



## Economic Impact of Rice Tractor and Combine Harvester Custom Services in Northwest Cambodia

**DALIN SUN\***

*Graduate School of Agriculture, Tokyo University of Agriculture, Japan  
Email: da.lin3019@gmail.com*

**TOMOHIRO UCHIYAMA**

*Faculty of International Agriculture and Food Studies, Tokyo University of Agriculture, Japan*

**NINA N. SHIMOGUCHI**

*Faculty of International Agriculture and Food Studies, Tokyo University of Agriculture, Japan*

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**Abstract** Agricultural machinery has become significantly important to carry out farm work and to address labor scarcity in Cambodia. However, rural areas face many challenges such as lack of farmers' improper machinery utilization and lack of skilled operators in order to implement agricultural mechanization. The effective use of tractor or combine harvester (CH) requires not only management knowledge and experience, but also proper the economic evaluation. This study aims to determine the potential of rice tractor and combine harvester custom service to create an economic advantage for the agricultural machinery owners. A survey of 28 tractor owners (group T), 21 CH owners (group CH), and 23 tractors and CH owners (group B) in Banan District, Battambang Province was conducted in March 2019. The result indicated that the annual custom service area by group T, CH, and B were 133.4 ha, 213.1 ha, 398.9 ha (tractor 180.8 ha, and CH 216.1 ha), respectively. The average operating cost was estimated at 30.0 USD/ha for group T, 58.9 USD/ha for group CH, and 26.2 USD/ha (tractor) and 56.3 USD/ha (CH) from group B. Among the costs incurred, depreciation cost was the highest cost, followed by diesel and labor costs. In some cases, owners tend to offer higher pay to skilled operators to work for them especially during the peak seasons. The break-even point per year were estimated at 116.4 ha for group T, 117.5 ha for group CH, and 113.0 ha (tractor) and 109.6 ha (CH) for group B. In general, custom service by group seemed to vary on the field and infrastructure conditions, operators' skill, frequently machine breakage, and owners' desire to gain profit. Therefore, this study suggests that the owners should prolong the economic life of tractors or CHs by conducting proper and regular maintenance that will eventually lead to decrease break-even area.

**Keywords** tractor, combine harvester, custom service, operating cost, break-even point, payback period

### INTRODUCTION

In some areas of Cambodia, rice farming system has been changed in agricultural sense from single cropping to double cropping per year and transplanting method to direct seeding method. Also, the use of animal powers has been declined from 47% in 2001 to 33% in 2013 (Chhim et al., 2015). Due to urbanization, the size of rice cultivated land has been reducing, and productivity is also declining due to non-availability of inputs such as fertilizers, labor inputs, and machineries. According to Ministry of Agriculture Forestry and Fishery (MAFF) Cambodia, the total labor force was decreasing from 57.6% in 2009 to 45.3% in 2014.

Agricultural machinery has played a significant role in increasing agricultural production by completing farm operations in time, reducing production costs, and address labor scarcity (Chan et al., 2014). Currently, Cambodia has imported hundreds of modern farm machineries to enhance land preparation or harvesting proportionally. The number of tractors increased 5-fold from 2,602 units



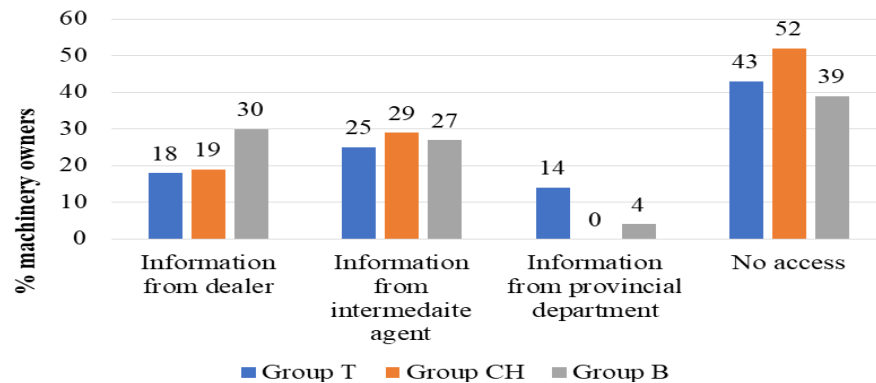
## General Characteristics of Respondents

The 72 respondents were categorized into three groups: namely group tractor (T) has 28 tractor owner-farmers, group combine harvester (CH) has 21 CH owner-farmers, and group both (B) has 23 tractors and CH owner-farmers. Table 1 show average age of the owners was 40 years, with at least 14 years in farming experience. There is no significant difference between those groups.

