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Chea, Saintdona
Graduate School of Bioresource and Bioenvironmental Sciences, Kyushu University

Tsuji, Masao
Faculty of Agriculture, Kyushu University

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The Effect of Off-farm Income from Industry on Rice Production A Case Study of Cheung Kaeub Commune, Kandal Stueng District, Cambodia

Saintdona CHEA[1] and Masao TSUJI*

Laboratory of Farm Management, Division of International Agricultural Resource Economics and Business Administration, Department of Agricultural and Resource Economics, Faculty of Agriculture, Kyushu University, Fukuoka 812–8581, Japan.
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Using cross-sectional household data from a field survey conducted in Cheung Kaeub commune in 2004, this paper explored the effect of off-farm income from industry on rice production.

By using with and without comparative study approach and other data analysis methods consisting of two-independent samples t-test, production function, correlation and economic profitability analyses, this paper found the effect of off-farm income from industry on rice production as follows: (1) off-farm income has a strong correlation with input investment and rice output, (2) farm households with off-farm income harvested rice yields around 3 tones per hectare, while farm households without off-farm income obtained around 2.5 tones per hectare. This large difference in crop yields attained by farm households with and without off-farm income was found to be highly significant at 1% percent level of confidence, (3) Farm households with off-farm income could get economic profit around 49 thousand riels per hectare from rice enterprise, while farm households without off-farm income lost around 38 thousand riels per hectare due to poor performance of the crop, and (4) the results of production function analysis indicated that three important factors of production consisting of input investment, land and labor contributed to rice output significantly. Based on the standardized coefficient beta of each variable, it can be implied that if farmers could increase operating expenses on inputs by one percent, rice output would increase around 0.439 percent, holding other factors constant. Similarly, one percent increase in cultivated area, rice output would increase by 0.309 percent, holding other factors constant. One percent increase in the amount of labor used on rice cultivation, rice output will increase about 0.200 percent, holding other factors constant. Farm households with off-farm income harvested rice output around 0.205 percent higher than farm households without off-farm income did.

INTRODUCTION

Cambodia is one of the poorest countries in the world, resulting from a prolonged civil conflict (1975–1992) and especially slow economic growth due to lack of human and financial resources to develop the economy. 36 percent of Cambodian people live below poverty line (Heng and Poch, 2002). Most of the poor live in the rural areas. Over 10 million (around 85 percent of total population) of Cambodian population currently live in rural areas. Of this population, approximately 80 percent (>7 million people) are

[1] Laboratory of Farm Management, Division of International Agricultural Resource Economics and Business Administration, Graduate School of Bioresource and Bioenvironmental Sciences, Kyushu University

* Corresponding author (Email: mtsuji@agri.kyushu-u.ac.jp)

subsistent farmers (Bruce and Prom, 2002). Rice crop is the staple food for Cambodian people and is the main source of income for rural farm households.

Although, rice yields increased remarkably from 1.3 tones to 2.1 tones per hectare between 1993 and 2003 (MAFF, 2004), rice productivity in Cambodia is still the lowest among countries in Asian region, deriving from a number of factors such as poor quality of paddy soil, low input investment in crop production, limited financial resources of farmers, uncontrolled irrigation (depend on rain fall pattern), and poor infrastructure (NRICCD report, 2000). One most important factor contributing to low rice productivity at present is low input investment in rice cultivation because most rural farm households experience shortage of working capital to invest in farming. Most Cambodian farmers invest inputs such as crop seeds, farmyard manure, and chemical fertilizer on rice production depending on the resources that they have, because of socio–economic constraints. FAO (1999) found that amount of chemical fertilizer applied on rice production per hectare by most Cambodian farmers was about 20–25 kg or less than 10 kg of nutrients per hectare.

Beginning in the mid– 1990s, when Cambodia was largely at peace for the first time in two decades, and when the government had converted from a centrally–planned to free market economy, Garment industry was established and has been flourishing in Cambodia. Off–farm employment from industry increased remarkably at Phnom Penh city. Some rural people especially young women and men with age between 18 and 35 years old, shifted from agriculture to work for garment industry remarkably. Kasumi (1999) and Chan (2003) found that rural people working for industry at Phnom Penh city send remittance back to their farm households at varying amounts every month. Since farm households use off–farm income (remittance) in many purposes, they are likely to invest it in rice cultivation as well. Hence, their rice productivity might be higher than other farm households with limited working capital to invest in rice production.

