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WHAT LIMITS AGRICULTURAL INTENSIFICATION IN CAMBODIA? The Role of Emigration, Agricultural Extension Services and Credit Constraints

TONG Kimsun, HEM Socheth and Paulo SANTOS

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Responsibility for the ideas, facts and opinions presented in this research paper rests solely with the authors. Their opinions and interpretations do not necessarily reflect the views of the Cambodia Development Resource Institute.

Front cover photos:
1. Agricultural extension workers in Bati, Takeo province
2. Farm labour shortage caused by youth migration to urban areas, Preah Dak, Siem Reap province

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TABLE OF CONTENTS

LIST OF FIGURES & TABLES

ACRONYMS & ABBREVIATIONS

ACIAR	Australian Centre for International Agricultural Research
ADB	Asian Development Bank
AusAID	Australia Aid for International Development
CDRI	Cambodia Development Resource Institute
GDP	Gross National Product
JICA	Japan International Cooperation Agency
MAFF	Ministry of Agriculture, Forestry and Fisheries
MEF	Ministry of Economy and Finance
MOWRAM	Ministry of Water Resources and Meteorology
NGO	Non-government Organisation
NSPD	National Strategic Development Plan
RUPP	Royal University of Phnom Penh
USYD	University of Sydney
WB	World Bank
WRMRCDP	Water Resource Management Research Capacity Development Programme

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ABSTRACT

This paper attempts to define the factors which determine emigration and rice double-cropping, i.e. rice cultivation on the same plot twice per year, by rural households in Cambodia, and investigates whether these decisions influence each other using data from a two-period panel survey of 231 households in three provinces in rural Cambodia. In the analysis, we take into account possible correlation between these decisions (through estimating a seemingly unrelated bivariate probit model) and unobserved heterogeneity among farmers (through estimating a random-effects probit model). It is found that rice double-cropping and emigration decisions are not closely inter-related. We can also conclude that the availability of water and agricultural land are the key determinants of rice double-cropping. Households which rely on animal draught power for agricultural production are unlikely to engage in rice double-cropping. Policies aimed at increasing irrigation and providing socioeconomic land concessions in rural areas may play a critical role in improving agricultural production.

CHAPTER 1

INTRODUCTION

Cambodia's economy, largely driven by growth in the garments, construction and tourism sectors, has grown rapidly over the last decade. However, despite substantial growth in these sectors, Cambodia's economy is still predominantly agrarian: in 2008 the agriculture sector accounted for 26 percent of GDP and employed over 56 percent of the total labour force.

Agricultural growth, on average, has lagged behind that in the industry and services sectors since the mid-1990s, with large fluctuations and even occasional negative growth recorded in the early 2000s (MEF 2010). However, the sector's performance has been consistently positive since 2005 and was only marginally affected by external shocks such as the recent global financial crisis. Given its tropical climate, ample unused arable land and large unskilled labour force, Cambodia has comparative advantages in agriculture. Promoting agriculture and agro-industry is widely recognised as the best strategy for broadening the economic base to offset macroeconomic shocks, ensure food security, improve rural people's livelihoods and reduce poverty. The government's recent promotion of paddy production and rice export policy is expected to also improve investment in the agricultural sector which will diversify and strengthen the foundations for economic growth.

Crops make up the largest share of the agricultural sector, followed by fishing, livestock and forestry. The main agricultural crops are rice, maize, cassava, soybeans, tobacco and rubber. Of these, rice is the most important crop, averaging 55 percent of total agricultural produce and contributing 9 percent of GDP during the period 1994 to 2006. It is also the staple food. Despite its importance, however, rice farming has historically been entirely dependent on rainfall as opposed to irrigation. The rainfall pattern determines the success and size of the harvest. As a result, farmers generally grow only one crop per year.

The construction of irrigation schemes, funded by the government, NGOs, and international development agencies such as the Japan International Cooperation Agency (JICA), the World Bank (WB) and the Asian Development Bank (ADB), has increased since the 1980s.[1] Investment in irrigation went up as the government recognised the importance of water management to promoting the country's rice production. For example, in 2004 the government adopted the Rectangular Strategy as the guiding national development plan, one cornerstone of which is the promotion of agricultural production with particular emphasis on increasing the area of irrigated land. The expectation is that irrigation will make farmers less reliant on rainfall, allowing them to cultivate more crops with more certainty and predictability, resulting in higher productivity and improved livelihoods.

Although irrigation is prioritised in Cambodia's development strategy, there has been no attempt to systematically quantify how water is managed at farm level. The main objective of the economic component of the Water Resource Management Research Capacity Development Programme (WRMRCDP) is to attempt to address this knowledge gap by focusing on three key questions: (1) What is the value of water when used in farming? (2) What other factors

1 See Nang *et al*. (forthcoming) for detailed list of donors.

besides water availability limit farmers' adoption of stated policy objectives such as double-cropping? (3) What are the farming and non-farming impacts of irrigated farming?

Wokker *et al*. (forthcoming) attempt to assess the value of water used in Cambodian rice farming systems. They estimated the marginal productivity of water on both wet and dry season rice production and found that the elasticity of rice output with respect to water input is in a range of 0.058 to 0.082 in the wet season, and 0.125 in the dry season. In other words, a 1 percent increase in water input would raise paddy rice production by 0.058 percent to 0.082 percent in the wet season and 0.125 percent in the dry season.

Irrigation alone does not automatically increase agricultural production; there are also other constraints to the adoption of more productive technologies. This study aims to address the second research question: What other factors besides water availability limit farmers' adoption of policy objectives such as rice double-cropping? Using an empirical approach, we examine the relationship between credit, agricultural extension services, emigration and rice double-cropping.

The paper is organised as follows: Previous studies are reviewed in Section 2, and characteristics of the data are described in Section 3. The empirical approach used in this study and findings are discussed and presented in Section 4. Section 5 is the conclusion.

