Research article

Factors Causing Deficits in Traditional Rice Liquor Production in Rural Areas of Cambodia

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Abstract Adding value to agricultural products is expected to play an important role in increasing income and reducing poverty in rural areas of Cambodia. The promotion of agro-processing is one of the key strategies for the value addition. A variety of processed foods produced by individual small-scale farmers have helped generate income, with the exception of rice liquor which has been faced deficits and low profitability. This study aimed to clarify the socio-economic status of rice liquor farmers in rural areas and to examine the factors leading to deficits and surpluses in rice liquor production. Data on the economic status of rice liquor farmers and non-rice liquor farmers were collected by conducting structured interviews using questionnaires at the targeted areas in Takeo Province. Comparisons of the income structures of the two groups revealed that the rice liquor farmers mainly depended for income on agricultural activities including rice liquor production and pig rearing, whereas non-rice liquor farmers depended on non-agricultural activities such as off-farm businesses, labor work, and remittances. Rice liquor production was less profitable, and around 30% of rice liquor farmers faced deficits in this activity. A comparison of the economic status between deficit and surplus operations of rice liquor production revealed the key factors that caused deficits, such as a low sales price, high cost of rice, low productivity, and high frequency of production failure. Rice liquor farmers expected improvements in the production techniques, in the quality and productivity of liquor. Thus, modifying production techniques to improve the quality and productivity of rice liquor, and to reduce the rate of production failure are the key strategies to increase the profitability of rice liquor businesses.

Keywords agro-processing, added value, traditional product, business improvement, Cambodia

INTRODUCTION

Adding value to agricultural products is expected to play an important role in increasing income and reducing poverty in rural areas. The promotion of agro-processing in rural areas has emerged as one of the key strategies to add value to local agricultural products (Royal Government of Cambodia, 2006; Royal Government of Cambodia, 2013). In rural areas of Cambodia, individual small-scale farmers have produced a variety of processed products, such as pickled vegetables, processed fish, traditional sweets, charcoal, and rice liquor (*sraa sar* in Khmer). The production of these processed foods, with the exception of rice liquor, has helped generate income for rural households; in contrast, rice liquor production has faced deficits and low profitability (Yagura et al., 2010). Instead, such producers have obtained profit from pig farming by reducing the cost of feeding pigs by using the by-products derived from the distillation of fermented rice (Vathana and Takeya, 2004; Yagura et

al., 2010). This production system kept pig farming profitable despite rice liquor operations staying in the red (Yagura et al., 2010). However, recent sales prices of pigs have been fluctuated in the Cambodian market due to increasing the imported pigs from Vietnam and domestic pig from large-scale farms. (Tornimbene and Drew, 2012). This situation have made the small scale rice liquor farmers with pig farming difficult to sustain their businesses in rural areas. It is significantly important to examine the strategies to improve profitability of rice liquor production.

The cultural norms and general production methods of alcoholic beverages from rice in Southeast Asian countries such as Vietnam and Laos have been clarified (Kozaki et al., 2002; Kozaki et al., 2005). The production methods of traditional brewed and distilled rice liquor in Cambodia were revealed by Kozaki (2007). Yamamoto and Matsumoto (2011) identified the production methods and raw materials of starter cultures for rice wine and rice liquor in Cambodia. However, there have been no studies which examined the economic issues and possibilities of the improvements in rice liquor productions.

OBJECTIVE

This study aims to clarify the socio-economic status of rice liquor farmers in rural areas and to examine the factors that lead to a deficit or surplus to come up with the strategies of the development in rice liquor production.

METHODOLOGY

This study attempted to clarify the socio-economic status of rice liquor farmers by comparing the farmers who were engaged in rice liquor production (rice liquor farmers) and those who were not (non-rice liquor farmers). Then, a detailed analysis was conducted by focusing on rice liquor production, including its economic and technical issues, to examine the factors that lead to deficit and surplus operations based on the economic analysis and the farmers‘ awareness.

In September 2008, structured interviews were conducted to understand the socio-economic status of farmers in six targeted communes consisting of 93 villages in Takeo Province, one of the areas where rice cultivation is most popular, given the region’s high productivity and quantity of produce (Hamano et al., 2013). The most popular communes in rice liquor production were selected as surveyed areas according to the key informant interview results to the officers of the provincial department and the district offices, commune chiefs, and village chiefs. These structured interviews were conducted using questionnaires. All rice liquor farmers in the six communes were interviewed. They were identified based on the information provided by key informants, such as village and commune chiefs, since the accurate official information on the number and locations of rice liquor producers were not found in governmental institutes. In all of the 93 target villages, a non-rice liquor farmer was randomly selected in each village for comparison in this study.

