Research article

The Current Situation of Farmers' Practice of Rice Seed Use in Cambodia: An Exploratory Study in Takeo Province

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Abstract Rice productivity in Cambodia has increased dramatically in recent decades. The main factor behind this breakthrough has been the spread of irrigation and modern rice varieties. However, the formal rice seed supply system is still not well established, and most farmers use seeds collected by themselves. In this situation, it is difficult to maintain the new varieties' field performance. This study investigated the current situation of farmers' rice seed treatment practices and the concern that these practices hinder the improvement of rice productivity in Cambodia. Data for this study were collected from 80 conveniently selected farmers in irrigated and rainfed areas in Takeo Province of Cambodia. Farmers in the irrigated area cultivated modern varieties and sold most of their production, while farmers in the rainfed area grew traditional and improved varieties and used them for home consumption. In both areas, farmers procured rice seed through self-collection, and when they changed the variety cultivated, they mostly procured seed from relatives or neighboring farmers. This fact suggested that most farmers did not purchase formally produced seeds. The seed used per hectare in the irrigated area was two times higher than in the rainfed area. In addition, the rice yield per seed used in the irrigated area was lower than in the rainfed area, even though farmers in the irrigated area were growing modern varieties.

Keywords seed renewal, variety adoption, irrigation access, farmer-to-farmer transaction

INTRODUCTION

In recent decades, rice productivity increased rapidly in Cambodia. Even though the unit rice yield was 2.06 ton/ha in 2001, the unit yield rose to 3.75 tons/ha in 2020 (FAOSTAT). This rapid growth was due to the diffusion of modern varieties, increased use of fertilizer, and improvement of irrigation access (Cramb et al., 2020; Kodo et al., 2021). Even though these agricultural inputs increased and/or improved, supplying good quality rice seeds was one of the remained subjects of rice production in Cambodia. Although the significance of investment in rice seeds was confirmed to increase productivity, most farmers prepare rice seeds by self-collection (ADB, 2014).

In Cambodia, the formal rice seed supply system was composed of the Agricultural Quality Improvement Program (AQIP) seed company established by the Ministry of Agriculture, Forestry and Fisheries (MAFF), the Tuol Samrong seed farm established by the World Bank project, and some other private seed producers (Chamroeun et al., 2015). The Cambodia Agricultural Research and Development Institute (CARDI) distributes the breeder's seeds to the seed producers and they multiple seeds and sell them to farmers, retailers, and millers. However, the production of rice seeds cannot satisfy the demand for formally produced rice seeds at present. Against this situation, some programs aiming to improve rice seed quality used by farmers and to establish the system of seed

certification were launched in 2022, which were supported by overseas institutions (APSA, 2022; GAFSP, 2022).

Regarding the established seed supply system, the participation of rice farmers is one of the important requirements. No matter how good seeds are provided, if farmers prefer to obtain seeds by self-collection or farmer-to-farmer transaction to reduce cost, rice productivity should not be improved. To consider how to involve farmers in the refined seed supply system, it is necessary to understand the present farmers' practices of rice seed use.

OBJECTIVE

To find some implications for the refinement of the rice seed supply system in Cambodia, we set the following objectives: 1) Grasp an actual situation regarding the practice of rice seed use among farmers in a rice production area in Cambodia, and 2) Explore concerns regarding rice production due to the present practices of farmers' seed use.

METHODOLOGY

The data for this study was collected through face-to-face interviews with farmers using a structured questionnaire. To grasp the farmer's practices under the different preconditions of rice production, we selected 2 survey sites: Borei Cholsar district as an irrigated area and Tam Kak district as a rainfed area, both located in Takeo Province in southern Cambodia which is one of the major rice production areas in the nation (Chhun et al., 2020). Since this study was intended as an exploratory study based on the objectives, we adopted a convenience sampling method and selected 40 farmers in each site. The survey was conducted in January and February of 2022. The contents of the questionnaire were as follows: land possession and use, income sources, methods and outputs of rice production, and treatment of rice seed. We collected information on 3 cropping seasons: wet season (WS) in 2021, early wet season (EWS) in 2021, and dry season (DS) in 2020-21.