Therefore, this study sought to find out the effect of off–farm income on rice production by comparing rice yields, determining factors affecting rice output and analyzing economic profitability of rice production between farm households with and without off–farm income in one rural area in Cambodia.

METHODS

The data used in this paper came from a field survey data, which was conducted in September 2004. 53 farm households consisting of 25 farm households with off–farm income (farm household A) and 28 farm households without off–farm income (farm household B) were selected randomly from the survey area. Rich farm households within farm household with and without off–farm income groups in the study area were excluded because this study aimed at finding out the effect off–farm income from industry on rice production.

With and without comparative study approach was used to achieve the stated objective. Some data analysis methods consisting of Two–independent samples t–test, Correlation, Production Function (Cobb Douglas function) and Economic Profitability analyses were used to analyze primary data in this paper. SPSS 12.0 and Excel software packages were used to process primary data and produce the results for this paper.

Production function model used in this paper

$$Y=aX_1^{b1}X_2^{b2}X_3^{b3} \quad (1)$$

Since this relation is not linear, all variables are converted into natural logarithm in order to be used in the production function model. Equation (1) in its log– linear form is as follows:

$$\ln Y=\ln a+b_1\ln X_1+b_2\ln X_2+b_3\ln X_3+b_4\,df+e$$

Where Y is rice output, X_1, X_2, and X_3 are input costs (costs come from seed, manure, chemical fertilizer, pesticide, and water), land and labor respectively. df is dummy variable for farm household type. Where df is equal to 1 for farm household A (farm household with off–farm income), and Zero otherwise (farm household B, farm household without off–farm income). **a** and $\mathbf{b_i}$ are parameters to be estimated, **e** is the error term.
The Analysis of Economic Profitability of rice production used in this paper

EPR =GM - TFC
GM =GR - TVC
GR =APP×Py
TVC =VC+ITVC
ITVC =TVC×annual interest rate / 2
TFC =DPC+FLC+ELC+LC+IDA
IDA =Amount paid on durable assets×annual interest rate
Strait line method=Initial cost or basis cost of asset / useful years of life of asset
(Savage value is 0)

Where

EPR is the Economic Profitability of Rice production
GM is gross margin
GR is gross returns
APP is average physical product of rice crop per unit of harvested area (per hectare)
Py is the average price of rice sold by farmers in the study area in 2003
VC is Variable cost of each variable input paid by farmers in rice cultivation
TVC is Total Variable Costs deriving from the sum of all variable input cost including seed cost , farmyard manure cost, animal cost, chemical fertilizer cost, water cost, hired labor cost, pesticide cost, threshing cost, transportation cost, maintenance cost and the interest charge on total variable cost.
ITVC stands for the interest charge on total variable cost
DPC is the depreciation cost coming from agricultural tools used in rice cultivation (pump, plough, harrow, Ox–cart, hoe, threshing tool, drying mat, rice basket and hand–held sickle). DPC was computed by using straight line method
FLC refers to family labor cost (opportunity cost of labor in the study area)
ELC refers to exchange labor cost
LC refers to land cost (opportunity cost of land in the study area)
IDA stands for the interest charge on durable assets used in rice cultivation,

including pump, plough, ox-cart, harrow, hoe, threshing tool, drying mat, basket, and hand held sickle.

The definition of key words used in this paper

Farm household A refers to farm households with off-farm income from industry
Farm household B refers to farm households without off-farm income from industry
Off-farm income refers to the remittance that farm households receive from their family members working for industry.
Garment industry refers to industry making clothes

RESULTS AND DISCUSSION

General information of surveyed farm households in the study area

Education and age of householders

Based on the survey results, the age of householders within farm household A and farm household B ranged from 24 to 76 years old, with an average of 50.8 years old and 27 to 82 years old, with an average of 43.43 years old respectively (table 1). This can be assumed that householders within farm household A and farm household B have good farming experience especially in rice cultivation since rice growing is the main occupation of farmers in the study area.