One of the questionnaires required rice liquor farmers and non-rice liquor farmers to identify their socio-economic status. The questionnaire sought the following information: details about the head of the household and his/her spouse; businesses operated by the farmers; and income generated from the businesses, including other agricultural and non-agricultural economic activities to identify the main bearers and sources of a household’s income. The other questionnaire was devised exclusively for rice liquor farmers in the region, and it consisted of questions designed to elicit detailed information about the production and sale of rice liquor to identify the factors leading to its deficit and surplus. The questions were designed to elicit the following information: the experience of producing rice liquor; the production process and frequency; the costs of raw materials and equipment needed for rice liquor production; production failures; sales price and amount of the product; and existing issues and areas of improvement in rice liquor production. Closed-ended questions were used to elicit answers regarding these issues and areas of improvement. The frequencies of keyword appearances as used by the farmers during their responses were also factored into the analysis. The farmers’ awareness was also examined to ascertain whether there were issues that significantly affected the production and business of rice liquor farming.

The Statistical Package for Social Science Student Version 16.0 was used to conduct the Mann–Whitney test to compare the averages of the parameters between rice liquor farmers and non-rice liquor farmers. The deficit and surplus operation groups involved in the production of rice liquor were also compared in the same way.

RESULTS AND DISCUSSION

Interviewees and Features of the Households

Table 1 shows the numbers of farmers interviewed for this study and the numbers of their valid responses that were factored into the analysis. The 93 villages (in the six targeted communes) in the region consisted of 13,548 households (National Institute of Statistics 2009). A total of 166 rice liquor farmers, spread across 56 villages, were interviewed, and 117 valid responses were obtained. In each village in the target areas, a non-rice liquor farmer was randomly sampled for the interviews, and 87 valid responses were obtained from them. Table 1 shows that the average age of the husbands of rice liquor farmers was 39.9 years old and the average age of the wives was 38.5 years old. These averages are approximately six years younger than the average ages of the non-rice liquor farmers. There was, however, no difference in terms of the size of the household. Table 1 also shows the average sizes of the paddy fields and rice yields of the rice liquor farmers and non-rice liquor farmers. Most of both rice liquor and non-rice liquor farmers (96.6%) produced rice as the main staple food. Rice liquor farmers cultivated rice in 1.12 hectares of paddy field and harvested 1.78 tons of rice yield on average, which are larger by 31.8% and 27.1% than the corresponding values of non-rice liquor farmers (0.85 hectares and 1.40 tons), respectively.

Table 1 Interviewees

	Rice liquor farmers[2]		Non-rice liquor farmers[3]		Sig.[4]
Valid responses[1]	117		87		-
Average age (years old) of husbands (n)	39.9	(110)	46.5	(78)	0.00**
Average age (years old) of wives (n)	38.5	(116)	44.8	(85)	0.00**
Average number of household members (n)	6.0	(117)	6.2	(87)	0.63
Average size (ha) of the paddy fields in wet season (n)	1.12	(113)	0.85	(84)	0.02*
Average rice yield (t) in wet season (n)	1.78	(113)	1.4	(84)	0.02*

Note: [1]Overall, 166 rice liquor farmers were interviewed; 117 valid responses were obtained. Moreover, 93 non-rice liquor farmers were interviewed; 87 valid responses were obtained.
[2]Rice liquor farmers: 7 female household heads and 1 male household head did not have a souse.
[3]Non-rice liquor farmers: 9 female household heads and 2 male household heads did not have a spouse.
*[4]The Mann–Whitney test was used to compare the averages between the rice liquor farmers and the non-rice liquor farmers. The average difference is significant at * 5% and ** 1% levels.*

The Economic Status of Rice Liquor Farmers and Non-rice Liquor Farmers in Rural Areas

