

## **Cost Benefit Analysis in Adaptation of Rice Combine Harvester Entrepreneurs.**

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### **Abstract**

For the first time, NakhonSawan rice farmers changed their farm production from rice to maize during the 2015 drought. This development affected also many businesses along the rice supply chain, including the rice combine harvester service which was heavily affected from the reduction of rice farming areas. Quick to respond, rice combine harvester entrepreneurs in NakhonSawan began switching to harvester headers for maize, to be in line with the suddenly growing demand for maize harvest service in the area. This phenomenon led to a research question that whether to adapt or not adapt to the change would be more profitable for these entrepreneurs. This paper aims to first examine the principle of the rice combine harvester service. Then it attempts to analyze three different scenarios using cost-benefit analysis to determine the optimal choice for the entrepreneurs during drought. The first scenario is under the normal condition where drought is not a factor. The second scenario takes drought into account but the entrepreneurs choose not to adapt. The final scenario is where entrepreneurs choose to adapt with farmers during drought. Data are analyzed assuming the business's lifetime is 10 years and each entrepreneur uses just one rice combine harvester. Cost-benefit analysis is then utilized to obtain net present value (NPV), internal rate of return (IRR), and benefit-cost ratio (B/C ratio). Results show that all three scenarios are profitable, with the third scenario being the most worthwhile in all three indicators.

**Keywords:** Rice combine harvester, Cost-benefit analysis, Adaptation, Mechanization, Investment feasibility.

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## Introduction

Rice production in Thailand was traditionally labor intensive, where rice farmers formed groups and handpicked their harvest. However, a recent trend in the agricultural sector shows a migration of labor to the industrial and service sectors (National Statistic Office, 2011). This results in not only a labor shortage but also higher costs accrued to farmers. Rich farmers then, in turn, started to employ rice harvesting machines to solely harvest rice. Seeing the effectiveness of said machines, other farmers asked these rich farmers to provide them the service. This inspired many other rich farmers to follow suit and thus turned it into a business. Later on, these farmers-turned-entrepreneurs upgraded their machines by adding the thresher for rice grain, turning them into combine rice harvesters.

Nantajit (2016) finds the following: on average, a combine harvester owner in Central Thailand charges 500 baht per rai and provides the service four times a year in all regions, depending on the season in each region. Normally, an entrepreneur can earn as much as 1,483,221.63 baht per year. However, this business is costly for low income stakeholders in the agricultural sector. For entrepreneurs, the main cost comes from the prices of large rice combine harvesters which range from 1,800,000 - 2,400,000 baht each. Large combine harvesters can harvest rice grain for a maximum of two and a half tons. The machines have limited on-road mobility and are often carried by trailer trucks, which add an extra cost of 1,166,666.67 baht per truck. Variable costs include maintenance of more than 100,000.00 per year, wages paid to the harvester and trailer drivers, fuel, and bribery to checkpoint guards.

The drought in November 2015 caused a significant impact to the Thai agriculture nationwide. Rice production, especially near the Chao Phraya River in Central Thailand, was reduced to two crops from the usual three crops where the farmers would normally grow one wet season and two dry season crops. The 2015 drought severely affected rice production to the point that the Thai government prevented rice farmers from planting the second dry season crop. Rice harvest areas during the dry season were reduced from 6,241,763 rai in 2014 to 3,250,844 rai in 2015 or a 47.92% decline (Office of Agricultural Economics, 2016). The incident forced rice farmers near the Chao Phraya River in Nakhon Sawan to change their behavior by planting drought-resistant crops, such as, maize or mungbean for their third rice crop. This change also led the rice combine harvester service entrepreneurs to expand their service to cover more crop variety.

## Objectives

This paper aims to 1) examine the principle of the rice combine harvester service and 2) to answer whether an entrepreneur should adapt to the sudden crop change or not by analyzing three different scenarios using cost-benefit analysis: i) under the normal condition where drought is not a factor, ii) drought is taken into account but the entrepreneur does not adapt with farmers, and iii) the entrepreneur chooses to adapt during drought.