CHAPTER 2

LITERATURE REVIEW

It is widely acknowledged that crop diversification in Cambodia is minimal, even in agro-ecological systems that do not suit rice (ACIAR 2011). Recognising this, the government has prioritised increasing agricultural productivity and diversification, and the promotion of agro-industry. However, it has shifted its emphasis from extending the cultivated area to intensive farming. Government policies for 2009-13, namely the National Strategic Development Plan (NSPD), aim to achieve high and sustainable growth in paddy rice production through continuing to issue land titles (particularly to farmers), increasing irrigation and improving agricultural water management systems, encouraging farmers to adopt new technologies, enhancing cooperation between government and NGOs, using paddy land effectively, and accelerating land concessions to smallholders.

The few studies (e.g. ACIAR 2011) that have analysed the key determinants of crop diversification in Cambodia found that farmers' lack of familiarity and limited knowledge of non-rice crops as well as unpredictable rainfall have led to the perception that diversifying paddy field to cultivate other crops is highly risky. Consequently, market infrastructure for non-rice crops is underdeveloped. These findings are similar to studies in other countries. For example, Mastuda and Igata (1993, cited in Rangsan 1995) found that water condition was the key determinant of paddy land diversification in Thailand and the Philippines. In addition to the availability of water, farm size, household head characteristics–including education and experience, resource endowment–especially farm assets and number of plots occupied, market, and desire for higher income were important factors in farmers' willingness to change from rice cultivation to other crops (Seetisarn 1977 and Limpaphinun 1992, cited in Rangsan 1995).

CDRI's most recent social assessment on selected irrigation schemes in six provinces around the Tonle Sap Lake reveals that farmers do not grow dry season rice because irrigation schemes are located in lowland areas, the cost of pumping water from the main canal to the rice field is high, dry season rice is more susceptible to insect infestation and likely to be damaged by free-roaming livestock, and water availability is insufficient (CDRI 2010). The study also highlights that soil type (e.g. sandy soil which does not hold water well) is another factor influencing dry season rice adoption (ibid). However, the effect of emigration, credit and agricultural extension services on rice double-cropping decisions in Cambodia has never been empirically studied. As emigration may reduce the amount of labour available for agricultural production, it could constrain rice-double cropping activities. Similarly, rice-double cropping is expected have a negative effect on emigration because it may reduce the need for household members to move away temporarily. This paper therefore investigates whether emigration and rice double-cropping decisions influence each other, and the role of credit and agricultural extension services in agricultural intensification decisions, namely rice double-cropping.

CHAPTER

3 DATA

The empirical analysis in this study is based on the results of household surveys conducted by CDRI in 2008 and 2009 in 10 irrigation schemes located around the Tonle Sap Basin across three provinces, Kampong Chhnang, Kampong Thom and Pursat. In October 2008, 300 households were selected for baseline interviews to capture household characteristics (i.e. all household members' educational level, age, marital status, employment status in both dry and wet seasons), household enterprise, residential and agricultural land characteristics, livestock and other capital assets. Then four follow-up surveys were conducted to collect detailed information on migration, nutrition, agricultural expenditure and production, land ownership (investment/irrigation), shocks to agricultural production, livestock, agricultural extension services and remittances, covering both wet and dry seasons in 2008 and 2009.[2] The questionnaire was designed based on a recall method and is similar to that used in the World Bank Living Standard Measurement Survey (Reardon & Paul 2000).

In the follow-up surveys, 235 households were interviewed during the 2008 and 2009 wet seasons, while only 220 households were interviewed in the 2008 and 2009 dry seasons (Table 1). This is equivalent to 21 percent and 26 percent of attrition rate—raising the possibility that the subsample might be statistically different from the original sample. To confirm whether this was the case, Wokker *et al*. (2010) tested the differences between mean values of variables relating to wealth, demographic and plot characteristics for statistical significance and found that there was no significant difference between the subsample and the original survey.

Table 1: Number of Interviewed Households, Fieldwork and Coverage Periods

	No. of households	Fieldwork	Coverage
Baseline survey	300	Oct/Nov 2008	2008
2008 wet season	235	Nov 2008-Feb 2009	May/Oct 2008
2008 dry season	220	May/Jul 2009	Oct2008-May 2009
2009 wet season	235	Nov 2009-Jan 2010	May/Oct 2009
2009 dry season	220	May/Jun 2010	Oct 2009-May 2010
Follow-up baseline survey	269	Aug 2010	2010

For the purposes of this study, we defined rice double-cropping households as those that cultivate rice in both wet and dry seasons on the same plot, and emigration was defined as having at least one household member absent from the household for more than two consecutive months. These definitions were determined through discussion with farmers, farmer water user communities (FWUCs) and other local partners in three provincial consultation workshops. Given the definition of rice double-cropping households, we merged the wet (235 households) and dry (220 households) season data, resulting in the reduced total number of 233 households for each year.

2 Thirty households in each scheme were randomly selected for the survey.

A second baseline survey was conducted in August 2010 to update data regarding household characteristics, the number of livestock (animal draught power) and other capital assets (farm equipment). We noted that the second baseline survey is not consistent with the 2009 wet and dry season data. To achieve the objective of this study, we assumed that the information from the baseline survey in August 2010 does not differ from that collected in the follow-up survey (for the 2009 dry season) conducted in May-June 2010.