Apart from age structure, educational attainment of householders is also an important factor for individual householder to lead the family as well as to make decisions in farming. The educational attainment of householders within farm household A was 4.28 years, followed by householders within household B at 3.5 years (table 1). This indicates that education level of householders within farm household A and B is low. However, they are not illiterate. Therefore, their educational level and farming experience are not significantly different factors that might lead to differences in decision making in rice cultivation.

Table 1. Socio-economic characteristics of surveyed farm households

	Unit	Household A (n=25)		Household B (n=28)	
		Total	Average	Total	Average
Family size	Person	140	5.6	160	5.71
Number of active labor	Person	51	2.04	83	2.96
Age of householder	Year	.....	50.8	.....	43.43
Educational attainment of householder	Number of years	.....	4.28	.....	3.5
Cultivated area	Are	2163	86.52	2148	76.71

Source: Field survey, September, 2004

Family size and active labor force

The results of the survey revealed that farm household A and household B consisted of an extended family which has many family members, ranging from 3 to 9. Average family size of farm household A and farm household B was 5.6 and 5.71 persons respec-

tively (table 1). The average family size of household B was 0.11 persons larger than family size of farm household A.

The average numbers of active labor force of farm household B is 2.96 persons, while farm household A is 2.04 persons. Farm household B has about one active labor force more than farm household A. This large difference in farming labor force is due to the fact that some active labor force of farm household A shifted from agriculture to work for garment industry at Phnom Penh city.

Farm household A and farm household B may hire in additional labor force to cultivate rice depending on the number of farming labor available within their households. The extent of hired labor that farm household A and household B hired has an impact on the economic profit of rice enterprise. Since farm household A has fewer numbers of active farming labor force than farm household B, their expenses on hired labor are likely to be higher than farm household B. Therefore, the expenditure on hired labor incurred on rice production was taken into account in this study.

Rice yields attained by farm household type

In order to examine rice productivity between farm household A and household B, crop yield comparison was made. Two- independent-samples t-test was used to compare crop yields between farm household A and farm household B. Table 2 illustrates that the average Wet season rice yields per hectare harvested by farm household A was 3,043.84 kg, followed by farm household B at 2,521.42 kg per hectare. The mean variances of crop yields per hectare between household A and B was 522.42 kg. This large difference in rice yields per unit of harvested area (per hectare) indicates the statistically significant difference at 1% level of confidence between farm household A and farm

Table 2. Descriptive statistics of rice yield attainment by farm household type

		N	Mean	Std. Deviation	Std. Error Mean
Wet season rice yields (kg/ha)	Family A	25	3,043.84 kg	185.31003	37.06201
	Family B	28	2,521.42 Kg	435.28164	82.26050

Source: Field survey, September 2004

Table 3. Output of two- independent samples t-test

		Levene's Equality of Variances		T-tes for Equality of Means		
		F	Sig	t	df	Sig (2-tailed)
Wet season rice yields (kg/h)	Equal variance assumed	12.84	0.001	5.563	51	0.000
	Equal variance not assumed			5.790	37.343	0.000

household B (Table 3). Farm household A harvested higher crop yields than farm household B because they used off–farm income to invest more inputs including farmyard manure, chemical fertilizer and supplementary water on rice production than farm household B.

Factors contributing to rice output

There are several factors affecting rice output. Those factors consist of topography, soil type, climate, production knowledge, input investment in crop, and so on. Since farm household A and farm household B live in the same area, natural factors such as soil type, topography and climate were assumed to be the same. Similarly, production knowledge and educational attainment of householders within farm household A and B were found to be similar (table 1). Therefore, the most important factors affecting rice output that this study took into consideration consist of input investment, land, and labor.

An analysis of the factors contributing to rice output

According to the results of Cobb–Douglas function analysis, three variables are the main factors contributing to rice output. Those three variables consist of input investment, land, and labor. Table 5 shows that input investment is the first important factor affecting rice output, followed by land and labor respectively. Based on the estimated standardized coefficient beta of input investment variable (table 5), it can be implied that if farmers could increase operating expense of inputs by one per cent, on average, rice output would increase around 0.439 percent, holding other factors constant. Input investment is the first important factor and contributed to rice output because, based on the survey result, it reveals that all farm households with off–farm income (farm household A) incurred costs in inputs such as rice seed, farmyard manure, chemical fertilizer, and irrigation on rice production at large amount, while most farm households without off–farm income paid for those inputs on rice cultivation at small amount due to financial constraints.