Table 1 Overview of labor and land possession among surveyed farmers

Area	N	Family member (person)	Family farm labor (person)	Family off-farm labor (person)	Own farmland		Rent-in paddy (ha)	Total farmland (ha)	Labor-land ratio (person/ha)
					Paddy (ha)	Others (ha)			
Irrigated	40	4.3	1.7	0.8	2.3	0.0	1.0	3.3	0.9
Rainfed	40	4.6	2.4	1.2	0.8	0.4	0.4	1.6	4.1

Source: Made by authors with the data of the survey in January 2022

Table 2 Annual income of surveyed farmers by each income source (Unit: US$*/year)

Area	N	Agriculture				Off-farm income	Total in 2021
		Rice	Non-rice crop	Livestock	Farm labor		
Irrigated	40	4,349	0	175	0	1,105	5,629
Rainfed**	39	305	82	105	157	2,789	3,438

Source: Same as Table 1

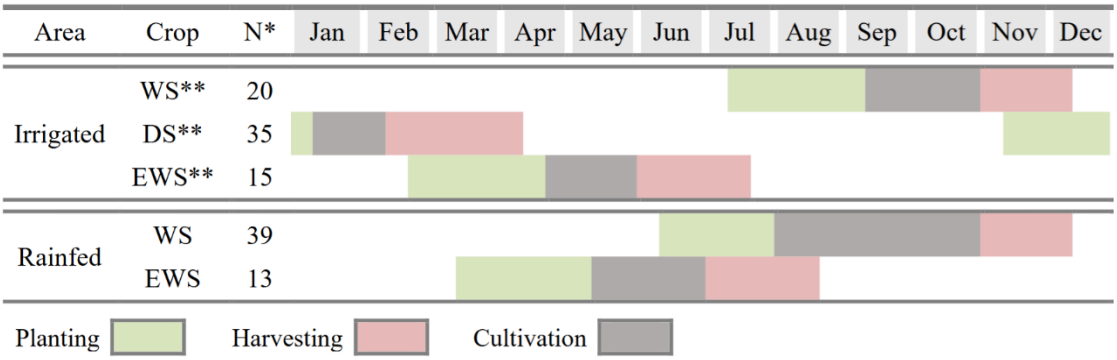
*Remarks: * Exchanged from "Riel" with the rate on November 17th, 2022: 1 US$ = 4,150 Riel; ** From the averages in Tam Kok, we exclude one farm in which the rice income was abnormally high.*

RESULTS AND DISCUSSION

Rice Production among Surveyed Farmers in Irrigated and Rainfed Areas

Table 1 gives an overview of the labor and land holdings of the farmers surveyed. Although the amount of land owned in the irrigated area was more than twice that of the rainfed area, the amount of labor in the irrigated area was less than that in the rainfed area. Thus, there was a large difference

in the labor-land ratio between the irrigated area (0.9) and the rainfed area (4.1). Regarding the source of income (Table 2), the sale of rice was the main source of income for farmers in the irrigated area. In contrast, income from rice was much lower for rainfed farmers than for irrigated farmers, and off-farm income was a major source of income for most of them.



Source: Same as Table 1.
*Remarks: * Frequency of farmers who conducted each type of rice crop in 40 farmers in each area; ** WS = Wet season, DS = Dry season and EWS = Early wet season.*

Fig. 1 Crop calendar of rice production among surveyed farmers in 2020-21

Table 3 Water access, variety, and scale of rice production among the surveyed farmers

Area	Crop	N	Irrigation (Freq.*)			Variety adoption (Freq.*)			Cultivated area (ha) ***
			Rain-fed	Surface water	Groundwater	Modern variety**	Improved variety**	Traditional variety**	
Irrigated	WS	20	0	19	1	20	0	0	2.15
	DS	35	2	33	1	35	0	0	2.78
	EWS	15	1	14	0	15	0	0	1.56
	Annual	40							4.19
Rainfed	WS	39	33	6	0	0	33	14	1.22
	EWS	13	6	10	0	9	4	1	0.43
	Annual	40							1.33