CHAPTER

4 EMPIRICAL APPROACH AND ESTIMATES

4.1. Econometric Model

To examine the relationship between double-cropping and emigration, we estimated two functions, one for each decision. We utilised the reduced form equations derived from a theoretical model of rural household decision-making to specify the factors that potentially affect household decisions on crop diversification and emigration. This gives the following model:

$$C_i^* = \alpha_0 + \alpha_1 X_i + \alpha_2 Z_i + \epsilon_i \quad (1)$$

$$C_i = \begin{cases} 1 \; if \; C_i^* > 0 \\ 0 \; otherwise \end{cases}$$

$$E_i^* = \beta_0 + \beta_1 X_i + \beta_2 Z_i + \omega_i \quad (2)$$

$$E_i = \begin{cases} 1 \; if \; E_i^* > 0 \\ 0 \; otherwise \end{cases}$$

The variables C_i^* and E_i^* are (unobserved) latent variables that measure the propensity to engage in double-cropping or emigration, respectively, while C_i and E_i are the corresponding observed variables: C_i is a dummy variable that is equal to 1 if there was at least one household plot involved in cultivating rice twice per year[3], and E_i is also a dummy variable which is equal to 1 if there was at least one household member involved in emigration. X_i and Z_i are vectors of explanatory variables, α and β are vectors of parameters to be estimated, ϵ_i and ω_i are unobservable error terms, and i indexes household. Finally we assume that (ϵ_i and ω_i) are independent of X and Z and distributed as:

$$E[\varepsilon_i] = E[\omega_i] = 0$$
$$Var[\varepsilon_i] = Var[\omega_i] = 1$$
$$Corr[\alpha_i, \omega_i] = \rho$$

The vector X_i is used to capture household characteristics such as gender of household head, age of household head, education of household head, experience (farm and non-farm) of household head, household size, the number of dependants, farm equipment, the number of cattle as well as village characteristics. The vector Z_i is intended to capture other factors such as agricultural extension services, access to credit, and the average adult age and education.[4]

3 Crop diversification or multiple-cropping is the practice of growing two or more crops in the same space during a growing season. It can take the form of double-cropping when the second crop is planted after the first has been harvested, or relay-cropping when the second crop is started amid the first crop before it has been harvested (Boyd 2009, Marra & Carlson 1990). In this study, the definition of double-cropping is confined to the cultivation of rice on the same plot twice per year.

4 It is crucial to distinguish between X and Z variables when we assume that rice double-cropping and emigration decisions are correlated because both equations i.e. equation 1 and equation 2 may not depend on the same explanatory variables.

The explanatory variables are expected to affect rice double-cropping and emigration decisions as briefly detailed below:

Gender of household head: females and males may differ in physical strength in agriculture production. If males are more productive in agriculture, a female household head is expected to have a negative effect on crop diversification and a positive effect on emigration.

Age of household head: older household heads are more likely to engage in crop diversification as they have more skills and experience in agriculture. The square of the age of the household head captures the relationship between crop diversification and age. It helps identify the age at which the marginal impact of age on crop diversification becomes negative.

Education of household head: the higher the educational level of the household head, the higher the likelihood of engaging in crop diversification. Higher educational level of the household head is expected to have a negative impact on emigration. However, education can also play a role in gaining access to limited emigration opportunities. Mincer (1978) noted that the motivation for emigration comes from both the household head and the prospective emigrant; consequently, the average adult age and education within households are more appropriate explanatory variables for the decision to emigrate than the age and education of the household head.

Dependants and household size: the number of dependants in each household is defined as household members under 16 and those over 64 years old. Large households with fewer dependants are likely to consume more food; hence such households may increase agricultural production and therefore engage in crop diversification and less emigration. There is often a labour surplus in rural Cambodia (Tong 2005), therefore larger households often send one or more family members to other parts of the country or abroad to increase overall family income.

Agricultural extension services: the availability of agricultural extension services is likely to increase crop diversification. It is unlikely that the availability of agricultural extension affects emigration decisions.

Credit market: the availability of funds to purchase cash inputs and capital equipment, like ploughs or water pumps for agricultural production, could raise productivity in small farm agriculture which in turn increases the likelihood of crop diversification. Similarly, the availability of funds may increase emigration.

The number of cattle: households that use cattle in agricultural production tend to engage more in crop diversification because cattle are a source of cheap energy for crop production.

We expect that emigration may be related to and reduce double-cropping because it reduces the amount of labour available for agricultural production. Similarly, double-cropping is expected to have a negative effect on emigration because it may reduce the need for household members to move away temporarily and increase the need for on-farm labour. Thus, in the estimation we assumed that both decisions are correlated, i.e. both decisions result from the same decision-making. If this is the case, and are also correlated, which implies that the probit estimates for and from equations 1 and 2 are inconsistent. Green (2008) suggests that estimating these equations through a seemingly unrelated bivariate probit model, where rice double-cropping and emigration decisions may not depend on the same lists of explanatory variables but are still correlated, can correct this problem. To this end, we used the age and

education of the household head and availability of agricultural extension services to specify double-cropping, and the average adult age and education to specify the emigration equation.

Given the nature of the panel data, equation 1 and equation 2 can be rewritten as follows:

$$C_{it}^{*} = \alpha_0 + \alpha_1 X_i + \alpha_2 Z_{it} + a_i + \epsilon_{it} \quad (3)$$

$$C_{it} = \begin{cases} 1 \; if \; C_{it}^{*} > 0 \\ 0 \; otherwise \end{cases}$$

$$E_{it}^{*} = \beta_0 + \beta_1 X_i + \beta_2 Z_{it} + b_i + \omega_{it} \quad (4)$$

$$E_{it} = \begin{cases} 1 \; if \; E_{it}^{*} > 0 \\ 0 \; otherwise \end{cases}$$

where a_i and b_i capture all unobserved time-constant factors, and ϵ_i and ω_i represent unobserved time-variable factors that affect C_{it}^{*} and E_{it}^{*}, respectively. The vector X_i captures the initial household characteristics such as gender of household head, age of household head, education of household head, experience (farm and non-farm) of household head, household size and the number of dependants (X_i has no t subscript because it does not change over time), while the vector Z_{it} is intended to capture other factors varying over the two-year period such as agricultural extension services, the number of cattle, access to credit, and village characteristics. The subscript indexes time.

The estimators α and β are biased if a_i and b_i are correlated with X_i or Z_{it}. To remove the unobserved time-constant factor, several studies (e.g. Wooldridge 2002; Green 2008) suggest adopting a fixed effects method. However, it is not possible to estimate a probit model with fixed effects due to what is known as the incidental parameter problem (Green 2008) and we are left with the possibility of estimating these relations using the random effects estimator. However, given the wealth of information in our data, it seems plausible to accept the assumption that there is no correlation between the individual effects and the error term.

