

DESIGN, FABRICATION AND PERFORMANCE EVALUATION OF MECHANIZED PADDY GATHERER

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ABSTRACT

This study aimed to design, fabricate, and evaluate a mechanized paddy gatherer to lessen the labor cost and time spent in gathering the paddy. Performance evaluation of the machine was based on its capacity (cavan/hr), efficiency (%), economic feasibility and its comparison with the manual or traditional use of paddy gathering.

Evaluation was done in three (3) trials at 50 cavans per trial. Fuel consumption and number of cavan per man-hour was recorded. Results revealed that the machine has a capacity of 110 cavans/hour, far much higher than the traditional or manual use of paddy gathering with 52 cavans/hour. In terms of efficiency, the paddy gatherer has an efficiency comparable to the traditional use with 97.71% and 97.98%, respectively. Its operation cost is only PhP1.18/cavan that includes the labor cost, fuel and lubricants, depreciation charge, repair and maintenance while the cost of operation in traditional way is PhP 3.00/cavan which only includes labor cost.

The cost of machine is approximately PhP 27,598.00 for labor, materials and engine. The computed return of investment (ROI) is 81.55% and payback period is 13.2 months.

INTRODUCTION

Paddy farmers and traders have options with regards to paddy handling. Some can sell it immediately after threshing without the benefit of drying while others can perform drying operations to take advantage of the higher price paid for dried paddy. Drying of paddy assumes that there are available drying facilities and that the conditions are favorable for such an activity.

Farmers and traders commonly exercise the process of drying on flat exposed surfaces after harvesting and threshing (Mendoza, 1982). It is easy to

spread the paddy into the floor but it's too hard and consumes a lot of time to heap and sack the dried paddy. This method is acceptable only in small amount of wet paddy to be dried. But when large volume of paddy is to be collected or gathered, a lot of time and labor is needed.

In sun drying, it relies from the heat of sunlight and this method needs at least three to four persons to perform the drying operation. It takes a mean time of two hours to collect the 50 cavans of dried paddy from drying pavement and it spends 3.00PhP/cavan for collecting the dried paddy (Chiva and Cayapas).

Hence, this machine was designed and fabricated to minimize the time spent and labor cost in the gathering and bagging of dried paddy.

It specifically aimed to design and fabricate a mechanized paddy gatherer; test and evaluate its performance based on the capacity, efficiency (paddy gathered), economic feasibility and compare the economic significance of the machine to the manual gathering and bagging.

METHODOLOGY

Machine Description

The Motorized Paddy Gatherer is composed of six main parts: the frame assembly, conveyor cover, pulley, V-belt, motor and wheels. The machine has a dimension of 62 inches length, 25 inches width, and 34 inches height.

The frame assembly is made up of 1/4 x 1 angular bar which serves as a frame support to the whole structure of the machine.

Its conveyor is made up of a pair of belt that has a width of 4 in. and 10 ft. length each belt which is attached to a bucket with a length of 12 in. and 3 in. width. It has also a gauge 16 of Galvanized Iron (G.I.) sheet cover.

The pulley and V-belt are used in transmitting power and reducing and/or increasing power from the 5 Hp gasoline engine to the conveyor.

The wheel is made of rubber with a diameter of 6 inches. Three (3) pieces of rubber tire are used for easy transport and to operate the machine.

Machine Operation

This Motorized Paddy Gatherer used the conveyor principle to collect the dried paddy. The conveyor moves in clockwise direction and can be speed up by increasing the revolution of the engine.

The scattered paddy can be collected by pushing the machine on the drying pavement. The paddy will continuously move to the feeding hopper of the machine by the use of a conveyor.

Collection of Data

The drying thickness of paddy, the average walking speed of human, and the speed of the engine were considered as bases of analysis. For comparison, the mean capacity of manual gathering is determined through an interview with selected big rice millers and traders. Using 50 sacks of paddy to be collected the mean number of person, payment for labor and duration of manual gathering of dried paddy were determined.

Design Consideration

The Motorized Paddy Gatherer was designed using locally available materials. To attain better efficiency, it is designed to gather a large volume of paddy for reasonable production performance and ease in operation.

Machine Operation/ Process of Gathering

The Motorized Paddy Gatherer uses a belt conveyor to collect the dried paddy from the inlet hopper. As the conveyor rotates, the paddy is carried upward to the discharged hopper where the sack is located. When the sack is already full, it is removed and replaced with an empty one.

Manpower is needed for the forward movement of the machine and for the unloading of filled sack.