**Table 1 General characteristic of machinery owners**

Items	Group T	Group CH	Group B
n	28	21	23
Average family size (persons)	3.8	4.0	3.5
Average member involves in rice farming (persons)	1.8	2.1	2.0
Average age (years old)	43.4	42.1	44.6
Average farm experience (years)	14.9	14.2	16.1
Education background (years)	7.8	7.5	7.3

Source: Field survey, 2019



**Fig. 2 Percentage of machinery owners accessed to information**

In this study, approximately 20% of machinery owners have attended training programs related to tractor and CH at least one time a year. According to the interviewed owners, training programs are related to managing, maintenance and repair, and operation of machinery properly, which is usually provided by the Kubota dealer. Yet, there was no training provided by the provincial department or extension workers.

The rate of machinery owners' access to information related to tractor and CH is still limited. Those three group owners commonly received the information from intermediate agents, such as neighbor farmers, friends, and relatives, and some received information from the dealer rather than from the provincial department (Fig. 2).

## Tractor and Combine Harvester Utilization

In the survey area, most tractors and CH worked seasonally with an average of 200 days/year. The variation of working days between tractor and CH is due to differences in local climatic conditions and land conditions. Tractors work mostly concentrated on land preparation (plowing, harrowing, and rotavating) and the working hours about 7 to 8 hours/day with an average capacity of about an hour/ha. CH work focused only on rice harvesting and frequently can harvest at least 4 to 5 ha/day (about 2 hours/ha).

Table 2 shows that total annual utilization of group T was from the owners' farm (40%) and remaining (60%) was custom service. Group CH, approximately 85% of CH was from custom service. Besides, annual utilization of a tractor and CH on group B owners' farm was 36% (tractor), and 28% (CH), and remaining from custom service. This result means that tractor or CH owners only offered custom service during the rice cropping season and after they completed with their farm. Aside from that, machines are stored in the shed or parked in open area when they not in use.

**Table 2 Average annual use per tractor and CH by group machinery owners**

Items	NHH	Average operated land (ha)	%
Group T	28	133.4	
Own farm		53.0	40
Custom service		80.4	60
Group CH	21	213.1	
Own farm		31.0	15
Custom service		182.1	85
Group B	23		
<i>Tractor</i>		181.2	
Own farm		65.6	36
Custom service		115.6	64
<i>Combine harvester</i>		216.1	
Own farm		60.6	28
Custom service		155.5	72

Source: Field survey, 2019

### Total Cost of Tractor and Combine Harvester Custom Service

Table 3 shows average annual operating cost, which calculated both custom service and the owners' farm. Tractors and CH operators are the owners, owners' relatives, or hired operators. Approximately 80% of tractor and CH operators are hired operators who have reimbursed on a hectare basis. Machinery owners commonly contracted operators during land preparation and harvesting. Sometimes machinery owners tend to offer higher pay to skilled operators to work for them, especially during peak seasons.

**Table 3 Average operating cost per tractor and CH operation**

Items	Group T	Group CH	Group B	
	Tractor	CH	Tractor	CH
Annual operated land (ha)	133.4	213.1	180.8	216.1
a. Fixed cost (USD)	1,832.0	5,574.9	1,895.7	5,205.0
b. Variable cost (USD)	2,169.7	6,981.8	2,841.6	6,963.4
Repair	60.0	423.4	89.0	296.9
Operators	388.7	1,291.3	509.5	1,597.2
Diesel	1,648.2	5,133.6	2,164.8	4,971.7
Commission broker	72.8	133.5	78.3	97.6
c. Total annual cost (c=a+b)	4,001.7	12,556.7	4,737.3	12,168.4
Total operating cost (USD/ha)	30.0	58.9	26.2	56.3