4.2. Empirical Estimates

Descriptive statistics of the variables used in the regression analysis are presented in Table 2. It shows that about 85 percent of the households in the sample are headed by married men. The average educational level of household heads is relatively low with only 4.7 years of education. This indicates that the majority had not completed primary school. The average age of the household head is 50.

Average household size in the sample villages is approximately six persons, while the number of dependents is about two per household. Eighteen percent of the sample households in 2008 had at least one household member involved in emigration – one percentage point higher than in 2009. The proportion of households engaged in double-cropping was 14 percent in 2008 and 17 percent in 2009. It is worth noting that only 9-10 percent of the sample households received agricultural extension services in either survey year. The mean of pull and/or draught animals per household was 1.75 in 2008, dropping significantly to 1.28 in 2009. Conversely, the average farm equipment index[5] increased from 0.01 in 2008 to 0.07 in 2009, which implies

5 Farm equipment index is estimated by using the Principal Component Analysis Method.

that rural households are adopting higher levels of farming modernisation. The proportion of households in debt increased from 32 percent in 2008 to 40 percent in 2009.

Table 2: Descriptive Statistics of Dependent and Independent Variables

Variables	N	2008		2009	
		Mean	Standard Deviation	Mean	Standard Deviation
household head gender (1=male)	233	0.85	0.36	0.85	0.36
household head age (years)	233	49.91	12.42	49.91	12.42
household head marital status (1=married)	233	0.85	0.36	0.85	0.36
household head education (years)	231	4.71	2.66	4.71	2.66
household size	233	6.08	2.23	6.08	2.23
number of dependants	233	1.98	1.51	1.98	1.51
average adult household age (years)	232	33.67	6.23	33.67	6.23
average adult household education (years)	231	5.73	1.96	5.73	1.96
emigrant (1=yes)	233	0.18	0.39	0.17	0.38
rice double-cropping (1=yes)	233	0.14	0.34	0.17	0.38
agricultural (paddy) extension service (1=yes)	233	0.10	0.30	0.09	0.29
farm equipment index	233	0.01	1.35	0.07	1.35
pull/plough animals	233	1.75	1.90	1.28	1.18
loan (1=yes)	233	0.32	0.47	0.40	0.49

Source: CDRI Survey Data (2008-2009)

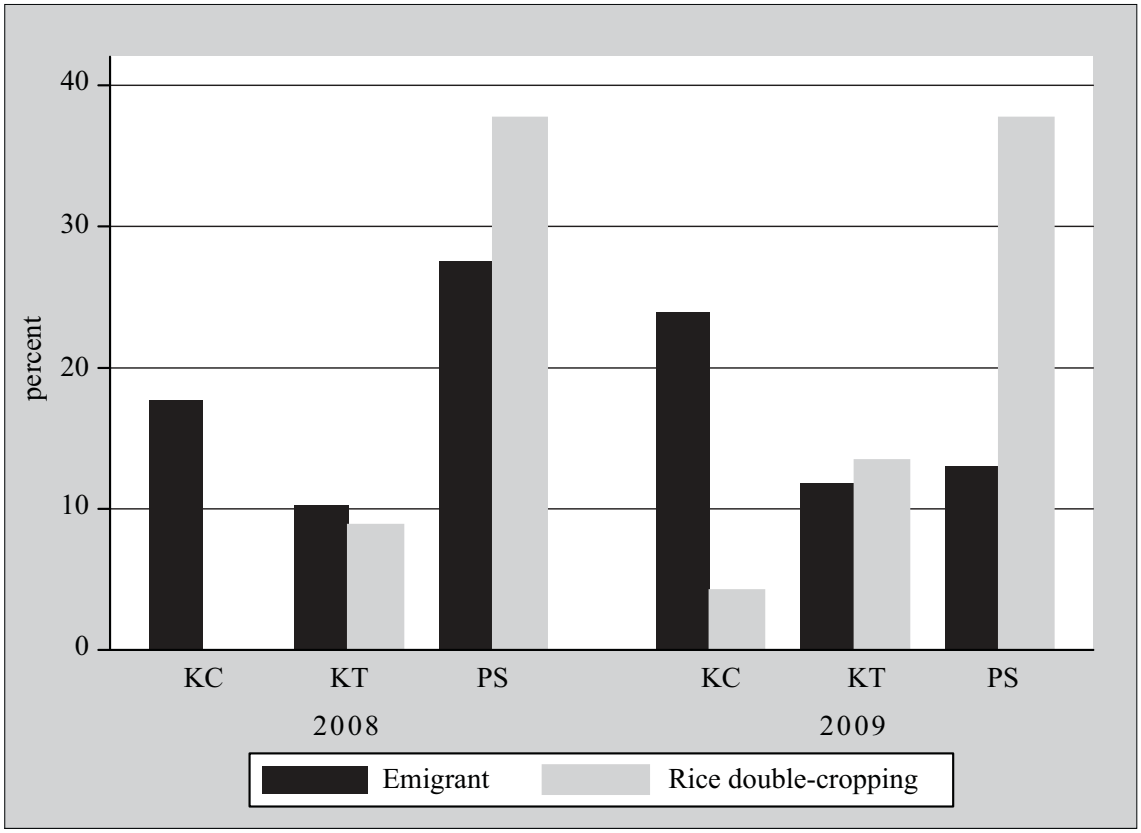
The proportion of the sample households engaged in double-cropping was highest in Pursat province, followed by Kampong Thom and Kampong Chhnang provinces. In terms of stream position, downstream households were more likely to be involved in double-cropping than midstream and upstream households.

Approximately 28 percent of the sample households in Pursat province participated in emigration in 2008 compared to only 18 percent in Kampong Chhnang and 10 percent in Kampong Thom. But in 2009, the overall participation in emigration was 24 percent in Kampong Chhnang, 13 percent in Pursat and 12 percent in Kampong Thom. Participation in emigration did not vary according to downstream/upstream location.