Figure 1 shows the average annual incomes derived from all economic activities by both groups: the rice liquor farmers and non-rice liquor farmers. The average income of rice liquor farmers was found to be 5,601,000 Riel (R) (4,000 R = 1 U.S. Dollar), which was lower than the average income of non-rice liquor farmers of 5,980,000 R by 379,000 R (6.3%). A large proportion (73.8%) of the income obtained by rice liquor farmers came from agricultural activities, of which 26.5% came from agro-processing including rice liquor, 38.7% from animal husbandry, 7.2% from rice milling, and 1.4% from crop/vegetable productions. On the other hand, non-rice liquor farmers obtained 73.8% of their income through non-agricultural activities, of which 43.9% came from off-farm business enterprises such as grocery shops, food stalls, and small restaurants; 17.4% came from the paid work (employment) such as agricultural work, construction, and public services; and 12.5% came from remittance provided by family members who lived away from home. The higher average income of non-rice liquor farmers was a direct result of the difference of average remittance that the two groups

received, which was 608,000 R. Rice was cultivated by both groups mainly for self-consumption, even though some of the rice was sold on the market. In addition, the rice liquor farmers fed rice to their pigs. As a result of this, the sales revenue could not cover the production costs. The rice production resulted in a negative income of minus 315,000 R for rice liquor farmers and minus 147,000 R for non-rice liquor farmers.

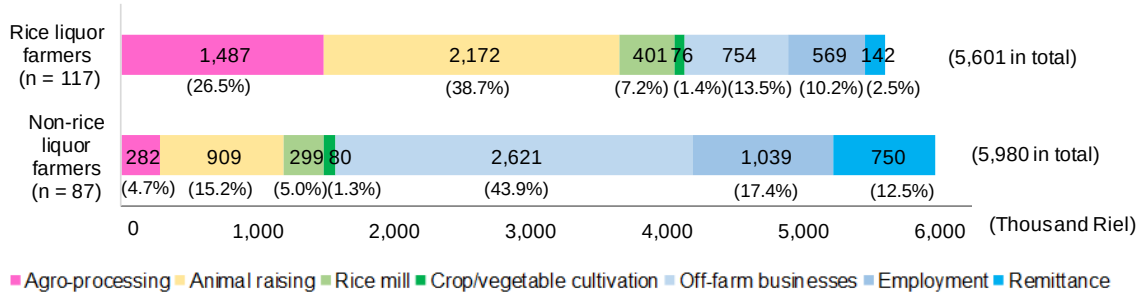

Fig. 1 Average annual incomes derived from economic activities

Table 2 shows the detailed figures of the average income structure from the related businesses practiced by rice liquor farmers and non-rice liquor farmers. The table shows details such as their annual revenue and income from each business, as well as the numbers of farmer who were engaged in. For the purpose of this study, the costs involved in family labor were not factored into the general costs. All 117 rice liquor farmers earned an average income of 1,364,000 R through the rice liquor production. Moreover, 31 out of the 117 households earned an additional 463,000 R by producing other agro-processed foods such as processed fish, palm juice and sugar, pickled vegetables, and traditional sweets. Of the 87 non-rice liquor farmers, 19 households earned an average income of 1,291,000 R through their involvement in agro-processing practices. The profitability of rice liquor, which was found to be 12.7%, was lower than the profitability of other agro-processing practices, which was found to be 39.8% for rice liquor famers and 46.5% for non-rice liquor farmers. All rice liquor farmers raised pigs, and the average income from pig rearing was found to be 2,012,000 R, and the profitability was found to be 55.6%. Most rice liquor farmers (107) also acquired an average income of 174,000 R through other animal husbandry involving cattle, chicken, duck, and fish, and the profitability was found to be 13.0%. A total of 26 non-rice liquor farmers obtained an average income of 649,000 R by raising pigs and 78 farmers obtained one of 798,000 R from other animal husbandry, the profitability of each of which was 54.1% and 33.6%, respectively. Forty rice liquor farmers obtained an average income of 1,172,000 R through rice milling; the profitability of this was found to be 38.3%. On the other hand, four non-rice liquor farmers obtained an average income of 6,495,000 R through rice milling, the profitability of which was 66.1%. For the latter, operating the rice mills was the main business, whereas for the former, rice milling was a secondary business.

