FARM LEVEL IMPACTS OF ADOPTION OF POSTHARVEST TECHNOLOGIES AND INTERVENTIONS IN CAMBODIA[1]

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1. Introduction

In 2005, the International Rice Research Institute (IRRI) launched a project, 'Improving Poor Farmers Livelihoods through Improved Rice Postharvest Management' in Cambodia. The project included four villages each in Battambang, northwestern Cambodia and Prey Veng, eastern Cambodia. The goals of the projects are to: (a) reduce losses due to poor postharvest techniques and storage that results in spoilage, wastage, and quality deterioration; (b) strengthen rice milling technology to reduce loss during milling and improve the quality of milled rice; (c) increase farmers' financial return on rice through better understanding of the rice market; (d) establish a network of postharvest practitioners that will continue to build postharvest information and technology, share market intelligence, and deliver information to poor farmers (ADB, 2003).

The interventions were piloted to address identified postharvest needs. For harvesting, the project facilitated the demonstration and introduction of mini-combine harvester from Viet Nam. For storage, the project introduced hermetic super bags, 5-ton hermetic cube marketed as Cocoons™ and granary improvements. A market information system where price data is collected every three days in three different markets (rural, provincial, and Phnom Penh) was also set up to help farmers get better selling prices. Lastly, moisture meters were provided to key farmers to check the quality of grains (Gummert, 2008).

We aim to examine ex-post farm level impacts of postharvest technologies and interventions using comparative mean analysis of selected impact indicators and actual and hypothetical costs and returns analyses.

2. Data and Estimation Methods

The project was monitored by different independent evaluation groups from 2005 to 2008 (Table 1). In 2005, 120 farmers randomly selected from categories of poor, better off and rich households in the 8 villages were interviewed. The same farmers were interviewed for the other surveys done from 2006-2008. The sampling was expanded in the 2008 impact monitoring to get a 'without intervention' analysis. Four control villages were added (Table 2).

The impact monitoring included focus group discussions as well as key-informant interviews with different project partners. A pre-tested questionnaire was used in collecting input-output data and farmers' knowledge, attitudes and practices (KAP) in postharvest.

The farm level impacts of the project were assessed using the 'with and without' project scenarios. Mean values of selected impact indicators are compared between farmers in project and control site (Table 3). To do this, the two groups were established to have similar characteristics except for their adoption of project technologies and interventions. To account for partial adoption, farmers who stated that they have heard of the project, attended trainings, and used at least one of the technologies or interventions were considered part of the 'with intervention' group.

Actual costs and returns analysis was done to compare net income of farmers from the two sites. Estimation of benefits are attributed to the package of technologies and interventions as a whole even in cases where it seems that only one technology is introduced in the site. Hypothetical costs and returns analysis was also done in order to assess farmers' profitability had the materials not been given for free.

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In this case, cost to farmers of the following project technologies and interventions were included in the costs and returns analysis: (1) harvesting fee through the use of mini-combine harvester; (2) hermetic super bags; (3) granary improvements; (4) drying fee through the use of flat bed dryer; (5) moisture meter (5 moisture meters were allocated per village and the total costs of these moisture meters including batteries were divided to the number of farmer-respondents per village to get cost per farmer); (6) market information boards (the cost of transmitting price data from the province to the village was also divided by the number of farmer-respondents per village).

3. Results

Brief Description of Farmer-Respondents

There is no significant difference in the age, education level, household size, rice farming experience, rice area and distance of farm to market between project site and control site farmers (Table 4). On the average, farmers were 48 years old with about 5 years of schooling and 30 years of experience in rice farming. Average household size was 5. Mean rice area cultivated in the wet season was 1.79 hectares and the largest rice parcel cultivated was 1.10 hectares. Mean distance of the farm to the market was 3.71 kilometres.

Analysis of Impact Indicators

Seed Rate

Farmers reported to have either used their own seed or bought from dealers or input suppliers. Seed rate (for own seeds) was compared between super bag and conventional storage of control site farmers. Seed rate was also compared between those stored in super bag and those from other sources (it is assumed that seed purchased from dealers or input suppliers were not stored in super bags) **(**Table 5**)**.

In terms of own seed used, the seed rate of super bag adopters was significantly lower compared to farmers from the control sites. On the average, seed rate was lower by 22 kg/hectare. Across the two provinces, seed rate of super bag adopters was also significantly lower compared to that of control site farmers. It was also lower by 32 kg/hectare in Battambang and 11 kg/hectare in Prey Veng. The results suggest that hermetic storage provides an effective method of maintaining high seed germination rate. With higher germination rate, seed rate can be reduced.