With respect to the estimated coefficient beta of land variable, it can be concluded that if farmers could increase cultivated area by one percent, holding other factors constant, on average, rice output would increase around 0.309 percent. This is due to the fact that land is also the main constraint for farm households. Most farm households in the study area own small farm size (less than 1 hectare, table 1) due to some reasons: (1) the study location is densely populated, so an individual farm household receives smaller farm size from government compared to other farm households in other rural areas which are sparely population, (2) land–subdivision to the children and (3) some farm households sold land for urgent needs such as illness, traditional ceremony organization, and debt repayment, etc.

Apart from input investment and land constraints, farmers also experience shortage of labor force to cultivate crop during the busiest period of rice cultivation such as land preparation, thinning, transplanting, and harvesting crop. This is due to the fact that farmers in the study area still use traditional methods to cultivate rice, meaning that they use intensively human labor force and animal draught power for farming and they cultivate rice depending on rainfall pattern, so every farm household hurries to grow rice at the same time when the rain water arrive. Thus most farm households need external

labor force to help because their family labor is not enough for farming. Therefore, based on the estimated coefficient beta of labor force, it illustrates that if farmers could increase the amount of labor used on rice cultivation by one percent, on average, rice output would increase around 0.2 percent, holding other factors constant.

For dummy variable family A, based on its estimated coefficient beta in table 5, it clearly demonstrates that the variable has positive sign and highly significant differences compared with farm nousehold B, implying that farm household A harvested rice output around 0.205 percent higher than farm household B. This is consistent with this study's hypothesis that farm households with off-farm income could harvest higher rice output than farm household without off-farm income, resulting from their large input investment on rice production because they have additional off-farm income (remittance) to invest in rice production.

Table 4. Descriptive statistics of variables used in production function

	Mean	Std. Deviation	N
Output log	7.6537	0.38295	53
Input log	12.1471	0.60126	53
Land log	4.3310	0.38659	53
Labor log	4.2355	0.31061	53
Family type	0.4717	0.50398	53

Table 5. Output of production function analysis

	Standardized Coefficients	t	Sig
	Beta		
Constant		3.723	0.001**
Input log	0.439	5.456	0.000**
Land log	0.309	3.166	0.003**
Labor log	0.200	2.110	0.040*
Dummy family A	0.205	3.276	0.002**

Adjusted R square=0.816, F=(4, 48) 58.664, Sig P<0.001
** And * denote the statistically significant at 0.01 and 0.05 level respectively

The relationship between off-farm income, input investment and rice output

Since rice cultivation is the main occupation of farmers in the study area, this study assumes that farm households having remittance (off-farm income) would use it to purchase inputs to apply on rice production in order to get high yields. Thus, there is likely to be a relationship between off-farm income, input investment and rice output. In order to find out the relationship between off-farm income, input investment and rice output, correlation analysis was used. Based on the theory of correlation, the degree of association or strength of relationship between two variables is represented by a number called correlation coefficient. The value of a correlation coefficient can range from plus one (+

1) and minus one (-1) (Roger, 1999). A value of (+1) denotes a perfect positive relationship, meaning that high score of one variable/factor are pared with high scores on the other, and low scores are paired with low scores. A coefficient of (-1) denotes a perfect negative or inverse relationship between two factors, meaning that high scores on one variable/factor are paired with low scores on the others and vice versa.

When the two factors/variables have low degree of association or strength or relationship, the correlation coefficient falls in between less than 0 ($-1<r<0$) or by coefficient greater than 0 ($0<r<1$). The degree of association or strength of relationship between two factors depends on the absolute value of correlation coefficient, meaning that when the absolute value of coefficient is closer to 1, it indicates a higher degree of association or correlation between two factors. By contrast, when absolute value of coefficient is closer to null or less than 0, it demonstrates a weak degree of strength between two factors.

Based on the estimated coefficient of variables in table 6, the results of correlation analysis clearly indicate that there appear to be a strong correlation between off–farm income, input investment and rice output. The estimated coefficient between off–farm income and input investment is 0.809 (table 6). This clearly shows that there is strong correlation between off–farm income and input investment, implying that farm households use off–farm income (remittance) to purchase inputs such as crop seeds, farmyard manure, chemical fertilizer, and water to apply on rice production. Similarly, since off–farm income was used by farmers to purchase inputs to apply on rice production, the estimated coefficient of off–farm income and rice output was 0.787 (table 6), indicating that off–farm income has very strong correlation with rice output.

