 2. Farmers' perceptions of challenges towards organic rice farming

Table 1. List of opportunities and challenges for organic rice farming

Variable	Definition
Opportunities of organic farming	
Price premium	Does organic rice farming provide price premium?
Soil improvement	Does organic rice farming improve quality of farm soil?
Cost reduction	Does organic rice farming reduce production cost?
Health/Environment benefit	Does organic rice farming benefit to our health and environment?
Yield premium	Does organic rice farming result in higher yield?
Market opportunities	Does organic rice product have higher demand?
Challenges of organic farming	
Lack of organic fertilizer	Do you have enough organic fertilizer to apply in organic field?
Insect & disease problems	Is it difficult to control insect and disease in organic field?
Weed problems	Is it difficult to control weed in organic field?
Intensive labor	Does organic farming require many labors?
Yield lose	Does organic rice farming result in lower yield?
Documentation problems	Is it difficult to fill and process the document of organic rice?
Market instability	Is it difficult to sell organic product?

Table 2. Description of variables included in the regression analysis

Variable	Definition	Unit
Adopter	= 1 if farmer produces organic rice	Dummy
Age	Age of household head	Years
Gender	= 1 if household head is male	Dummy
Education	Years of schooling of household head	Year
Farming labor	Number of family labors available for rice farming	Person
Rice field	Total rice field size farmers owned	Ha
Other farming	= 1 if farmers have other farm activities besides rice	Dummy
House size	The square meter of house farmers owned	M^2
Off farm	= 1 if farmers have off-farm job	Dummy
Own-tractor	= 1 if farmers have two-wheel tractor	Dummy

Table 3. Characteristics and comparison between organic and conventional farmers

	Pool sample (N=170)		Organic (N=84)		Conventional (N=86)			
Variable	Mean	SD	Mean	SD	Mean	SD	Difference	Test[a]
Adopter	0.494	0.501						
Age	46.318	11.135	47.345	9.930	45.314	12.172	2.031	1.191
Gender	0.906	0.293	0.940	0.238	0.872	0.336	0.068	1.527
Education	6.071	3.486	7.107	3.058	5.058	3.595	2.049	3.9984***
Farming labor	2.824	0.969	2.845	1.047	2.802	0.892	0.043	0.288
Rice field	1.064	0.557	1.167	0.521	0.964	0.576	0.203	2.4118**
Other farming	0.288	0.454	0.440	0.499	0.140	0.349	0.301	4.3312***
House size	38.654	12.403	39.354	12.383	37.971	12.458	1.383	0.726
Off farm	0.212	0.410	0.262	0.442	0.163	0.371	0.099	1.581
Own-tractor	0.200	0.401	0.250	0.436	0.151	0.360	0.099	1.611

Note: [a] t test is used for continuous variable and probability test for binary variables; *, **, *** significant at 90%, 95%, and 99% respectively.

Table 4. Determinants of the opportunities of organic rice farming

Variable	Price		Soil		Cost		Health/Environment		Yield		Market	
	Coef.	SD	Coef.	SD	Coef.	SD	Coef.	SD	Coef.	SD	Coef.	SD
Adopter	0.906***	0.318	1.139***	0.374	2.412***	0.529	0.421*	0.256	0.308	0.312	-0.984***	0.299
Age	0.005	0.015	0.031**	0.014	-0.001	0.016	0.021*	0.012	-0.034**	0.015	-0.011	0.013
Gender	0.582	0.425	-0.683	0.472	0.094	0.667	0.225	0.393	0.424	0.546	-0.541	0.462
Education	0.009	0.048	0.099**	0.048	0.018	0.055	-0.001	0.038	-0.088*	0.050	-0.026	0.039
Farming labor	-0.046	0.141	0.077	0.139	0.061	0.17	-0.172	0.119	-0.226	0.181	0.249	0.159
Rice field	-0.168	0.282	-0.72*	0.375	-0.273	0.354	-0.322	0.241	-0.055	0.288	0.204	0.255
Other farming	-0.529	0.362	0.298	0.319	-1.134***	0.39	0.416	0.288	-0.123	0.379	-1.205***	0.455
House size	-0.018	0.013	-0.002	0.013	-0.004	0.014	0.032***	0.011	0.01	0.012	-0.01	0.012
Off farm	-0.183	0.342	0.746**	0.332	-0.775*	0.457	-0.424	0.289	0.044	0.373	0.102	0.396
Own-tractor	0.295	0.415	-0.267	0.417	0.535	0.352	-0.431	0.308	0.152	0.346	0.599*	0.337
Constant	0.917	0.943	-2.834***	0.987	-2.201**	1.096	-1.781**	0.788	0.612	0.942	0.596	0.827
	Log likelihood = -347.55559; N = 150; Chi^2 = 138.5; Prob> Chi^2 = 0											