Seed rate of super bag adopters was also significantly lower compared to those who used seed purchased from a dealer or input supplier. On the average, seed rate was lower by 30 kg/hectare. It was significantly lower by 33 kg/hectare in Battambang and 2 kg/hectare in Prey Veng, but this was statistically insignificant. Again, these results suggest that hermetic storage can help in maintaining high seed germination rate, which in turn can result to lower seed rate.

Farm Price

Farm paddy price was compared across sites and provinces (Table 6). Farmers from the project sites received a significantly higher price compared to control site farmers. Price received by project site farmers was 0.20 USD/kg (794 Riel) while control site farmers received 0.17 USD/kg (702 Riel).

Within each province, project site farmers also received significantly higher price than control site farmers. In Battambang, project site farmers were paid around 0.20 USD/kg (804 Riel) while control site farmers were paid 0.17 USD/kg (700 Riel). On the other hand, project site farmers in Prey Veng received around 0.19 USD/kg (785 Riel) while farmers from the control sites received around 0.17 USD/kg (704 Riel).

Farmers in project sites attest that the significantly higher price they got was due to the market information boards making them more informed on market prices and other market-related information. This put them in a better bargaining position because traders would not give prices lower than what was on the board. Some farmers mentioned that the higher price may also be attributed to better quality paddy produced by the project site farmers.

Costs and Returns

Costs were divided into production cost and postharvest cost. Production cost includes cost involved in crop establishment, land preparation, fertilizer and pesticide application as well as irrigation and seed

cost. Postharvest cost, on the other hand, includes cost in harvesting, hauling, threshing/cleaning, drying, and storage. Summary of the total cost as well as the gross returns and net returns incurred by the farmers across the two sites are shown in Table 7. Details of the costs and returns analysis by site are shown in Table 8.

Total cost incurred by project site farmers was around 369 USD/ha. Of the total cost, around 251 USD was spent for production activities and 118 USD for postharvest operations. On the other hand, total cost incurred by control site farmers was higher by 39 USD/hectare. Their production cost was 273 USD/hectare while postharvest cost was 135 USD/hectare. The differences in costs were found to be insignificant.

While there were no significant differences in the costs, net returns were still significantly different across the two sites. Project site farmers had significantly higher yield per hectare (2.63 tons) compared to control site farmers (2.28 tons) which could be due to better handling of produce. With higher yield and farm price, net income of project site farmers was significantly higher compared to that of the control site farmers. This implies that the package of technologies and interventions provided by the project had significant positive impact on the net returns of the project site farmers.

Hypothetical costs and returns analysis

The hypothetical costs and returns analysis revealed that project site farmers would have incurred additional cost of 87 USD/ha, increasing their total cost to 456 USD/ha if project technologies and interventions were not provided for free (Table 9). With yield and farm price the same as with the actual costs, net income would have decreased although still positive and higher compared to net income of control site farmers.

4. Conclusion

Comparison of means was used to assess the farm level impacts of adoption of postharvest technologies and interventions. Results show that the seed rate of project site farmers who used the super bag was significantly lower compared to control site farmers. Project farmers also received a significantly higher farm price compared to farmers from the control sites. While there were no significant differences in the costs incurred by farmers across the two sites, net returns were still significantly different.

Thus, based on the simple comparison of means, project site farmers have benefited from adopting the project's technologies and interventions. There are inherent limitations of the simple comparison of means and one of them is that there is no way to control for other factors which affect the impacts and which likely may vary between the project and control sites (Duryea and Morrison, 2004); we recommend other impact evaluation methods such as the propensity score matching to validate further the impacts presented here.

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Table 1. Monitoring and evaluation done for the project since 2005.

Monitoring and Evaluation	Date	No. of respondents	Done by
Baseline HH Survey	October-05	120	Crenn and Associates
Monitoring	December-06	120	Crenn and Associates
Monitoring	December-07	120	IRRC Consultant
Impact and Learnings	May-08	185	IRRC Consultant

Table 2. Project and control villages monitored in 2008 in Battambang and Prey Veng.

Name of Village	Classification	No. (n)	Name of Village	Classification	No. (n)
Battambang			**Prey Veng**		
Salatrav	Project site	17	Ansorng	Project site	15
Sna Pi Mok	Project site	13	Bentelbous	Project site	14
Samrong Snor	Project site	16	Chrey Veal	Project site	15
Balat	Project site	17	Po Chrey	Project site	17
Truol Sbov	Control site	16	Prey Tanann	Control site	15
Samrong Takkok	Control site	14	Kruel	Control site	16

Table 3. Distribution of farmer-respondents used in the analysis by site and province.