Source: Same as Table 1.
*Remarks: * Frequencies of farmers in the number of who practiced each crop, shown in the "N" column. If farmers use more than one type of irrigation, we count them for all. "Surface water" includes canals, ponds, lakes, and rivers; ** "Modern variety" is bred by IRRI and mainly cultivated in Vietnam, e.g., IR504 and OM5451. "Improved variety" is a pure line of traditional variety, which is generally processed by CARDI, e.g., Phka Malis and Phka Rumduol; *** Averages of the farmers producing rice in each cropping season.*

The rice cropping schedule of the surveyed farmers is described in Fig. 1. In the irrigated area, farmers cultivated rice in all 3 cropping seasons in a year. The main cropping season in the irrigated area was DS. On the other hand, farmers in the rainfed area cultivated rice in WS and EWS in a year and most farmers cultivated rice in WS. Almost all farmers used direct seeding in the wetland and hired contractors with combined harvesters for harvesting. The average number of rice crops in a year by area was 1.75 and 1.30 in the irrigated and rainfed areas, respectively.

Table 3 shows the status of water access, variety adoption, and land use in relation to rice production among the farmers surveyed. In the irrigated area, most farmers had annual access to irrigation water from canals, ponds, lakes, and rivers, and all farmers cultivated the modern varieties that were photoperiod insensitive and short maturing, such as IR504 and OM5451. These modern varieties are popular in Vietnam and most of their production is exported to Vietnam (Chhun et al., 2020). In contrast, farmers in the rainfed area cultivated rice with rainwater in WS, but most farmers cultivating rice in EWS used surface water irrigation. The rice varieties grown were traditional varieties and improved varieties (pure line of traditional varieties) in WS, and EWS the farmers grow modern varieties as in the irrigated area. Regarding the rice cultivated area, the aggregated area planted in the irrigated area (4.19 ha) was three times greater than that in the rainfed area (1.33 ha).

Table 4 shows the rice yield and its disposal among the farmers surveyed. The production and yield of rice in the irrigated area was higher than in the rainfed area. While farmers in the irrigated area sold almost 90% of their rice yield, farmers in the rainfed area disposed of half of their yield for consumption. In both areas, about 10% of production was saved as rice seed. Although the total sales of rice were higher in the irrigated area than in the rainfed area, the unit price of rice was lower in the irrigated area than in the rainfed area. For EWS in the rainfed area, the price was closer to that in the irrigated area than for WS. This indicated that the price of modern varieties such as IR504 and OM5451 was lower than traditional and improved varieties. Kodo (2021) mentioned that farmers produce varieties that are popular in Vietnam because they are easy to sell. Rice traders buy rice for Vietnam from farmers at a low price, but always buy the entire quantity brought by farmers, regardless of its quality. From the above, farmers in irrigated areas made rice production more commercial than rainfed areas, and they adopted the strategy to sell a large number of modern varieties even if the price was lower than traditional and improved varieties.

Table 4 Yield and disposal of rice production by each area and cropping season

Area	Crop	N	Production (ton)	Yield (ton/ha)	Disposal of rice yield (%)				Unit rice price (US$/ton)	Total rice sales (US$*)
					Sold	For home	For seed	Animal feed		
Irrigated	WS	20	11.2	4.7	79.7	6.7	12.4	1.2	195.4	1,975
	DS	35	14.4	5.0	85.8	2.2	11.1	0.8	205.8	3,047
	EWS	15	7.2	4.3	75.7	6.7	17.7	0.2	198.9	1,227
	Annual	40	21.2	4.8	87.2	2.7	9.4	0.7	201.7	4,349
Rainfed	WS**	38	3.1	3.0	34.3	51.3	11.9	1.4	285.2	275
	EWS	13	0.9	2.3	34.4	42.4	12.6	10.0	241.0	113
	Annual**	39	3.4	2.8	34.9	49.6	12.3	2.0	278.6	305

Source: Same as Table 1.

*Remarks: *Exchanged from "Riel" with the rate on November 17th, 2022: 1 US$ = 4,150 Riel; **From "WS" and "Annual" in Tam Kok, we exclude one farm in which the unit price and total sales are abnormally high.*

Rice Seed Use and Procurement among Surveyed Farmers

The number of seeds used per unit in the irrigated area was twice that of the rainfed area (Table 5). While farmers in the rainfed area collected their rice seed, farmers in the irrigated area bought half of their seed from other farmers and/or material dealers. In addition, the rice yield per unit seed input differed between the areas (Table 6). The rice yield per unit seed used in the irrigated area (12.3 kg/1 kg seed) was lower than in the rainfed area (16.0 kg/1 kg seed). However, the yield per seed use was not significantly different in the EWS and the difference was more significant in the WS than in the annual aggregation. This result suggests that the difference in yield per seed between modern and traditional and improved varieties was observed.