## Method

The research uses primary data to answer the first objective. The data were collected through six in-depth interviews with entrepreneurs in NakornSawan province. Each interview focused on service operation, costs and earnings – such as, service prices, number of services given per season, prices of combine harvesters, maintenance costs, wages for drivers, etc. The entrepreneurs were also asked to share problems and risks associated with this business.

The paper utilizes cost-benefit analysis or project investment analysis to answer the second objective, since combine harvesters are considered to be a long time investment. Cost-benefit analysis tools utilized in this paper include net present value (NPV), internal rate of return (IRR), benefit-cost ratio (B/C ratio), and discounted payback period.

Net present value (NPV) is the difference between present value of the benefit and cost of project. The formula of NPV is as follows:

$$NPV = \sum_{t=0}^n \frac{B_t - C_t}{(1+r)^t}$$

Where

$B_t$  = benefit during period t

$C_t$  = cost during period t

r = interest rate or discounted rate

n = lifetime of project

t = number of time period 1,2,3....n

Benefit-cost ratio (or B/C ratio) is defined as the present value of benefit divided by cost:

$$BCR = \frac{\sum_{t=1}^n \frac{B_t}{(1+r)^t}}{\sum_{t=1}^n \frac{C_t}{(1+r)^t}}$$

Investopedia (2016) refers to internal rate of return (or IRR): a metric used in capital budgeting measuring the profitability of potential investments. IRR is a discount rate that makes the net present value (NPV) of all cash flows from a particular project equal to zero.

Investment analysis criteria for an investment decision are given in table 1:

Table 1 Criterion of NPV B/C ratio and IRR for investment decision.

Feasibility of investment	NPV (baht)	B/C ratio	IRR (%)compare with loan interest rate
Worth investment	+	>1	> loan interest rate
Normal profit investment	0	=1	= loan interest rate
Not worth the investment	-	<1	< loan interest rate

Source: Piputsitee (2001)

Investopedia (2016) refers to discounted payback period (DPB): a capital budgeting procedure used to determine the profitability of a project. A discounted payback period gives

the number of years it takes to break even from undertaking the initial expenditure, by discounting future cash flows and recognizing the time value of money.

The study assumes the lifetime of the project is 10 years and uses an interest rate of 7%, which is the loan interest rate at the Bank of Agricultural and Cooperative. Another assumption is that the entrepreneur uses just one rice combine harvester. Only the risk from drought is taken into account, while other risks are assumed to be non-factors.

Under the First Scenario, each combine harvester can harvest in NakhonSawan and nearby areas around 616.67 rai in August (first crop), 566.67 rai in December and April(second and third crops), and can harvest in the Northeast around 1,000 rai in November. The entrepreneur in this scenario earns 1,444,171.50 per year. Under the Second Scenario, the entrepreneur is faced with drought, in which rice farmers cannot grow their third crop rice. The entrepreneur in this scenario earns 1,160,836.50 baht per year, a decrease of 19.62% from the First Scenario. The Third Scenario allows the entrepreneur to service maize farmers during drought 1,000 rai per year, yielding the highest benefit among the three scenarios or 1,660,836.50 baht per year (see Table 2).

Table 2 Compare benefit from each scenario.

Harvest activities	First Scenario			Second Scenario			Third Scenario		
	Service price (baht/rai)	Service areas (rai)	Benefits (baht)	Service price (baht/rai)	Service areas (rai)	Benefits (baht)	Service price (baht/rai)	Service areas (rai)	Benefits (baht)
First crop	450	616.67	277,501.50	450	616.67	277,501.50	450	616.67	277,501.50
Second crop	500	566.67	283,335.00	500	566.67	283,335.00	500	566.67	283,335.00
Third crop	500	566.67	283,335.00	-	-	-	-	-	-
North east area	600	1,000.00	600,000.00	600	1,000.00	600,000.00	600	1,000.00	600,000.00
Maize harvest	-	-	-	-	-	-	500	1,000.00	500,000.00
Benefit summarize			1,444,171.50			1,160,836.50			1,660,836.50

Source: from study

## Findings

In NakornSawan, most entrepreneurs own one to three large combine harvesters, assembled at local factories and each costing around 2,386,666 baht. To get to a farm, a harvester is placed on a large trailer truck, accruing to the entrepreneurs another 610,000 baht for a second-hand trailer truck. The harvester and the trailer also require heavy maintenance with the cost for repair rising yearly and accounts for 19% of the total fixed cost throughout the 10-year period.