Province	Project Site	Without project intervention (Control Site)	Total
Battambang	44	30	74
Prey Veng	46	29	75
Both Provinces	90	59	149

Table 4. Basic socio-economic and farm characteristics of farmer-respondents.

Characteristic	Project Site	Control Site	Both Sites
	n=90	*n=59*	*n=149*
Age [ns]	47.58	49.76	48.44
Years in school [ns]	5.28	4.75	5.07
Household size [ns]	4.97	5.07	5.01
Farming experience (year) [ns]	29.39	31.00	30.03
Rice area cultivated (ha), wet season [ns]	1.88	1.64	1.79
Largest rice area cultivated (ha), wet season [ns]	1.14	1.04	1.10
Distance of farm to market (km) [ns]	3.74	3.66	3.71

[ns] Difference between project site and control site is not significant

Table 5. Seed rate (kg/ha) of own seed and purchased seed by site and province, Wet season 2007.

Province	Own Seed			Purchased Seed	Difference in own seed stored in SB and purchased seed
	Project Site	Control Site	Difference		
Battambang	99.80	132.05	-32.25 ***	132.79	-33.00 **
Prey Veng	55.10	65.93	-10.83 ns	57.26	-2.16 ns
Both Provinces	76.24	98.31	-22.07 ***	105.81	-29.58 **

***, ** Significant at 1% and 5% levels, respectively

[ns] Difference is not significant

Table 6. Farm-level price by site and province, Wet season 2007.

Province	Project Site	Control Site	Difference
	n=90	*n=59*	
	Riel/kg (USD/kg)		
Battambang	804.25 (0.198)	700.47 (0.173)	103.78 (0.026) ***
Prey Veng	784.67 (0.193)	703.59 (0.173)	81.09 (0.020) ***
Both Provinces	794.25 (0.196)	702.00 (0.173)	92.24 (0.023) ***

Exchange rate: 1 USD = 4056.17 Riel
*** Significant at 1% level

Table 7. Summary of actual costs and returns (USD/ha) of rice production by site, Wet season 2007.

Item	Project Site	Control Site	Difference
	n=90	*n=59*	
Total production cost	251.26	272.87	-21.61 *ns*
Total postharvest cost	117.55	135.40	-17.85 *ns*
Total cost	368.81	408.27	-39.46 *ns*
Gross returns	514.85	393.80	121.05 ***
Net returns	146.04	-14.47	160.51 ***

Exchange rate: 1 USD = 4056.17 Riel
*** Significant at 1% level
ns Difference is not significant

Table 8. Actual costs and returns (USD/ha) of rice production by site, Wet season 2007.

Item	Project Site	Control site	Difference
	n = 90	*n = 59*	
Returns			
Yield (kg/ha)	2,629.31	2,275.40	353.91
Paddy price (USD/kg)	0.20	0.17	0.02
Gross returns (USD/ha)	514.85	393.80	121.05
Costs			
Material inputs			
Seed	18.26	22.65	- 4.39
Organic fertilizer	37.07	58.28	- 21.21
Inorganic fertilizer	40.07	39.15	0.91
Herbicide	0.85	1.37	- 0.52
Insecticide	0.70	0.91	- 0.20
Fungicide	0.00	-	0.00
Rodenticide	1.10	0.20	0.90
Molluscicide	0.14	0.16	- 0.02
Food cost	6.75	5.68	1.07
Machine rental	29.75	25.97	3.78
Fuel and oil	1.64	1.51	0.14
Amortization/land rent	1.44	9.67	- 8.23
Hired labor	39.05	29.28	9.77
Family labor	187.36	195.28	- 7.92
Exchange labor	4.62	18.16	- 13.55
TOTAL COST	368.81	408.27	- 39.46
NET RETURNS	146.04	-14.47	160.51

Exchange rate: 1 USD = 4056.17 Riel

Table 9. Hypothetical costs and returns (USD/ha) of rice production by site, Wet season 2007.

Item	Project Site	Control Site	Difference
	n=90	*n=59*	
Total production cost	251.26	272.87	-21.61
Total postharvest cost	204.66	135.40	69.26
Total cost	455.92	408.27	47.65
Gross returns	514.85	393.80	121.05
Net returns	58.92	-14.47	73.40

Exchange rate: 1 USD = 4056.17 Riel