

The Capabilities of Paddy Rice and the Threshing Machines in Iraq

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Abstract. This study aims to obtain rice from paddy rice and determine the capacity of the threshing machine that does such separation. The research question is how to convert the paddy rice into rice, then how to use the rice husk left the paddy rice, and its ground rice by-product while mixing the paddy rice of several people. Our research method is separating the rice, rice husk, and ground rice using several mathematical equations to find the value of paddy rice, rice husk, and ground rice. Finally, we will be able to distinguish between the amount of rice and the ground rice of each person simultaneously and know the capacity of the threshing machine that does the job. Some MATLAB code was utilized to validate the equations and produce the table.

Keywords: ground rice, paddy rice, rice husk, threshing machine

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1. Introduction

Previously, such threshing machine [1, 2] was not found and people used cattle to get rice from rice mills, then for the rice husk that remains as the residue of the paddy rice, we can use the rice husk again as food for birds and cattle [3, 4]. The authors also provide secondary data on how using rice straw as animal feed affects animal performance and production efficiency, as well as how it affects the production of meat and milk, increases farmers' income, and safeguards the environment [5].

As we know rice is everywhere worldwide at a high rate and is consumed by humans, takes over about 70% of the world humans depend on rice for their vital nutrition intake, especially people in Asia and Africa, a paddy [3], also known as a paddy rice, is a small, level field or a crop that are in their natural, unprocessed state, they have been flooded and are used to grow rice in southern and eastern Asia [6]. So, therefore, rice is the seed of paddy.

Then we discuss the purpose of the milling machine which is to remove the husk and the bran layers and create an edible, pure white rice kernel also the different milling machines or processes

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approached to obtain rice from paddy, each with different techniques, different efficiency rate and factors. Our objective in this study of rice processing is to produce high-quality rice by separating the endosperm from other components with the least amount of fragmentation possible. We showed the following list of paddy rice in the literature as shown in Table 1.

Table 1. List of previous study of the Paddy Rice

No	Author	Year	Title
1	Moulick, D., et al. [7]	2023	A cumulative assessment of plant growth stages and selenium supplementation on arsenic and micronutrients accumulation in rice grains.
2	Martins, M.A., et al. [8]	2023	On the sustainability of paddy rice cultivation in the Paraiba do Sul River basin (Brazil) under a changing climate.
3	Indrasari, S.D., et al. [9]	2023	Physical and milling quality of local rice variety and new superior varieties in Indonesia
4	Castelein, R.B., et al. [10]	2022	Mechanization in rice farming reduces greenhouse gas emissions, food losses, and constitutes a positive business case for smallholder farmers – Results from a controlled experiment in Nigeria
5	Bomoi, M.I., et al. [11]	2022	Sensing Technologies for Measuring Grain Loss during Harvest in Paddy Field: A Review
6	Nath, B.C. et al. [12]	2022	Combine Harvester: Small Machine Solves Big Rice Harvesting Problem in Bangladesh
7	Eyarkai Nambi, V., et al. [13]	2017	Rice milling technology to produce brown rice
8	Firouzi, S., et al. [14]	2017	Energy consumption and rice milling quality upon drying paddy with a newly-designed horizontal rotary dryer

Moulick, et al. [7], they have mentioned that during the investigation, it was also discovered that priming rice seeds with selenium is effective in reducing (As) the content in brown rice, regardless of where (growth stages here) (As) stress has been introduced. The first report on how the growth stages respond to Arsenic (As) stress and their relative contribution to the (As) accumulation pattern in rice. The materials of this study are to an effective means to minimize as accumulation in rice, and by using machine learning.

But then again, Martins, et al. [8]. Because irrigation is a major water consumer as material, particularly for paddy rice cultivation, the method of this study is used a crop simulation model in this study to determine the water requirements of paddy rice under current and future climate conditions based on three different regionalized climate scenarios and different land use and land cover change projections. This trend can be offset by implementing sustainable rice cultivation practices such as rational soil fertility and water management, which can increase current productivity by 50% while reducing water use by up to 15%. At that time, Indrasari, et al. [9], the results showed that all rice varieties met the Indonesian standard grain quality class except for Sembada Merah and Inpari 43, which did not meet the moisture content requirement and Sembada Merah and Sembada Hitam, which did not meet the empty grain requirement. To increase the percentage of head rice or decrease the percentage of broken rice, the milling machine as the material and method in this study, must be adjusted to the shape of the grain to be milled.