Generally, Central farmers who wish to use the service would contact the entrepreneurs themselves to reserve a time slot. However, limited by the distance, entrepreneurs who want to extend their business to the Northeast (mostly in the provinces of Khonkaen, RoiEt, Kalasin, Surin, and Burirum) must hire agents to expand their reach in the region. A common commission rate for an agent stands at 50 baht per rai, and in return, the agent is also responsible for collecting payment from farmers and providing accommodations to the harvest team.



A harvest team includes a minimum of two people – one to drive the trailer and the other to operate the harvester. Their wages are 17.50 baht and 35 baht per rai, respectively. At 17.50 baht per rai, the trailer driver also becomes a handyman while the harvester is in operation. The harvest team is also given an additional 10,000 baht for not only fuel, but also bribery for “passing certain checkpoints<sup>1</sup>” en route to Northeast.

On average, a rice harvester can harvest up to 2.5 tons of rice for the maximum of 20 rai per day, costing an additional 122 baht per rai for fuel. For more details on costs, see Table 3.

In terms of earnings from Central farms, in one year, a harvester can service around 616.67 rai in the wet season for 500 baht per rai, and can service 1,133 rai in the dry season for 450 baht per rai. For Northeastern farms, however, with 1,000 rai available for each harvester, entrepreneurs charge on average 600 baht per rai (see Table 3).

Table 3 Cost - Benefit of combine harvester service in NakhonSawan province

Cost - Benefit of combine harvester service in NakhonSawan province		
	Mean	SD
<b>Fixed Cost</b>		
Combine harvester:Price (Baht/car)	2,386,666.67	185,831.46
Maintenance year 1-2 (Baht/year)	80,000.00	-
Maintenance year 3-5 (Baht/year)	140,000.00	-
Maintenance year 6-8 (Baht/year)	200,000.00	-
Maintenance year 9-10 (Baht/year)	250,000.00	-
Trailer:Price (Baht/car)	610,000.00	288,097.21
Maintenance year 1-5 (Baht/year)	30,000.00	-
Maintenance year 6-10 (Baht/year)	40,000.00	-
Garage (Baht)	45,000.00	-
Land for garage (Baht)	50,000.00	-
<b>Variable Cost</b>		
Combine harvester driver (Baht/Rai)	35	8.66
Trailer driver (Baht/Rai)	17.5	3.54
Combine harvester fuel (Baht/Rai)	113.3	32.17
Trailer fuel (Baht/Rai)	9.44	5.09
Agent commission in Northeast (Baht/Rai)	50	-
Travel to Northeast (Baht)	10,000.00	-
<b>Revenue</b>		
Wet season harvest area (Rai)	616.67	104.08
Wet season service price (Baht/Rai)	450	-
Dry season harvest area (Rai)	1,133.33	461.88
Dry season service price (Baht/Rai)	500	-
Northeast harvest area (Rai)	1,000.00	-
Northeast service price (Baht/Rai)	600	-
Combine harvester salvage value (Baht)	800,000.00	-
Trailer salvage value (Baht)	350,000.00	-
Garage salvage value (Baht)	10,000.00	-

Source: from study

<sup>1</sup> Information from interviews with entrepreneurs

Furthermore, based on the interviews, the paper finds that farmers and entrepreneurs are faced with the same types of risks. One main risk is caused by natural disasters, such as, flood and drought. With flood, entrepreneurs are left with no alternative options than to halt all operations. During a drought, however, entrepreneurs now have a new option, thanks to the farmers who sparked the idea of switching to drought-resistance crops. In NakhonSawan in particular, maize is becoming more popular due to the newly operated animal industry. Pressured by severe drought in 2015 and from the government not allowing the farming of dry season rice, farmers were forced to explore the next best crop, which was maize. At that time, local machinery factories saw the opportunity to sell maize headers to the rice harvester entrepreneurs (see Figure 1) for 600,000 baht per header.