Note: *, **, *** significant at 90%, 95%, and 99% respectively

Table 5. Correlation matrix of the error terms for equations on opportunities

Error terms	Coef.	Std. Err.	z	P>z
Rho (price & soil)	-0.370**	0.160	-2.32	0.021
Rho (price & cost)	-0.310	0.214	-1.45	0.146
Rho (price & health)	0.002	0.141	0.02	0.988
Rho (price & yield)	-0.345*	0.181	-1.90	0.057
Rho (price & market)	0.048	0.162	0.30	0.767
Rho (soil & cost)	0.080	0.185	0.43	0.665
Rho (soil & health)	0.056	0.162	0.34	0.731
Rho (soil & yield)	0.389**	0.174	2.24	0.025
Rho (soil & market)	0.145	0.287	0.50	0.614
Rho (cost & health)	0.186	0.165	1.13	0.259
Rho (cost & yield)	0.241	0.171	1.42	0.157
Rho (cost & market)	-0.136	0.224	-0.61	0.544
Rho (health & yield)	-0.463***	0.154	-3.00	0.003
Rho (health & market)	-0.711***	0.102	-6.96	0.000
Rho (yield & market	0.308	0.180	1.71	0.086
[1] Likelihood ratio test of rho12 = rho13 = … = rho46 = rho56 = 0: $chi^2(15)$ = 49.4009; Prob > chi^2 = 0.0000				

Note: *, **, *** significant at 90%, 95%, and 99% respectively; 1: all Rho listed in first column

Table 6. Determinants of the challenges of organic rice farming

Variables	Fertilizer		Insect/disease		Labor		Market	
	Coef.	SD	Coef.	SD	Coef.	SD	Coef.	SD
Adopter	-0.086	0.264	1.818***	0.385	0.765***	0.269	-1.706***	0.333
Age	-0.008	0.012	-0.023	0.015	-0.023*	0.012	0.028**	0.013
Gender	0.714	0.438	-0.653	0.556	-0.844*	0.433	-0.242	0.47
Education	-0.009	0.037	0.147***	0.054	0.008	0.036	0.112***	0.043
Farming labor	0.226*	0.135	-0.098	0.179	-0.169	0.133	0.019	0.144
Rice field	-0.258	0.256	-0.55	0.345	-0.274	0.272	0.178	0.28
Other farming	-0.039	0.296	-0.828**	0.356	-0.886***	0.299	0.301	0.323
House size	-0.027**	0.01	0.008	0.013	-0.013	0.01	0.014	0.011
Off farm	0.486	0.305	-1.986***	0.668	0.146	0.314	-0.557	0.341
Own-tractor	0.168	0.291	-0.087	0.35	0.75**	0.302	-1.052***	0.371
Constant	0.192	0.719	-0.367	0.967	2.586***	0.758	-1.716**	0.821
	Log likelihood = -295.48077; Chi^2 = 120.7; Prob> Chi^2 = 0							

Note: *, **, *** significant at 90%, 95%, and 99% respectively

Table 7. Correlation matrix of the error terms for equations on challenges

Error terms	Coef.	Std. Err.	z	P>z
Rho (fertilizer & insect/disease)	-0.432***	0.164	-2.63	0.008
Rho (fertilizer & labor)	-0.406***	0.144	-2.82	0.005
Rho (fertilizer & market)	-0.117	0.14	-0.84	0.403
Rho (insect/disease & labor)	-0.083	0.176	-0.47	0.638
Rho (insect/disease & market)	0.314*	0.17	1.85	0.065
Rho (labor & market)	-0.432***	0.133	-3.25	0.001

[1] Likelihood ratio test of rho12 = rho13 = … = rho42 = rho43 = 0:
$chi^2(6)$ = 31.6036 Prob > chi^2 = 0.0000

Note: *, **, *** significant at 90%, 95%, and 99% respectively; 1: all Rho listed in first column