Additionally, Castelein, et al. [10]. Experiment with replacing manual rice harvesting and threshing with mechanized rice harvesting and threshing. By switching to mechanized harvesting and threshing, greenhouse gas emissions are reduced by 1696 kg CO₂-eq per hectare. Paddy losses are reduced from 9.6% to 0.9% when manual harvesting is replaced with mechanized harvesting. The use of mechanical threshing instead of manual threshing increases efficiency from 31.1% to 33.1%. Switching to mechanical practices generates more revenue than it costs. Likewise, Bomoi, et al. [11], this paper presents an overview of the conventional methods of grain loss measurements, and the factors that contribute to grain losses, and further reviews the development and operation of sensor components for monitoring grain loss during harvest. Then Nath, et al. [12], the result in this work showed that the manual reaping system is more concerned with postharvest losses (3.09%) than the semi-mechanized and mechanised harvesting systems, which both save time, labor, and money. Also, Nambi, et al. [13], they study emphasizes the significance of combine harvesters; however, additional research is needed to explore the detailed potential of combine harvesters in other locations using large and small combine harvesters under various cropping conditions. The harvesting unit areas 283, 15, and 9.87 man-hha¹ for the T1 (Sickle + Head carry + Beating + Kula), T2 (Reaper + Trolley carry + Close drum thresher + winnower), and T3 (Combine harvester) systems, respectively, required the least amount of labor. According to this paper, in order to produce brown rice, we fully depend on RMs they talk about the different terms or slangs used in RMs, the machines they use in the process and how the different degrees affect the quality of the brown rice produced. Finally, Firouzi, et al. [14], here they use the paddy drying method with an industrial horizontal rotary dryer (IHRD) in comparison with (IBBD), the good thing about this process (IHRD) is that it affects the final product, which is considered a very important and efficient factor, another great factor of this process is the moisture level, less electrical and thermal energy use, in conclusion the quality of the final product of paddy dried with IHRD were significantly superior to those of IBBD.

The purpose of this paper is to extract rice from paddy rice and ascertain the threshing machine's capacity for carrying out this kind of separation. New knowledge and the characteristic presented in this article is by using several mathematical equations to find the value of paddy rice, rice husk, and ground rice.

2. Materials and Method

Materials, description threshing machine, and methods in this study, have explained below:

First of all, the threshing machine makes the rice in a few steps:

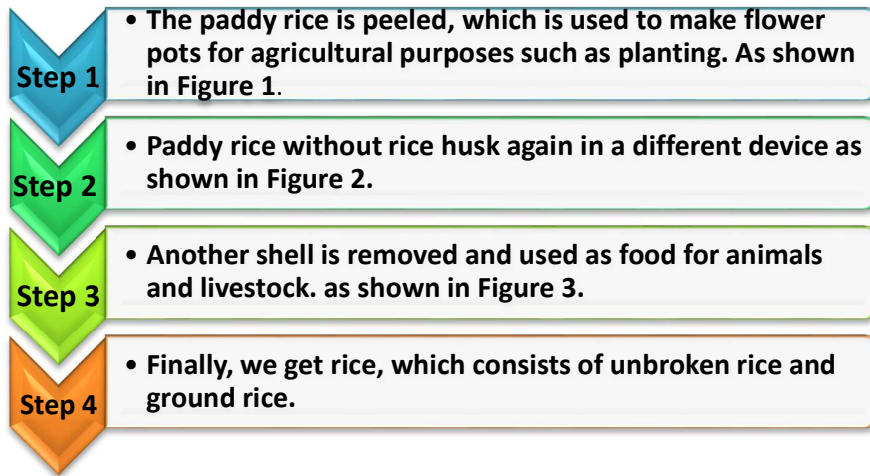


Figure 1. Paddy Rice to a Powder Like Sand



Figure 2. The Threshing Machines



Figure 3. Rice Husk From Paddy Rice

We suppose that the input paddy rice of first person (*1st person*), $x_1 = 12.5$ kg, and the input paddy rice of second person (*2nd person*), $x_2 = 32.5$ kg, means x_1 and x_2 are given. That is means:

$$A = \sum_{i=1}^2 x_i = x_1 + x_2 \tag{1}$$

R = The rate of the threshing machine

Ba = The total rice = 31.05 kg (given)

A = The total input of paddy rice = 45 kg (given)