To examine the relationship between double-cropping and emigration, we compared the percentage of sample households that participated in these activities across the three provinces The results illustrated in Figure 1 show that in 2008, the proportion of households in Pursat province engaged in double-cropping is higher than in Kampong Thom and Kampong Chhnang provinces. During the same period, the share of emigrant households in Pursat province is high compared to the other two provinces, which also have a lower rate of double-cropping. In 2009, the number of emigrant households in Kampong Chhnang province increases while it decreases significantly in Pursat province, even though the proportion of sample households involved in

double-cropping is essentially the same as in 2008. This evidence shows that the correlation between double-cropping and emigration may not be very strong and that the determinants of double-cropping may not necessarily be inter-linked with the number of emigrants, possibly because the large majority of the rural labour force in Cambodia is underemployed.

Figure 1: Rice Double-cropping and Emigration 2008-2009



Note: KC- Kampong Chhnang; KT - Kampong Thnom; PS - Pursat
Source: CDRI Survey Data (2008-2009)

In addition to the relationship between double-cropping and emigration, we explored other factors that limit farmers' capacity to cultivate rice on the same plot twice per year i.e. double-cropping. Descriptive information on farm equipment, pull and/or plough animal and loans (Table 3) offer an understanding of potential determining variables of double-cropping. It shows that double-cropping households were more likely to possess farm equipment than non-double cropping households in 2008 and 2009.

At the same time, households' double-cropping practice is strongly associated with higher borrowing (loans). The differences between provinces are also significant. This implies that farm equipment, pull and/or plough animals, and access to credit could be strong determining indicators of double-cropping. In contrast, rice double-cropping is unlikely to correlate with agricultural extension services given the result that mono-cropping households have more access to agricultural extension services than double-cropping households. The seemingly unrelated bivariate probit regression results are presented in Table 4.

Table 3: Key Potential Determining Variables of Rice Double Cropping (mean)

Variables	Province	2008		2009	
		Mono cropping	Double cropping	Mono cropping	Double cropping
Farm equipment index	Kampong Chhnang	-0.52	0.00	-0.45	-0.60
	Kampong Thom	-0.17	1.08	-0.11	0.70
	Pursat	0.53	1.28	0.79	1.09
	Total	-0.19	1.25	-0.07	0.83
Pull/plough animals	Kampong Chhnang	1.51	0.00	1.37	1.00
	Kampong Thom	2.16	0.50	1.34	1.00
	Pursat	2.35	0.92	1.28	1.04
	Total	1.89	0.84	1.34	1.03
Emigrant (1=yes)	Kampong Chhnang	0.18	0.00	0.23	0.50
	Kampong Thom	0.11	0.00	0.14	0.00
	Pursat	0.26	0.31	0.14	0.12
	Total	0.17	0.25	0.18	0.13
Loan (1=yes)	Kampong Chhnang	0.24	0.00	0.32	0.25
	Kampong Thom	0.32	0.67	0.48	0.56
	Pursat	0.37	0.46	0.35	0.54
	Total	0.29	0.50	0.38	0.51
Agricultural extension service (1=yes)	Kampong Chhnang	0.13	0.00	0.12	0.00
	Kampong Thom	0.16	0.17	0.12	0.00
	Pursat	0.00	0.04	0.05	0.04
	Total	0.11	0.06	0.10	0.03

Source: CDRI Survey Data (2008-2009)

Results for double-cropping: The regression results indicate that the size of agricultural land has a positive impact on rice double-cropping. Households that use cattle for agricultural production are unlikely to engage in rice cultivation in the dry season. One possible explanation is that households with draught animals are less productive compared to households with modern farming equipment, therefore they are unlikely to cultivate rice in the dry season. Nonetheless, the coefficient of the farm equipment index is positive but not statistically significant. Surprisingly, the coefficient of the number of dependants is positive and statistically significant at 10 percent level, indicating that households with more unproductive members tend to grow rice in both wet and dry seasons. The positive and statistical significance of the downstream dummy implies that households located in the Tonle Sap floodplain tend to cultivate rice in both the wet and dry seasons due to there being sufficient water available. Households in Pursat province are more likely to grow dry season rice than households in Kampong Chhnang and Kampong Thom provinces. Other variables such as household head characteristics (i.e. gender, age, education, marital status), household size, farm equipment, loan and agricultural extension services were not significant determinants to a farmer's decision to adopt double-cropping.

Table 4: Determinants of Rice Double-cropping and Emigration—A seemingly Unrelated Bivariate Probit Model (Pool Data)

Independent variables	2008-2009		2008-2009	
	Rice double-cropping	Emigration	Rice double cropping	Emigration
household head gender (1=male)	0.053	0.026	0.057	0.021
household head age (years)	0.010	0.012*	0.010	0.012*
household head marital status (1=married)	-0.232	0.291	-0.243	0.295
household head education (years)	-0.027	-0.077*	-0.027	-0.077*
household size	-0.019	0.123***	-0.020	0.124***
number of dependants	0.126*	-0.145*	0.130*	-0.145*
average adult household age (years)		-0.023*		-0.024*
average adult household education (years)		0.099*		0.100*
loan (1=yes)	0.203		0.189	
agricultural (paddy) extension service (1=yes)	-0.114		-0.108	
farm equipment index	0.016	0.021	0.009	0.020
pull/plough animals	-0.185***	-0.011	-0.179**	-0.016
agricultural land (log)	0.505***	-0.207*	0.526***	-0.210*
midstream	0.359	-0.264	0.375	-0.267
downstream	0.518*	-0.073	0.529*	-0.076
Kampong thom	0.412	-0.478*	0.418	-0.475*
Pursat	1.159***	-0.019	1.172***	-0.018
year dummy			0.222	-0.093
constant	-2.704***	-1.409*	-448.753	185.96
rho	0.052		0.074	
wald test of rho=0	chi2(1)=0.170, P>chi2=0.679		chi2(1)=0.331, P>chi2=0.564	
observations	458		458	

Note: * statistically significant at 10%; ** statistically significant at 5%; *** statistically significant at 1%.