Thirty-five rice liquor farmers and 31 non-rice liquor farmers sold surplus crops and vegetables such as maize, cucumber, pumpkin, watermelon, mung bean, sugarcane, cassava, and sweet potato, and their average incomes were 253,000 R and 225,000 R, respectively. Most rice liquor farmers and non-rice liquor farmers produced rice mainly for self-consumption, although 21 rice liquor farmers (18.6%) and 25 non-rice liquor farmers (29.8%) sold some of their rice. The incomes of rice production were minus 327,000 R by 113 out of 117 rice liquor farmers and minus 152,000 R by 84 out of 87 non-rice liquor farmers. The rice liquor farmers used some of their rice for rice liquor production and feeding their pigs. Since they spent most of their time on rice liquor production and rearing pigs within their daily activities, they tended to spend more on the hiring of extra labor during the transplantation and harvesting of rice than the non-rice liquor farmers did. As a result, the deficit for rice among the rice liquor farmers was greater than that by the non-rice liquor farmers, although the rice fields of the former were 31.8% larger than those of the latter group (Table 1).

In terms of non-agricultural activities, 69 (59.0%) rice liquor farmers were engaged in non-agricultural activities, while the number was 80 (92.0%) for non-rice liquor farmers. In detail, 28 (23.9%) rice liquor farmers managed off-farm businesses and gained an average income of 3,152,000

R through them. The profitability of these businesses was found to be 19.6%. On the other hand, 37 (42.5%) non-rice liquor farmers gained an average income of 6,163,000 R through off-farm businesses, the profitability of which was found to be 31.1%. In this context, the average income of the latter was 96% more than the former's income, and the latter's profitability through these businesses was 59% more than the former's profitability. It was found that 32 (27.4%) rice liquor farmers were employed as agricultural labor, construction labor, and government staff. Their average income through these sectors was 2,082,000 R. Twenty-three (19.7%) rice liquor farmers received an average remittance of 723,000 R from family members who lived away from home. On the other hand, 36 (41.4%) non-rice liquor farmers received an average income of 2,510,000 R through employment, and 33 (37.9%) received an average remittance of 1,977,000 R. The latter's income through employment was 21% more than the former's income. The average remittance received by the latter was 173% more than the remittance received by the former.

In summary, these results indicate that rice liquor farmers obtain a large part of their income through pig husbandry and rice liquor farming, although the profitability of rice liquor production is low compared with that of their other businesses. On the other hand, non-rice liquor farmers depend on non-agricultural businesses more than rice liquor farmers.

Table 2 Income structures of rice liquor farmers and non-rice liquor farmers

Economic activities	No. of operating farmers		Rice liquor farmers			Non-rice liquor farmers			Sig. [1]	Sig. [1]
Annual revenue and income	Rice liquor farmers	Non-rice liquor farmers	Average revenue	Average income[2]	Profit-ability[3]	Average revenue	Average income	Profit-ability[3]	*Revenue*	*Income*
	No. (% [4])	No. (% [4])	Thousand Riels	Thousand Riels	%	Thousand Riels	Thousand Riels	%		
Agriculture										
Agro-processing										
Rice liquor	117 (100.0)	-	10,728	1,364	12.7	-	-	-		
Others	31 (26.5)	19 (21.8)	1,164	463	39.8	2,775	1,291	46.5	0.00**	0.05*
Animal husbandry										
Pig rearing	117 (100.0)	26 (29.9)	3,622	2,012	55.6	1,199	649	54.1	0.00**	0.00**
Others	107 (91.5)	78 (89.7)	1,339	174	13.0	2,374	798	33.6	0.34	0.04*
Rice milling	40 (34.2)	4 (4.6)	3,059	1,172	38.3	9,819	6,495	66.1	0.03*	0.02*
Crop/vegetable	35 (29.9)	31 (35.6)	349	253	72.5	258	225	87.2	0.72	0.87
Rice[5]	113 (96.6)	84 (96.6)	305	-327	-107.2	286	-152	-53.1	0.89	0.09
Non-agriculture[6]	69 (59.0)	80 (92.0)								
Off-farm businesses	28 (23.9)	37 (42.5)	16,112	3,152	19.6	19,846	6,163	31.1	0.39	0.04*
Employment	32 (27.4)	36 (41.4)	-	2,082	-	-	2,510	-	0.36	0.36
Remittance	23 (19.7)	33 (37.9)	-	723	-	-	1,977	-	0.00**	0.00*

Note: The interviews asked the information on the previous year. Questionnaires on agricultural businesses included cost and revenue information such as the price and amount of the purchased materials and equipment for one operation cycle. On non-agricultural businesses, information on daily sales and cost of products were asked. On employment and remittance, amount of salaries and remittances in one month or one year were asked.