Table 5 Usage and sources of rice seed by each area

Area	Total usage of seed (kg)*	Unit usage of seed (kg/ha)				Ratio of seed source (%)*		
		Annual*	WS**	DS**	EWS**	Self-collection	Other farmers	Material dealers
Irrigated	1,676	408.3	413.6	417.4	391.0	50	37	13
Rainfed	206	215.1	194.8	-	261.8	91	9	-

Source: Same as Table 1.

*Remarks: * Frequencies of farmers in the number of who practiced each crop, shown in the "N" column. If farmers use more than one type of irrigation, we count them for all. "Surface water" includes canals, ponds, lakes, and rivers; ** "Modern variety" is bred by IRRI and mainly cultivated in Vietnam, e.g., IR504 and OM5451. "Improved variety" is a pure line of traditional variety, which is generally processed by CARDI, e.g., Phka Malis and Phka Rumduol; *** Averages of the farmers producing rice in each cropping season.*

In terms of sources of rice seed, farmers in the irrigated area renewed half of their seed, but the main source of renewed seed was farmer-to-farmer transactions, and the proportion of rice seed procured from material dealers was only 13% (Table 5). In the rainfed areas, there were no farmers who bought rice seed from dealers, and most rice seed was produced by self-propagation. Even when

a new variety was introduced, most farmers in both areas bought seed from other farmers (Table 7). Table 8 shows farmers' perceptions of the negative effects of rice seed spoilage. Most farmers recognized the problems caused by the contamination of rice seeds by other varieties and weed seeds. Regarding variety mixture, while farmers in the irrigated area emphasized the reduction in yield, most farmers in the rainfed area mentioned difficulties in selling due to low grain quality.

Table 6 Rice production per seed use by each area and cropping season

Cropping season	Annual		WS		DS	EWS	
Area classification	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Irrigated	Rainfed
No. of farmers	40	40	20	39	35	15	13
Production per seed use (kg/1kg seed)	12.3*	16.0*	12.1**	17.0**	12.5	11.0	10.8

Source: Same as Table 1.
*Remarks: *p < 0.05 and **p < 0.01 on a paired t-test between Borei Cholsar and Tam Kak.*

Table 7 Transactions of new varieties' seed

Area	Counterpart	Buy in cash	Buy in kind	Ex-change	Gift
Irrigated	Farmer	16	2	5	9
	Supplier	14	1	1	0
	Government	4	0	0	2
	Others	1	0	0	0
	N**	27	3	6	11
Rainfed	Farmer	21	2	9	5
	Supplier	0	0	0	1
	Government	4	2	0	0
	Others	2	0	0	0
	N**	25	4	9	6

Table 8 Negative effects of contamination

	Reasons for negative effects*	BC**	TK**
By variety mixture	Low yield	25	7
	Difficult to sell	8	25
	Low price	1	2
	Difference of growth	0	3
	Others	0	3
By weed seed	Hard to control weed	17	27
	Increase of herbicide	13	3
	Low yield	7	3
	Difficult to sell	1	3
	Others	0	2

Source: Same as Table 1.
*Remarks: * Frequencies of farmers in the number of who practiced each crop, shown in the "N" column. If farmers use more than one type of irrigation, we count them for all. "Surface water" includes canals, ponds, lakes, and rivers; ** "Modern variety" is bred by IRRI and mainly cultivated in Vietnam, e.g., IR504 and OM5451. "Improved variety" is a pure line of traditional variety, which is generally processed by CARDI, e.g., Phka Malis and Phka Rumduol; *** Averages of the farmers producing rice in each cropping season.*

CONCLUSION

This study explored the actual situation of farmers' practices of rice seed procurement and use in an irrigated and a rainfed area, and discussed the concerns of rice production driven by farmers' practices. The situation of rice production was different between the irrigated and rainfed areas due to the accessibility of irrigation. Farmers in the irrigated area grew rice in both the wet and dry seasons, adopted modern varieties, and produced rice commercially. In contrast, farmers in the rainfed area produced rice only in the rainy season, using traditional varieties, and more than half of the production was used for their consumption.