Table 6. Output of correlation analysis

	Farm household A	
	Input investment	Rice output
Off–farm income	0.809**	0.787**

** indicates the significance at the 0.01 level (2–tailed)

Costs incurred on rice production

The cost calculated here is composed of variable and fixed costs. Variable cost consists of animal cost, seed cost, farmyard manure cost, chemical fertilizer cost, supplementary water cost, pesticide cost, transportation cost, maintenance cost, threshing cost, hired labor cost, and the interest charge on total variable cost.

Fixed cost includes depreciation cost, land cost (opportunity cost of land), family labor cost (opportunity cost of labor), exchange labor cost, and the interest charge on agricultural assets used in rice cultivation. In order to analyze the economic profitability of rice production of farm household A and household B, all costs paid in cash and family endowments in Wet season rice enterprise are calculated and presented in (Table 7).

Tables 7 presents the absolute value of production cost of Wet season rice and the percentage share of each input cost to the total production cost per hectare. Farm house-

Table 7. Wet season rice production costs in Riels per hectare

Input	Household A (n=25)		Household B (n=28)	
	Total cost	% to total cost	Total cost	% to total cost
Variable cost				
Animal cost	57,960	4.08	76,950	6.13
Seed cost	54,155.4	3.81	46,714.2	3.72
Farmyard manure cost	40,040	2.82	17,745	1.41
DAP cost (di-ammonium phosphate)	94,720.5	6.67	49,009.25	3.9
Urea cost	91,525.05	6.44	46,399.05	3.69
Hired labor cost	95,800	6.75	44,200	3.52
Pesticide cost	2,400	0.16	2,150	0.17
Water cost	27,980	1.97	15419.64	1.22
Threshing cost	3,800	0.26	1,250	0.09
Transport cost	8,800	0.62	13,650	1.08
Maintenance cost	11,310	0.79	5,416.82	0.43
Interest charge on total variable cost	58618.91	4.18	38268.47	3.09
Total variable cost	**547,109.86**	**38.55**	**357,172.43**	**28.45**
Fixed cost				
Interest on durable assets	16,097.54	1.13	12,116.33	0.96
Depreciation cost	83,541.36	5.88	45,360.14	3.61
Family labor cost	157,550	11.1	211,250	16.83
Exchange labor cost	204,800	14.43	219,100	17.45
Land cost	410,085	28.91	410,085	32.7
Total fixed cost	**872,073.9**	**61.45**	**897,911.47**	**71.55**
Total production cost	**1,419,183.76**	100	**1,255,083.9**	100

Source: Field survey, September, 2004

hold A spent around 547 thousand and 872 thousand riels per hectare on total variable and fixed costs in Wet season rice production respectively, followed by farm household B at 357 thousand and 897 thousand riels per hectare (table 7). Farm household B spent on animal cost around 19 thousand riels (about 14%) greater than farm household A. Farm household A and B paid for pesticide cost at smaller amount than other items. This is due to the fact that in Cambodia, farmers rarely apply pesticide on Wet season rice because pests are not a serous problem for Wet season rice like other crops such as Dry season rice and vegetables.

Farm household A incurred total variable cost around 190 thousand riels (around 21 %) larger than farm household B (table 7). This is due to the fact that farm household A paid almost double amounts on some inputs such as farmyard manure, water supplement, chemical fertilizer, maintenance, interest charge on total variable costs and especially hired labor . Farm household A paid on hired labor cost around 51 thousand riels (about 36%) higher than farm household B. This high expenditure on hired labor cost derives from the reason that farm household A hired in external labor to offset the deficit brought

about by their family members who shifted from agriculture to work for industry at Phnom Penh city. Farm household A could invest larger amount of working capital in rice cultivation because they have additional off–farm income received from their family members working for industry.

Economic profitability of rice production

In this study, economic profit of rice production (economic returns from rice enterprise) is defined as the amount left after deducting total production cost (variable and fixed cost) from gross returns. Since the opportunity cost of land (standard cost of land) is not yet set throughout the country, land cost or the opportunity cost of land that this study set was based on the actual land rent that farmers paid to rent in land in the study area. In the study location, farmers paid around 410 thousand riels to rent in one hectare of paddy field.