*[1]The Mann–Whitney test was used to compare the averages of the revenues and incomes between the rice liquor farmers and the non-rice liquor farmers. The average difference is significant at * 5% and ** 1% levels.*

[2]The farmer's labor costs were not included. [3]Profitability (%) = Average income ÷ average revenue × 100.

[4]Proportion for 117 rice liquor farmers and 87 non-rice liquor farmers.

[5]Numbers (proportions) of rice liquor farmers and non-rice liquor farmers who sold rice: 21 (18.6%) and 25 (29.8%).

[6]Numbers (proportions) of rice liquor farmers and non-rice liquor farmers who were not involved in non-agricultural activities: 48 (41.0%) and 7 (8.0%). Numbers (proportions) of rice liquor farmers and non-rice liquor farmers who depended on a single non-agricultural activity: off-farm businesses for 17 (14.5%) and 19 (21.8%), employment for 20 (17.1%) and 19 (21.8%), and remittances for 12 (10.3%) and 21 (24.1%). Numbers (proportions) of rice liquor farmers and non-rice liquor farmers.

Characteristics of Deficit and Surplus Operations of Rice Liquor Production

Table 3 describes in detail the economic status of rice liquor production. The average income obtained from rice liquor production was 5,210 R per production batch. The average sales revenue was found to be 51,548 R, and the total production costs were found to be 46,338 R. The average production costs include the costs of raw materials, equipment, and the equivalent value of

production failure. Rice, the main raw material in this process, accounted for 81.7% of the total costs, and the starter culture (*mee sraa*), fuel, and equipment accounted for 5.5%, 4.0%, and 2.6%, respectively. The production failure equivalent was found to be 6.2% of the total costs.

Table 3 Comparison of the economic status of surplus and deficit operations of rice liquor production

Rice liquor farmers	Total farmers		Deficit group	Surplus group	Sig. [1]
	n = 117 (100.0%)		n = 37 (31.6%)	n = 80 (68.4%)	
Average	Amount	%	Amount	Amount	
1) Income (Riel/time)	5,210		-8,065	11,349	0.00**
2) Sales revenue (Riel/time) [2]	51,548		45,359	54,411	0.00**
(1) Sales price of liquor (Riel/L)	1,561		1,435	1,619	0.00**
(2) Sales amount of liquor (L/time)	33.2		31.4	34.0	0.09
3) Total production costs (Riel/time)	46,338	100.0	53,423	43,062	0.00**
(1) Rice cost (Riel/time) [3]	37,869	81.7	42,660	35,653	0.00**
a. Rice unit price (Riel/kg)	1,890		1,994	1,842	0.00**
b. Rice amount (kg)/time	20.2		21.6	19.6	0.04*
(2) Starter cost (Riel/time)	2,550	5.5	2,895	2,391	0.94
(3) Fuel cost (Riel/time)	1,850	4.0	2,532	1,534	0.04*
(4) Equipment cost (Riel/time)	1,204	2.6	1,252	1,183	0.02*
(5) Failure cost (Riel/time) [4]	2,865	6.2	4,084	2,301	0.05*
a. Failure frequency (time/year)	9.7		12.7	8.4	0.02*
b. Production frequency (times/year)	211		186	223	0.07
4) Experience (years)	7.1		6.3	7.4	0.32
5) Age of husbands	39.9		41.3	39.2	0.23
Age of wives	38.5		39.5	38.0	0.34

Note: The interviews asked the questions on rice liquor production including production cost and revenue (sales) information such as the price and amount of the purchased raw materials, and sales amount and unit price for one time production, equipment cost, production frequency, and experiences.

*[1]The Mann–Whitney test was used to compare the averages between the surplus and deficit groups. The average difference is significant at * 5% and ** 1% levels.*

[2]The average sales revenue$= \frac{1}{N}\sum_{i=1}^{N} ab_i$. *[3] The average rice cost*$= \frac{1}{N}\sum_{i=1}^{N} ab_i$.

[4] Farmers recognized production failure when retailers and consumers refused to purchase the liquor due to its poor quality (Failure cost/time = Revenue/time × Failure frequency/year ÷ Production frequency/year).