Rice seed procurement and use practices also differed between the irrigated and rainfed areas. Farmers in the irrigated area used much more rice seed per unit of planted area and procured half of the seed from external sources: specified material suppliers and other farmers. On the other hand, farmers in the rainfed area mostly used rice seeds they collected themselves. Even though farmers in the irrigated area used the modern varieties and achieved higher land productivity than that in the rainfed area, the rice yield per seed use in the irrigated area was significantly lower than in the rainfed area. In addition, the yield per seed used in EWS in the rainfed area was also lower than in other seasons, and farmers cultivated modern varieties in this season. Therefore, the yield per seed use of modern varieties was lower than that of traditional and improved varieties among the farmers surveyed. The reasons for this situation were considered to be low quality and overuse of rice seeds. The farmers surveyed in both areas procured most of their seed through self-collection or farmer-to-farmer transactions, even when new varieties were introduced. Farmers recognized the following effects of using low-quality seed: reduced yield, falling farmgate prices, severe weed problems, and

increased use of herbicides. In addition, farmers in irrigated areas achieved high rice yields by increasing the planting density of modern varieties. In general, high planting densities interfere with plant uptake of light and nutrients. This is considered a major cause of low yield per seed input in the irrigated area.

In this study, we found the possibility that the benefits of modern varieties have not been fully demonstrated, and the situation was caused by the overuse of their seeds. If most farmers always use too much rice seed, meeting the demand for good quality seed becomes a difficult challenge for the government. In order to confirm this hypothesis, we need to conduct further studies on the sample representing the farmers growing modern varieties in the surveyed area.

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REFERENCES

Asian Development Bank (ADB). 2014. Improving rice production and commercialization in Cambodia, Findings from a farm investment climate assessment. Manila, Philippines, Retrieved from URL https:// www.adb.org/ publications/improving-rice-production-and-commercialization-cambodia

Chamroeun, M., Eliste, P., Stanelle, J.R. and Mak, S. 2015. Cambodia, Overview of a Cambodian seed sector, The International Bank for Reconstruction and Development in The World Bank, Washington, D.C., USA, Retrieved from URL https://documents.worldbank.org/en/publication/documents-reports/documentdetail /427071468188680084/

Cramb, R., Sareth, C. and Vuthy, T. 2020. The commercialization of rice farming in Cambodia. In White Gold: The Commercialization of Rice Farming in the Lower Mekong Basin, Springer Nature, St. Lucia, Queensland, Australia, 227-246, Retrieved from URL https://link.springer.com/book/10.1007/978-981-15-0998-8

Chhun, C., Vuthy, T. and Keosothea, N. 2020. The production, marketing, and export of rice in Takeo. In White Gold: The Commercialization of Rice Farming in the Lower Mekong Basin, Springer Nature, St. Lucia, Queensland, Australia, 247-260, Retrieved from URL https://link.springer.com/book/10.1007/978-981-15-0998-8

Food and Agriculture Organization (FAO). 2022. FAOSTAT, Rome, Italy, Retrieved from URL https:// www.fao.org/faostat/en/

Global Agricultural and Food Security Program (GAFSP). 2022. Strengthening rice production in Cambodia. Retrieved from URL https://www.gafspfund.org/news/strengthening-rice-production-cambodia

Kodo, T., Homma, K., Kobayashi, S., Yagura, K., Hor, S. and Kim, S. 2021. Effects of irrigation facilities development on cultivation management and productivity of rice in Cambodia, Implications based on comparison of adjacent irrigated and non-irrigated areas in Pursat Province. Japanese Journal of Southeast Asian Studies, 59 (1), 101-118, Retrieved from DOI https://doi.org/10.20495/tak.59.1_101(in Japanese)

The Asia and Pacific Seed Association (APSA). 2022. Cambodia seed industry news. Retrieved from URL https://web.apsaseed.org/news/cambodia-seed-industry