In testing the performance and capacity of the Motorized Paddy Gatherer, operators were categorized as non-skilled in collecting the dried paddy using the paddy gatherer and skilled in the traditional method or manual method.

Three non-skilled and skilled operators were employed during the evaluation. In determining the capacity (kg/hr) in both methods of gathering, they were given 50 sacks of paddy to be collected and the time spent in gathering was recorded.

The capacities tabulated were extrapolated from the capacity obtained in collecting 50 sacks of paddy. Each operator was given three trials.

The following formula was used during the performance testing and evaluation of the machine:

$$MC = \frac{SP}{T}$$

where:
MC = machine capacity
SP = no. of sack dried paddy
T = time spent

D. Sun drying / Traditional Method

$$MC_s = \frac{SP}{T_r}$$

where:
MC_s = Capacity using sun drying
T_r = time spent in paddy gathering
using traditional method

E. Motorized paddy gatherer

$$MC_m = \frac{SP}{T_m}$$

where:
MC_m = Capacity of motorized paddy
gatherer
T_m = time spent gathering using
traditional machine

Data Analysis

Data gathered during the performance evaluation were subjected to statistical analysis using Complete Randomized Design (CRD).

Assumptions for the Economic Analysis

1. Operation: 2 hours/day
180 days/year 360 hours/year
2. Labor Cost: P200.00 per day
3. Repair and Maintenance: 5% of Original Cost
4. Depreciation: Salvage Value= 10% of Original Cost
Life Span = 5 years
5. Payment for Use of Machine: P2.00/cavan

RESULTS AND DISCUSSION

Capacity of Machine and Manual Collection

The mean capacity using machine and manual collection in kilogram per minute is shown in Table 1. The Motorized Paddy Gatherer reaches 88.32 and 43.27 for the manual collection of paddy. As presented in the data, there is a big difference in the capacity of both machines, when analyzed statistically using Complete Randomized Design (CRD). The Analysis of Variance (ANOVA) reveals that there is a highly significant difference for the treatments given to different operators of the machine and manual collection. The mean capacity between the treatments and within each treatment showed highly significant difference.

Table 1. Capacity of machine and manual collection (kg/min)

	Replication			Total	Mean
	1	2	3		
Machine	85.41	93.41	86.14	264.96	88.32
Manual	43.06	43.04	43.70	129.80	43.27
Grand Total				394.76	
Grand Mean					131.59

ANOVA						
SV	Df	SS	MS	FC	F tab	
					5%	1%
Treatment	1	3044.704	3044.704	309.025**		
Error	4	39.410	9.853			
Total		3084.115				

** highly significant

Weight of Left Over

The mean weight of left-over using machine and manual method in kilogram is shown in Table 2. Motorized Paddy Gatherer reaches 53.89 and 50.28 for normal collection. The data were analyzed statistically using Complete Randomized Design (CRD). Analysis of variance (ANOVA) revealed that no significant difference was found in replications given to different operators using machine and manual collection. The mean weight of left-over between the treatments showed highly significant difference.

Table 2. Weight of left-over in machine and manual collection (kg)

	Replication			Total	Mean
	1	2	3		
Machine	55	53.33	53.33	161.66	53.89
Manual	55	50.83	45.00	150.83	50.28
Grand Total					
Grand Mean					

ANOVA						
SV	Df	SS	MS	FC	F tab	
					5%	1%
Treatment	1	19.548	19.548	1,495 ^{ns}	18.51	98.49
Error	4	18.271	9.136			
Total	5	71.867				

Comparative Performance to the Manual Operation

Table 3 shows the comparative performance of machine and manual processes of gathering the dried paddy. Machine and manual capacity, efficiency and cost of operation were shown in this table. Motorized Paddy Gatherer has greater capacity (110 cavans/hr) than manual gathering (52 cavans/hr).

For efficiency, both processes are almost the same. Motorized paddy gatherer has a rate of 97.71% and 97.86% for manual. The cost of operation is far less in using the Paddy Gatherer (P1.18/cavan) than manual gathering (P 3.00/cavan).

Comparing the two methods, the amount of paddy gathered showed no significant difference. They both have almost the same amount of left-over in the pavement. But in the duration or time spent of gathering there is a big significant difference using the machine and manual method.

Considering the time, effort and number of laborers in gathering the dried paddy, the manual method is time-consuming, laborious and many laborers are involved in the process of collecting the dried paddy.