Similarly, the interest charge on working capital varies with the type of financial intermediary, for instance, private lending money source charges interest rate on working capital at very high cost ranging from 70% up to 100 percent annually (Chan and Acharya, 2001) Official credit institutions (banks) also charge interest rate on lending money at different rate. However, in order to compute the interest charge on variable cost and on agricultural durable assets, this paper used interest rate charged by ACELEDA bank. ACELEDA charges interest rate on loan at 24 percent per year (flash report 2004). This study used the ACELEDA bank's interest rate because ACELEDA bank is the major official rural credit institution for rural people in Cambodia and it is the trusted bank that farmers can keep their savings as well. Therefore, in order to calculate gross margin and analyze economic profitability of rice production of farm household A and household B,

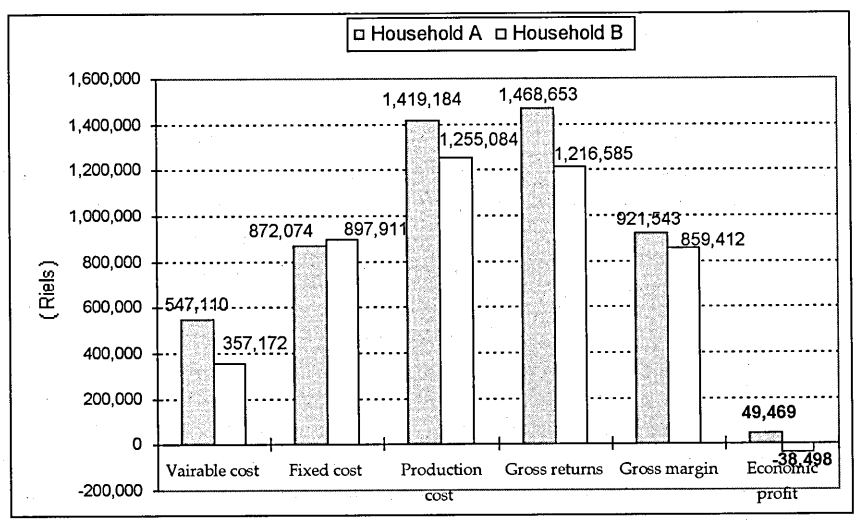

Fig. 1. Economic profitability of Wet season rice production
Source: Field survey, September 2004

variable and fixed costs calculated in table 7, land cost paid by farmers in the survey location, interest rate on working capital charged by ACELEDA, and the price of rice sold by farmers at the survey location were used in this paper.

Figure 1 presents gross returns, gross margin and economic returns from Wet season rice production between farm household A and household B. Farm household A and B obtained around 921 thousand riels and 859 thousand riels of gross margin per hectare respectively. Although farm household A spent on total variable costs around 190 thousand riels (about 21%) larger than farm household B, they still attained higher gross margin in absolute terms than farm household B. This derives from the fact that farm household A harvested higher crop yields per unit of harvested area than household B. Farm household A harvested 3,043.84 kg of rice yields per hectare, while farm household B obtained only 2,521.42 kg per hectare (table 2).

With respect to the economic profitability of Wet season rice enterprise, farm household A gained around 49 thousand riels per hectare, while farm household B lost about 38 thousand riels per hectare (Figure 1). Farm household B could not make profit from rice production, deriving from the poor performance of the crop, resulting from low input investment in crop production.

CONCLUSION AND SUGGESTION

Based on the important findings of this study, the conclusion can be drawn that off–farm income from industry has an effect on rice production, since farm households with off–farm income could harvest higher rice yields than farm households without off–farm income, and especially they could get economic returns to the factors of production consisting of capital, land, labor and management. Farm households with off–farm income could harvest rice output around 0.205 percent higher than farm households without off–farm income, resulting from their large input investment on rice production.

Since most farm households in the study area as well as other rural areas in Cambodia experience shortage of working capital to invest in farming and the Government lacks financial resources to subsidize farmers, the Government should pay more attention to industrial development as it would offer more off–farm employment and working capital to rural farm households enabling them to improve agricultural production.

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