Thirty-seven households (31.6%) of the rice liquor farmers in the region faced a deficit of an average of minus 8,065 R in their operation, whereas 80 households (68.4%) earned a profit, of 11,349 R on average. For the deficit group, the average revenue through sales was found to be 45,359 R, which is 83.4% of the revenue earned by the surplus group (54,411 R). The average total production costs for the deficit group were 53,423 R, which is 12.4% more than the surplus group (43,062 R). In terms of revenue, the average sales price for the deficit group liquor was 1,435 R/L, which is 11.4% less than the sales price of liquor produced by the surplus group (1,619 R/L). The deficit group produced rice liquor at 31.4 L/batch, which is 7.6% less than the liquor amount of the surplus group (34.0 L/batch). In terms of production costs, the cost of rice for the deficit group was 42,660 R (79.9% of the total product costs), which was 20% more than the amount paid by the surplus group (35,653 R, 82.8% of the total product costs). The deficit group used 21.6 kg of rice per batch and purchased rice at 1,994 R per kg; these amounts were 10% and 8% more than those by the surplus group, respectively. The deficit group experienced production failure at a rate of 12.7 times per year, which is 51% more than the failure rate by the surplus group. For the deficit group, the loss incurred from such failure was equivalent to 4,084 R, which is 77% more than the loss for the surplus group, and constituted the second highest cost. On average, the deficit group produced rice liquor 186 times per year, which is 16.6% less than the value of the surplus group.

These results indicate that a low sales price, high cost of rice, and frequent production failure were the key factors that caused deficits for rice liquor farmers. Younger and more experienced rice liquor farmers produced rice liquor more frequently and also tended to earn a greater profit as a result.

Table 4 shows the conditions that characterize production failures. Keywords that were frequently encountered in responses pertained to "unsuccessful fermentation" characterized by acidic and spoiled smell/taste, bubble expansion of the fermented rice, and a "burnt smell". These results indicate that the failures typically occurred during the fermentation and distillation stages.

Table 4 Characteristics of production failure as identified by the farmers

Criteria	Frequency[1]	%
Unsuccessful fermentation[2]	59	46.8
Burnt smell	59	46.8
Low amount of liquor	6	4.8
Uncooked rice	2	1.6
Total	126	100.0

Note: [1]Frequent use of keywords in response to an open-ended question. Interviewees were asked to identify situations of "production failure"; 126 keyword appearances by 100 respondents were analyzed.
[2]Unsuccessful fermentation was characterized by "acidic" and "spoiled" smell/taste and bubble expansion of the fermented rice.

Issues and Areas of Improvement Identified by Rice Liquor Farmers

The issues identified by the rice liquor farmers who participated in this study are shown in Table 5. The areas in which they expected improvement are shown in Table 6. Closed-ended questions were used to elicit information about the two most important issues and expected improvement areas from the farmers. In terms of issues, the respondents most commonly mentioned expensive rice (55.5%), followed by the low quality of products (40.9%), low sales price (21.8%), scarcity and high cost of fuel (20.0%), and low volume of alcohol (18.2%). In terms of expected improvements, the respondents most commonly mentioned the production techniques (79.8%), followed by the quality of rice liquor (60.5%), sales price (23.7%), productivity (12.3%), and the cost of rice (4.4%). Among the 91 farmers who expected production techniques to be improved, 54 indicated that the quality of the rice liquor should also be improved simultaneously. These results indicate that rice liquor farmers place emphasis on improving production techniques, while also acknowledging the need to improve the quality of their product.

Table 5 Issues related to rice liquor production

Issues	Answers	% n = 110
Expensive rice	61	55.5
Low quality	45	40.9
Low sales price	24	21.8
Scarcity of fuel (expensive)	22	20.0
Low alcohol volume	20	18.2
Difficulties acquiring sanitary water	17	15.5
Late or incomplete payment by buyer	13	11.8
Production failure	10	9.1
Others	8	7.2
Total	220	

Note: A closed-ended question was used to ask interviewees to identify the two most important issues in rice liquor production. Total respondents: 110. Unavailable answers: 7

Table 6 Improvements farmers expected in rice liquor production processes

Improvements	Answers	% (n = 114)
Production techniques	91	79.8
Quality	69	60.5
Sales price	27	23.7
Productivity	14	12.3
Cost of rice	5	4.4
Marketing and sales	5	4.4
Packaging/bottling	4	3.5
Others	13	11.3
Total	228	