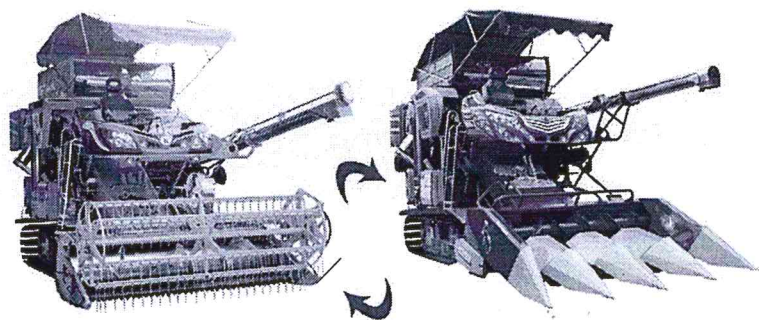


Figure 1 Rice combine harvester's transformation to maize combine harvester  
Source: Kasetphattana (2016)

To examine whether an entrepreneur should adapt to the sudden crop change or not, cost-benefit analysis has been utilized and the results are given in Table 4.

Table 4 Result of the Three Scenarios.

	First Scenario: Normal	Second Scenario: Drought	Third Scenario: Drough+Adapted
NPV	2,488,674.09	1,361,680.42	3,053,793.60
IRR	20%	10%	21%
B/C ratio	1.31	1.18	1.33
Discount payback period	4 years 9.5 months	6 years 10 months	4 years 8 months

Source: from study

Under all scenarios, investment in a large combine harvester is worthwhile. Project management analysis suggests that the third scenario yields most favorable results. The net present value under this scenario is better than that of the second scenario by approximately 1,692,113 baht or as high as 124%. Internal rate of return under the third scenario also implies that it is more desirable than no doing anything. Benefit-to-cost ratios for scenarios two and three are positive, but the third scenario yields a much higher ratio of 1.33, compared to 1.18.



## Conclusion

NakhonSawan combine harvester service entrepreneurs capitalize on the two largest rice farming markets in Central and Northeastern Thailand. On average, an entrepreneur owns one to three combine harvesters and requires a trailer truck to transport a harvester. Not only are these vehicles expensive to purchase, they are also costly to maintain. To reach the Northeast market, namely Khonkaen, RoiEt, Kalasin, Surin, and Burirum, the entrepreneur must hire an agent. Employing a harvest team of two adds an additional labor cost accrued to the business owner. Furthermore, there are extra costs, such as, fuel and bribery.

In terms of earnings from Central farms, in one year, a harvester can service around 616.67 rai in the wet season and can service 1,133 rai in dry season. For Northeastern farms, each harvester gets an average 1,000 rai per year.

Entrepreneurs and farmers also face the same risk of encountering a natural disaster. In the case of a drought, farmers in NakhonSawan have begun switching crops to the more drought-resistant types with maize being the most popular. Entrepreneurs then have the option to adapt to this change and switch to the maize header. The results from this study show that entrepreneurs should adapt since they will get much higher benefits than not adapting.

Note that this paper is limited by its assumption that the drought period occurs yearly during the lifetime of the project. A trend of drought occurrences should be used to forecast scenarios future chances to encountering drought, thus modifying scenarios two and three. To broaden this study, other provinces or regions should also be observed.

Nevertheless, this study shows that rice harvest entrepreneurs benefit greatly from the recent crop change. However, without the technology to switch headers for other crops, the entrepreneurs would not be able to reap the full benefits during drought. Even more so, farmers who switched crops would also suffer from the harvest labor scarcity. This study has found evidence that a problem with the supply chain can also directly and indirectly affect farmers just as much. If the government really wants to support the farmers, it needs to be worry of the supply chain too. The government should also be ready to guide the players in the market at times of changes.

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