Source: CDRI Survey Data (2008-2009)

Results for emigration: Household size has a positive impact on emigration, whereas the number of dependants has a negative effect. This finding suggests that larger households and households with fewer dependants divert part of their labour to non-farm activities to generate more income. In other words, the opportunity cost of labour might be lower in farm activities than in non-farm activities. The coefficient of the age of the household head is positive; in contrast the average adult age is negative in relation to emigration, suggesting that households with older heads tend to have more migrant household members than those with young heads, or those with older members who are less likely to emigrate.

The higher educational level of household heads has a negative impact on emigration. One possible explanation is that households with higher educated heads are unlikely to be poor, so it is not necessary for other household members to migrate to earn extra income. Highly

educated household heads may also be aware of unfavourable working conditions in destination countries, often described as difficult, dirty and dangerous (Chan 2009), which reduces the incentive to emigrate. Education also plays another important role in emigration. Average adult education, which captures a joint decision between household head and emigrant, is positive and statistically significant at 10 percent level, implying that emigration increases with household head and individual education. In other words, emigrants are more likely to have a high level of education. Therefore, emigration may lower the concentration of educated individuals which in turn worsens inequality and hinders rural development. As expected, the size of agricultural land also has a negative effect on emigration. This probably reflects the fact that having a larger agricultural landholding provides more employment opportunities for household members than a smaller landholding. This finding also suggests that households with larger agricultural land may find it difficult to lease their land (due to market imperfections) and therefore stay on the farm instead of emigrating. As a result, emigration decreases. Household members in Kampong Thom province are less likely to emigrate than those in Kampong Chhnang and Pursat provinces.

Holding other factors constant, the correlation coefficient between the error terms of the two equations was -0.015, indicating that rice double-cropping and emigration decisions are independent. Data for 2008 and 2009[6] as well as the overall sample (excluding the dummy year) provide the same conclusion. Therefore, we re-estimated the rice double-cropping and emigration equation using a random effects probit model. The results are presented in Table 5 and confirm that agricultural land size and animal draught power are key determinants of rice double-cropping, while household size, the number of dependants, age and education of household head, average household age and education, and agricultural land size are key determinants of emigration. Loans and agricultural extension services have no significant impact on rice double-cropping. Households located in the Tonle Sap floodplain (i.e. downstream) are more likely to be involved in both wet and dry season rice cultivation. It is also worth noting that the coefficient of dependent members is positive but not statistically significant.

A positive but insignificant coefficient of loan dummy is largely due to the endogeneity of financial market participation. Given observable and unobservable characteristics of the family and individuals, an individual's decision to borrow from money lenders or micro-finance programmes appears to be determined by the extent of incentives provided by lenders. In addition, unobservable factors such as social skills, entrepreneurship, management ability and other capabilities make some households more productive than others. If these factors are not taken into account, the evaluation of the effect of credit will be either over or underestimated.

The standard approach to the problem of estimating equations with endogenous regressors is to use instrumental variables. The instrumental variables method allows researchers to address problems posed by measurement error, reverse causality, and some omitted variables. The instrumental variables strategy involves finding an additional variable (or a set of variables) that explains credit participation and/or agricultural extension service programme placement, but has no direct relationship with the outcomes of interest (i.e. double-cropping and emigration). Specifically, the instrumental variable must satisfy two conditions: (1) it must affect the decision to participate in a credit market and agricultural extension services; and (2) it must not affect the household outcomes of interest condition on credit participation and agricultural extension services.

6 See Appendix 2 for the separated result of 2008 and 2009.

Table 5: Determinants of Rice Double-cropping and Emigration–Random Effects Probit Regression (Panel Data)

Independent variables	Model 1		Model 2	
	Rice double cropping	Emigration	Rice double cropping	Emigration
emigrant (1=yes)	0.227			
paddy double cropping (1=yes)		-0.001		
household head gender (1=male)	0.022	0.025	0.038	0.025
household head age (years)	0.015	0.012*	0.015	0.012*
household head marital status (1=married)	-0.472	0.294	-0.473	0.294
household head education (years)	-0.056	-0.077*	-0.058	-0.077*
household size	-0.054	0.122***	-0.045	0.122***
number of dependants	0.247	-0.145**	0.236	-0.145**
average adult household age (years)		-0.024*		-0.024*
average adult household education (years)		0.098*		0.098*
loan (1=yes)	0.359		0.363	
agricultural (paddy) extension service (1=yes)	-0.338		-0.363	
farm equipment index	0.045	0.022	0.048	0.022
pull/plough animals	-0.256**	-0.011	-0.248*	-0.011
agricultural land (log)	1.055***	-0.207**	1.042***	-0.207**
midstream	0.662	-0.262	0.672	-0.262
downstream	0.866*	-0.071	0.879*	-0.071
Kampong thom	0.645	-0.482**	0.602	-0.482**
Pursat	1.842***	-0.021	1.815***	-0.021
constant	-4.531***	-1.395**	-4.520***	-1.395**
rho	0.620	0.00001	0.685	9.26E-06
likelihood-ratio test of rho=0	chibar2(1)=15.87; P>chibar2=0.000	chibar2(1)=2.4E-05; P>chibar2=0.498	chibar2(1)=15.71; P>chibar2=0.000	chibar2(1)=2.0E-05; P>chibar2=0.498
observations	231	230	231	230

Note: * statistically significant at 10%; ** statistically significant at 5%; *** statistically significant at 1%.