Note: A closed-ended question was used to ask interviewees to identify the two most expected areas of improvement. Total respondents: 114. No answers: 1. Unavailable answers: 2

Table 7 shows the keywords typically used by the farmers to characterize low-quality rice liquor. The most frequently used keyword was "acidic smell/taste" (37.9%), followed by "burnt smell/taste"

(22.0%). Other frequently used words included "watery taste," "spoiled smell/taste," "stimulus smell/taste," "cloudy," and "addition of industrial alcohol."

Table 8 compares the sales prices and number of production failures of the 45 farmers who answered that "quality" was one of the most important issues with those of the 65 farmers who did not in Table 5. The sales price of rice liquor for the former was 1,495 R per liter, which is 6.7% lower than the sales price for the latter. The former tended to experience more production failures. On average, they experienced failures 12.2 times per year, whereas the latter experienced failures 8.6 times per year. These results show that the farmers who experienced more production failures tended to recognize the poor quality of their products and, as a result, sold their rice liquor at a lower price.

Table 7 Characteristics of low-quality rice liquor

Characteristics	Frequency[1]	%
Acidic smell/taste	67	37.9
Burnt smell/taste	39	22.0
Watery taste (no smell/taste)	23	13.0
Spoiled/bad/strange smell/taste	13	7.3
Stimulus smell/taste	8	4.5
Cloudy	7	4.0
Addition of industrial alcohol	6	3.4
Others	14	7.9
Total	177	100.0

Note: The question aimed to identify the characteristics of low-quality rice liquor, as perceived by the farmers. Overall, 102 out of 117 respondents provided answers; the keywords were mentioned a total of 177 times. Fifteen respondents had no opinion. [1]Frequent use of keywords in response to an open-ended question.

Table 8 Comparison of the operational status between the farmers who answered that quality was an important issue and those who did not

Farmers' recognition of the poor quality as an important issue	Farmers who answered [1] (n = 45)	Farmers who did not answered [2] (n = 65)	Sig. [3]
Sales price (Riel)/L	1,495	1,592	0.15
Production failures (times)/year	12.2	8.6	0.26

Note: [1] Farmers who answered that "quality" was an important issue in Table 5.
[2] Farmers who did not answer that "quality" was an important issue in Table 5.
[3] The Mann–Whitney test was used to compare the averages between the two groups.

Comparisons of the income structures between the rice liquor farmers and non-rice liquor farmers revealed that the rice liquor farmers mainly depend for income on agricultural activities such as rice liquor production and pig rearing, whereas non-rice liquor farmers depend for income on non-agricultural activities such as off-farm business enterprises, labor work, and remittances from family members living elsewhere. However, producing rice liquor is not very profitable, and around 30% of rice liquor farmers faced deficits in their rice liquor business. Improving the economic benefits of producing rice liquor may help economically uplift rice liquor farmers.

Analysis of the economic status of the rice liquor farmers revealed the key factors that cause deficits in their rice liquor businesses. These factors included the low sales price of rice liquor, high cost of rice, and low productivity, such as more volume of raw rice, less volume of product, and higher rate of production failure.

Rice liquor farmers in rural areas expected improvements in the production techniques used and in the quality and productivity of liquor that they produce. Improving the quality of rice liquor may also enable the farmers to increase their sales price and reduce the frequency of production failure. Gaining more experience in terms of technique and management could improve the operational status of rice liquor farmers who are currently in a deficit in their business.

Thus, modifying production techniques to improve the quality and productivity of rice liquor and to reduce the rate of production failure are key strategies to improve the economic benefits of rice liquor production. Preventing production failures and improving productivity would directly decrease the costs and increase profitability. Solving the issues during fermentation and distillation that the farmers had noted could contribute to reducing production failures and improving the quality of their liquor by reducing low-quality characteristics such as an acidic or burnt smell/taste. If farmers had confidence in the quality of their product, they could increase its sales price, which would also increase their revenue.

CONCLUSION

This study has identified the factors that lead to deficits in the rice liquor business in rural areas of Cambodia. Technical modifications to improve the quality and productivity of rice liquor, and to reduce the likelihood of production failure, are key strategies to increase profitability.

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