In Motorized Paddy Gatherer, although it uses fuel and involves manpower to operate the machine, gathering process is made easier and fast. Motorized Paddy Gatherer uses manpower to guide the machine and to unload the filled sack from the discharge hopper of the machine. In this design, it makes the process of gathering dried paddy faster and economical compared to the manual process. Moreover, this design is more efficient in collecting large volume of paddy.

Table 3. Comparative performance of machine and manual operation

Parameters	Machine	Manual
Capacity	110 cavans/hr	52 cavans/hr
Efficiency	97.71%	97.86%
Cost of Operation	P 1.18/cavan	P 3.00/cavan

Economic Analysis of Motorized Paddy Gatherer

In Table 4, the computation of cost and return analysis is being shown. The Motorized Paddy Gatherer has an assumed maximum service life of five (5) years. The average capacity of the machine per hour is 110 cavans, or 39,600 cavans per year for 15 days operation per month. Based on the assumptions, the total annual cost is P 46,794 (fixed and variable cost) with the gross income and net income of P69,300.00 and P22,506, respectively.

There is a return of investment of 81.55 % for every peso invested. Finally the amount invested for the machine can be generated for a period of 13.2 months (396 hours of operation).

Table 4. Cost and Return Analysis of Motorized Paddy Gatherer

Particular	Values (PhP)
I. Investment Cost	27,598.00
Materials	6,698.00
Labor	5,400.00
Engine	15,500.00
II. Annual Operational Cost	46,794.00
A. Fixed Cost	
Depreciation	4,968.00
Interest on capital (20% of Original Cost)	5,520.00
Total Fixed Cost	5,520.00
B. Variable Cost	
Labor Cost (P200/day x 360 hours/year x 2 laborers)	18,000.00
Repair and Maintenance (5% of Original cost/yr)	1,380.00
Fuel and Lubricant	16,926.00
Total Variable Cost	36,306.00
III. Volume of collected paddy per year	39,600 cavans/year
IV. Gross Income (P1.75/cavan)	69,300.00
V. Net Income	22,506.00
VI. Return on Investment	81.55%
VII. Payback Period	13.2 months

SUMMARY

Result showed that the capacity of the Mechanized Paddy Gatherer is highly significant (110 cavans/hr) compared to the manual gathering (52 cavans/hour). But in terms of their efficiency, they are comparable because the amount of left-over paddy in the pavement is almost the same. The cost of operation of the paddy gatherer is lesser (P1.18/cavan) compared to the manual gathering (P3.00/cavan).

Both processes used non-skilled operators. Therefore, the capacity can be further increased if the operator continuously uses and becomes familiar with the machine operation. Motorized Paddy Gatherer is advantageous over manual gathering in the sense that it is easy to operate and it minimizes the cost and time of paddy gathering.

The machine cost is P27,598.00 as shown in Table 4, however the return on investment (ROI) is computed at 81.55% with a payback period of 13.2 months or 396 hours of operation.

CONCLUSIONS

1. The Mechanized Paddy Gatherer has better performance compared to the manual operation based on its capacity, efficiency and economic feasibility.
2. It also lessens the labor cost and time spent in paddy gathering.

IMPLICATIONS

1. The machine can immediately gather the paddy when it is about to rain. This will save the grain from damage and maintain its quality for a better market.
2. The cost of gathering one cavan of paddy which amounted to P1.75 includes fuel, lubricants, labor, maintenance, and depreciation. While in manual gathering, one cavan costs P3.00 which is higher compared to gathering the paddy using the machine. This increases the farmers income.

RECOMMENDATIONS

1. The width of the inlet hopper could be increased to raise the machine capacity
2. The wheel could be driven by an engine to eliminate the effort of pushing the machine.
3. It can also be used for shelled corn and other grains.

REFERENCES

Apivathsnsnukul, A., Ouvithaya, T., 1997. Delay of Deterioration of Wet Paddy By Ventilation: Proceedings of the 18th Asean Seminar on Grains Postharvest Technology. Philippines, 11-13n March 1997. pp 80-88.

Mendoza, E.I., A.C. Rigor, Jr., C.C. Mordido Jr., A.A. Marjos. 1982. Grain Quality Deterioration in On-farm Level Operation: Proceedings of the 5th Annual Grains Post Harvest Workshop. Thailand, 19-21 January 1982.pp 101-117

Interviews:

Cayapas Rice Mill and Trader (2005). National Highway, Bgy. Taritien, Narra,
Palawan Chiva Rice Mill and Trader (2005). Panacan, Narra, Palawan