Source: CDRI Survey Data (2008-2009)

In empirical studies on micro-finance in Bangladesh, Khandker (2003) used the interaction dummies of credit programme availability and eligibility criteria (i.e. land holding) as an instrumental variable to evaluate the effects of three group lending credit programmes i.e. Grameen Bank, BRAC Bank and the Bangladesh Rural Development Board on household welfare[7]. Conversely, Zaman (2000) used the number of eligible households in each village as an instrumental variable for his research – a case study of BRAC. The current micro-finance programmes operating in Cambodia, however, particularly commercial banks and informal credit market players, such as money lenders, traders and relatives/friends, have no eligibility criteria. It is extremely difficult to find a potential instrumental variable to explain how agricultural extension services have been placed without having a direct effect on the double-cropping decision. For this reason, an instrumental variable approach was not adopted for this study.

7 This instrumental variable seems to be inappropriate as Murdoch (1998) shows that approximately 30 percent of participants do not meet the eligibility criteria.

CHAPTER

5 CONCLUSION

Crop diversification has been prioritised by the Cambodian government to achieve high and sustainable agricultural growth. This paper used a panel data of 231 households to investigate whether emigration and rice double-cropping decisions influence each other, and examined the role of credit as well as agricultural extension services for rice double-cropping. A seemingly unrelated bivariate probit model was used to examine the inter-relationship between emigration and rice double-cropping decisions, while a random-effects probit model was estimated to define the key determinants of emigration and rice double-cropping.

Our findings can be summarised as follows:

- Rice double-cropping and emigration decisions are not closely inter-related.
- The availability of water and agricultural land are key determinants to rice double-cropping.
- Loans and agricultural extension services have no significant impact on rice double-cropping.
- Households which rely on animal draught power for agricultural production are unlikely to engage in rice double-cropping.
- Larger households and households with fewer dependants are likely to have at least one member who emigrates.
- Households with large agricultural land endowments are unlikely to have members that emigrate.
- High educated household heads tend not to emigrate nor allow their household members to emigrate.
- Emigration is positively associated with highly educated households and individuals.
- Households with older heads tend to have more household members that emigrate than those with young heads, but households dominated by older members are less likely to have members that emigrate.

This analysis shows that water availability and agricultural land holdings are central to double-cropping. Policies aimed at increasing irrigation and providing social economic land concessions in rural areas may play a critical role in improving agricultural production.

Appendix 1: Correlation of Continuous Explanatory Variables

2008

		1	2	3	4	5	6	7	8	9
1	household head age	1								
2	household head education	-0.215	1							
3	household size	0.117	0.076	1						
4	number of dependants	-0.288	0.118	0.490	1					
5	average household member age	0.138	-0.055	-0.266	-0.053	1				
6	average household member education	0.068	0.628	0.163	-0.080	-0.217	1			
7	farm equipment index	0.115	0.098	0.276	-0.025	-0.073	0.187	1		
8	pull/plough animals	0.010	0.008	0.075	-0.057	-0.013	-0.036	-0.059	1	
9	agricultural land (log)	0.050	0.077	0.397	0.080	-0.193	0.202	0.496	0.0159	1

2009

		1	2	3	4	5	6	7	8	9
1	household head age	1								
2	household head education	-0.215	1							
3	household size	0.117	0.076	1						
4	number of dependants	-0.288	0.118	0.490	1					
5	average household member age	0.138	-0.055	-0.266	-0.053	1				
6	average household member education	0.068	0.628	0.163	-0.080	-0.217	1			
7	farm equipment index	0.083	0.131	0.262	0.080	-0.048	0.196	1		
8	pull/plough animals	0.016	0.014	0.064	0.080	-0.066	-0.054	-0.061	1	
9	agricultural land (log)	-0.017	0.110	0.343	0.060	-0.194	0.197	0.569	-0.0209	1

2008-2009

		1	2	3	4	5	6	7	8	9
1	household head age	1								
2	household head education	-0.215	1							
3	household size	0.117	0.076	1						
4	umber of dependants	-0.288	0.118	0.490	1					
5	average household member age	0.138	-0.055	-0.266	-0.053	1				
6	average household member education	0.068	0.628	0.163	-0.080	-0.217	1			
7	farm equipment index	0.099	0.115	0.269	0.027	-0.060	0.191	1		
8	pull/plough animals	0.012	0.010	0.068	-0.004	-0.032	-0.041	-0.062	1	
9	agricultural land (log)	0.0171	0.0929	0.37	0.0698		0.1993		0.003	1

Note: It is widely noted that econometric analysis with cross-sectional data is usually associated with problems of multicollinearity[8]. Multicollinearity among explanatory variables can lead to imprecise parameter estimates. To explore potential multicollinearity among the explanatory variables, we calculate the correlation between continuous independent variables (see Appendix 1). The result of the correlation analysis shows that our explanatory variables are weakly correlated, implying that multicollinearity is not a problem in our model.

Source: CDRI Survey Data (2008-2009)

8 High (but not perfect) correlation between two or more independent variables is called multicollinearity.

Appendix 2: Determinants of Rice Double-cropping and Emigration – A Seemingly Unrelated Bivariate Probit Model (Cross-Sectional Data)

Independent variables	2008		2009	
	Rice double-cropping	Emigration	Rice double cropping	Emigration
household head gender (1=male)	-0.050	0.940*	0.143	-0.602
household head age (years)	0.002	0.016*	0.013	0.010
household head marital status (1=married)	0.270	-0.241	-0.208	0.780
household head education (years)	-0.036	-0.059	-0.034	-0.102*
household size	-0.073	0.127*	0.006	0.131*
number of dependants	0.157	-0.159*	0.123	-0.148*
average adult household age (years)		-0.005		-0.046*
average adult household education (years)		0.078		0.134*
loan (1=yes)	0.324		0.108	
agricultural (paddy) extension service (1=yes)	1.207*		-0.497	
farm equipment index	0.094	0.067	-0.036	-0.063
pull/plough animals	-0.346**	-0.045	-0.100	0.021
agricultural land (log)	0.684***	-0.048	0.434**	-0.433***
midstream	0.812*	-0.297	0.094	-0.309
downstream	1.119***	0.016	0.404	-0.132
Kampong thom	4.897***	-0.559*	0.232	-0.407
Pursat	6.246***	0.061	0.858**	-0.143
year dummy				
constant	-7.889***	-2.536*	-2.565***	-0.508
rho	0.079		0.017	
wald test of rho=0	chi2(1)=0.130, P>chi2=0.717		chi2(1)=0.096, P>chi2=0.921	
observations	230		228	

Note: * statistically significant at 10%.;** statistically significant at 5%; *** statistically significant at 1%.