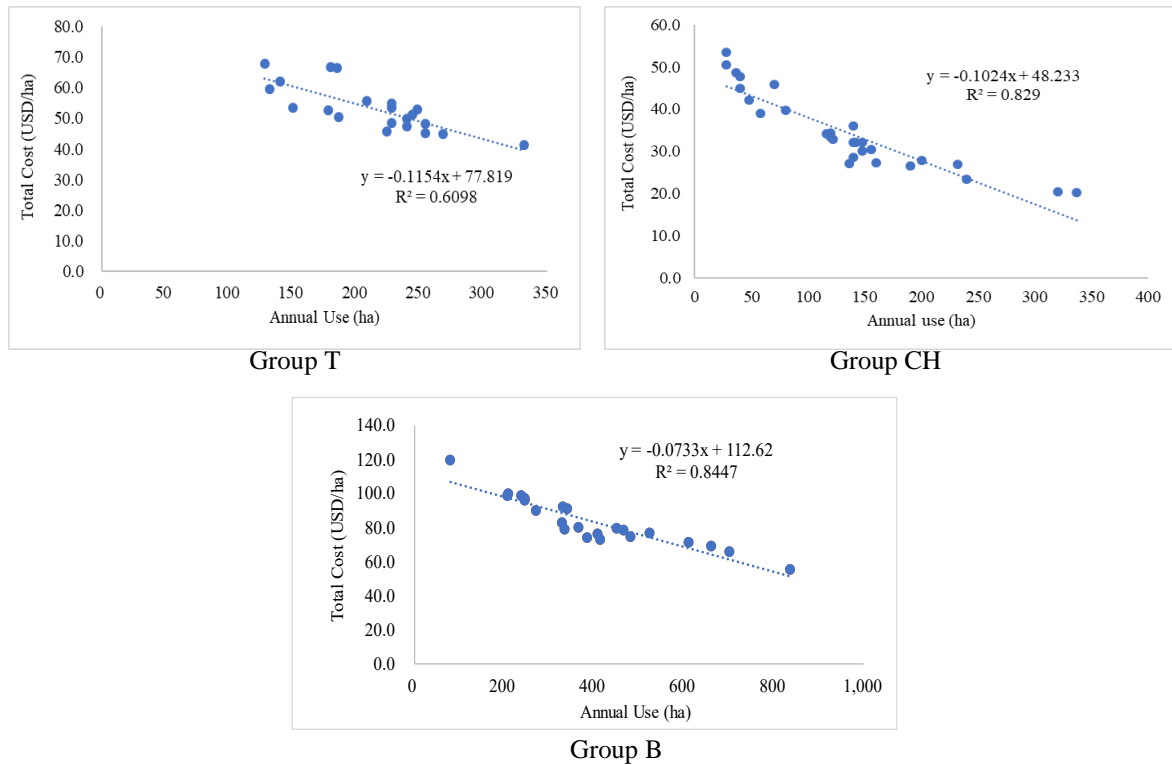
Source: Field survey, 2019

Note: Fixed cost consists only depreciation

As a result, average operating cost was estimated at 30.0 USD/ha for group T, 58.9 USD/ha for group CH, and 26.2 USD/ha (tractor) and 56.3 USD/ha (CH) from group B. Diesel is the highest single cost of total variable cost, followed by labor and repair cost. The higher cost of diesel and repair may be due to differences in machine age, annual use, operator skill as well as field conditions. Few machine owners revealed that they commonly did not use the aging tractor or CH for providing custom service because of low power and high risk of failure.

Fig. 3 presents the relationships between total operating costs per hectare and the annual use of three group owners. In order to derive a function for each cost, the least-squares regression method was used to determine the best fit function. The total operating cost is taken as the dependent variable (y) and annual use rates as the independent variable (x). The curves describe in terms of data points related to the above cost items per hectare to annual hectares of use. The r square value could explain at 83% and 84% of the observed variations in group T and B, respectively. This result indicated that there is a significant contribution to the annual use of decreasing total costs. The total operating costs

of machinery owners per hectare show a quick decline with an increase in annual use. The result suggests that there is a great potential to reduce total operating costs by increasing annual use (ha).