Source: CDRI Survey Data (2008-2009)

REFERENCES

Australian Centre for International Agricultural Research (2011), *Diversification and Intensification of Rainfed Lowland Cropping Systems in Cambodia*, http://www.aciar.gov.au (accessed 10 January 2011)

Boyd, D. (2009), *Double–Cropping in Northern Victoria,* Department of Primary Industries (Grains Research & Development Corporation)

Cambodia Development Resource Institute (2010), *Empirical Evidence of Irrigation Management in the Tonle Sap Basin: Issues and Challenges*, Working Paper Series No. 48 (Phnom Penh: CDRI)

Chan S. (2009), "Economic Costs and Benefits of Cross-Border Labour Migration in the GMS: Cambodia Country Study, Final Report" (Phnom Penh: CDRI)

Coleman, B. (2002), *Micro-finance in Northeast Thailand: Who Benefits and How Much?* Asian Development Bank, ERD Working Paper Series No.9

Green, W.H. (2008), *Econometric Analysis*, 6th edition (Upper Saddle River, NJ: Prentice-Hall)

Hashime, S. (1997), "Those Left Behind: A Note on Targeting the Hardcore Poor", in G. Wood & I.A. Sharif (eds), *Who Needs Credit? Poverty and Finance in Bangladesh* (London: Zed Books) pp. 249-257

Karina, S. & Zilberman, D. (2007), "The Economics of Water, Irrigation and Development", in Robert Evenson & Prabhu Pingali (eds.), *Handbook of Agricultural Economics Volume 3: Agricultural Development: Farmers, Farm Production and Farm Market* (Amsterdam: North-Holland Publishing) pp. 2933-2977

Khandker, S. (2003), *Micro-finance and Poverty: Evidence Using Panel Data from Bangladesh*, Policy Research Working Paper 2945 (Washington, DC: World Bank)

Manohar, S. & Zeller, M. (1999), "Placement and Outreach of Group-Based Credit Organizations: The Cases of ASA, BRAC, and PROSHIKA in Bangladesh", *World Development Journal*, Vol. 27, No. 12, pp. 2123-2136

Marra, M. & Carlson G. (1990), "The Decision to Double Crop: An Application of Expected Utility Theory Using Stein's Theorem", *American Journal of Agricultural Economics*, Vol. 72, No. 2, pp. 377-345

Matsuda, T. & M. Igata (1993), "Problems of Rice Land Use in the Philippines", in A.Fujimoto, C.B. Lamug, & T. Mastuda (eds.), *Contemporary Issues in Philippine Rice Farming* (Tokyo: World Publishing Co Ltd)

Mckernan, S. (2002), "The Impact of Microcredit Programs on Self-Employment Profits: Do Non-credit Program Aspects Matter?" *The Review of Economics and Statistics*, Vol.84, No.1, pp. 93-115

Mincer, J. (1978), "Family Migration Decision", *Journal of Political Economy*, Vol. 86, No. 5, pp. 749-773

Ministry of Economy and Finance (2010), Macroeconomic Data (Phnom Penh: MEF)

Murdoch, J. (1998), "Does Micro-finance Really Help the Poor? New evidence from flagship programmes in Bangladesh", Harvard University (mimeo)

Nang P., Khiev D., Isabelle, W. & Philip, H. (forthcoming), *Improving the Govenance of Water Resources in Cambodia: A Stakeholder Analysis*, CDRI Working Paper (Phnom Penh: CDRI)

Rangsan, P. (1995), "Determinants of Crop Diversification on Paddy Field: A Case Study of Diversification to Vegetables", *Kasetsart Journal*, Vol. 16, pp. 201-208

Reardon, T. & Paul, G. (2000), "Chapter 19: Agriculture", in Grosh & Glewwe (eds.), *Designing Household Survey Questionnaires for Developing Countries: Lesson from 15 Years of the Living Standards Measurement Study, Volumes 1, 2, and 3* (Washington, DC: World Bank)

Royal Government of Cambodia (2010), *Policy Paper on the Promotion of Paddy Production and Rice Export*, (Phnom Penh: Council of Ministers)

StataCorp (2009), *Stata: Release 11*, Statistical Software. College Station, TX: StataCorp LP

Todaro, M. & Smith, S. (2005), *Economic Development, Ninth Edition* (London: Person Education Limited)

Tong K. (2005), "Labour Surplus and Productivity in Cambodian Agriculture: The Case of Takeo Province", mimeo (Phnom Penh: CDRI)

Tong K. (2010), "Agriculture as the Key Source of Growth: A Focus on Paddy and Rice Production", published under the title "Promoting Export of Cambodia's White Gold", *Cambodia Development Review*, April–June 2010, Volume 14, Issue 2, pp. 6–10 (Phnom Penh: CDRI)

VanWey, K. L. (2005), "Land ownership as a determinant of international and internal migration in Thailand", *International Migration Review*, Vol. 39, No. 1, pp.141-172

Wooldridge, M. J. (2002), *Introductory Econometrics: A Modern Approach* (Cambridge, MA: MIT Press)

Wokker, C., P. Santos, Ros B. & K. Griffiths (forthcoming), *Irrigation Water Productivity in Cambodian Rice Systems*, CDRI Working Paper (Phnom Penh: CDRI)

Zaman, H. (2000), "Assessing the Poverty and Vulnerability Impact of Micro-credit in Bangladesh: A Case Study of BRAC", World Bank (mimeo)

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