**Fig. 3 Relationships between total cost per hectare and annual use**

**Service Charge and Profitability of Tractor and Combine Harvester Custom Service**

Normally, farmers contacted machine owners before any operations to secure their place to be available on time. In addition, farmers usually asked the same custom service providers of the previous year because they have been satisfied with that service. But in some emergency cases, farmers made decision to choose a new custom service provider who can respond to their needs.

The service charge of ploughing ranged from 25 USD to 29 USD per hectare, and rotavating ranged from 27 USD to 33 USD per hectare. The harvesting operation depends on the rice varieties and season (wet and dry season). The service charge of wet season rice varieties is about 85 to 90 USD per hectare, while the price of dry season rice varieties ranged from 68 to 80 USD per hectare.

In some cases, it found that the rate of harvesting service was a bit higher than the average estimated. The reasons were that rice stalks are bent and difficult to harvest, so hiring farmers had to pay higher rates according to an agreement made by farmer and machinery owners.

**Table 4 Average profitability per tractor and CH operation**

Items	Group T		Group CH		Group B	
	Tractor	CH	Tractor	CH	Tractor	CH
Annual operated land (ha/year)	133.4	213.1	180.8	216.1		
<b>Service charge (USD/ha)</b>	<b>32.0</b>	<b>80.2</b>	<b>32.5</b>	<b>79.7</b>		
Annual revenue (USD/year)	4,268.8	17,090.6	5,876.0	17,223.2		
Annual cost (USD/year)	4,001.7	12,556.7	4,737.3	12,168.4		
Annual profit (USD/year)	267.1	4,533.9	1,138.7	5,054.8		
<b>Profit (USD/ha)</b>	<b>2.0</b>	<b>21.3</b>	<b>6.3</b>	<b>23.4</b>		
Break-even area (ha/year)	116.4	117.5	113.0	109.6		
Payback period (years)	11.9	3.4	8.2	3.6		

Source: Field survey, 2019

Table 4 presents the average profitability per tractor and CH operation. As a result, group T, CH, and B received a profit from the operation were roughly 2 USD/ha, 21.3 USD/ha, and 29.7 USD/ha (tractor 6.3 USD/ha, CH 23.4 USD/ha). Moreover, the annual utilization of tractor and CH required for economic feasibility was evaluated using break-even analysis. The result indicated that the break-even areas per year were estimated at 117.4 ha for group T, 117.6 ha for group CH, and 112.8 ha (tractor) and 109.8 ha (CH) for group B. This means that after an additional hectare of either tractor or CH used would make a profit for the owners. Moreover, the payback period was estimated to be at 11.9 years for group T, 3.4 years for group CH, 8.2 years (tractor) and 3.6 years (CH) for group B to earn back investment.

## **CONCLUSION**

There were no significant differences in characteristic respondents and approximately 20% from three group owners aware of training programs about tractor and CH, which is usually conducted by the dealer. Yet, there were no training programs on proper management, repair, and operate machinery provided by extension workers or department of agriculture engineering.

Generally, farmers contacted machine owners before any operations to secure their place to be available on time, and they usually asked the same service providers of the previous year. Among the operating costs incurred, depreciation cost was the highest cost, followed by diesel and labor costs. In some cases, machinery owners tend to offer higher pay to skilled operators to work for them, especially during the peak seasons. Regarding profit, the utilization of tractor and CH under current conditions was profitable for machinery owners. Three group owners should increase annual use beyond the break-even areas by providing more custom service to other farmers in order to earn back the investment on tractors or CH. This result suggests that the break-even area and payback period analysis can also give an indication for farmers to decide whether to purchase a new tractor or combine harvester or ask more custom service.

Therefore, this study recommends that the owners should prolong the economic life of tractors or CHs by conducting proper and regular maintenance that will eventually lead to shorten the break-even areas and payback period in order to gain more profit. Additionally, the government or private company should provide special training programs for the machine operators, farmers, and mechanical extension officers on proper management, repair, and operation. Also, the local government should setup the formula for ensuring the fair prices of the custom service.

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