Now based on the total of the rice **Ba**, and the total input of paddy rice **A**, we could find **R** the capacity of the threshing machine as,

$$R = \frac{Ba}{A} \tag{2}$$

means:

$x_1 \times R = 12.5 \text{ kg} \times 69\% = 8.625 \text{ kg}$ (rice output with ground rice of 1st person), and,

$x_2 \times R = 32.5 \text{ kg} \times 69\% = 22.425 \text{ kg}$ (rice output with ground rice of 2nd person),

$$Ba = \sum_{i=1}^2 x_i R = x_1 \times R + x_2 \times R = (x_1 + x_2) R \tag{3}$$

Now we could find ground rice of 1st person

$$\frac{\text{The total input of paddy rice}}{\text{Total ground rice}} = \frac{\text{The input of paddy rice 1st person}}{\text{ground rice of 1st person}} \tag{4}$$

And by the same way we could find ground rice of 2nd person

$$\frac{\text{The total input of paddy rice}}{\text{Total ground rice}} = \frac{\text{The input of paddy rice 2nd person}}{\text{ground rice of 2nd person}} \tag{5}$$

The rice husk **C** that remains from paddy rice

$$C = A - (Ba+B) \tag{6}$$

3. Results and Discussion

In this section we will show that from paddy rice how to find the capacity of the threshing machine by using some mathematical laws, we have shown rice, ground rice, and rice husk, and also distinguish between first and second person.

$$A = 12.5 \text{ kg} + 32.5 \text{ kg}$$

$$A = 45 \text{ kg}$$

In equation (1), the total input paddy rice of both persons and the total ground rice is only **B**=4.05 kg. We can know the rate of the ground rice.

$$R = \frac{31.05 \text{ kg}}{45 \text{ kg}} = 69\%$$

From equation (2), we get the rate of the capacity of the threshing machine,

$$\mathbf{Ba} = 69\% \times 45 = 31.05 \text{ kg}$$

From equation (3) showed how we get the total rice **Ba** without ground rice in this study becomes means

$$31.05 \text{ kg} - 4.05 \text{ kg} = 27 \text{ kg}.$$

The ground rice of the 1st person is unknown, we get:

$$\text{Ground rice of 1st person} = \frac{\text{Total ground rice} \times \text{The input of paddy rice 1st person}}{\text{The total input of paddy rice}}$$

from (4) we get:

$$\frac{\mathbf{A}}{\mathbf{B}} = \frac{\mathbf{x}_1}{\mathbf{B}_{x_1}}$$

so,

$$\frac{45}{4.05} = \frac{12.5}{\mathbf{B}_{x_1}}$$

and,

$$\mathbf{B}_{x_1} = \frac{4.05 \times 12.5}{45}$$

then,

$$\mathbf{B}_{x_1} = 1.125 \text{ kg, ground rice of 1st person}$$

Ground rice of the 2nd person is unknown we get:

$$\text{Ground rice of 2nd person} = \frac{\text{Total ground rice} \times \text{The input of paddy rice 2nd person}}{\text{The total input of paddy rice}}$$

from the Equation (5) we get:

$$\frac{\mathbf{A}}{\mathbf{B}} = \frac{\mathbf{x}_2}{\mathbf{B}_{x_2}}$$

so,

$$\frac{45}{4.05} = \frac{32.5}{\mathbf{B}_{x_2}}$$

and,

$$\mathbf{B}_{x_2} = \frac{4.05 \times 32.5}{45}$$

then,

$$\mathbf{B}_{x_2} = 2.925 \text{ kg, ground rice of 2nd person}$$

The sum of ground rice of both persons is:

$$\mathbf{B} = \sum_{i=1}^2 \mathbf{B}_{x_i} = \mathbf{B}_{x_1} + \mathbf{B}_{x_2} = 1.125 \text{ kg} + 2.925 \text{ kg} = 4.05 \text{ kg ground rice}$$

That is means $8.625 \text{ kg} - 1.125 \text{ kg} = 7.5 \text{ kg}$ (only rice of the 1st person without ground rice),

$$22.425 \text{ kg} - 2.925 \text{ kg} = 19.5 \text{ kg}$$
 (only rice of the 2nd person without ground rice),

only rice of the 1st person and 2nd person is:

$$7.5 \text{ kg} + 19.5 \text{ kg} = 27 \text{ kg}$$

that is mean from equation (6)

$$C = 45\text{kg} - (31.05\text{kg}+4.05\text{kg})$$

$$C = 9.9 \text{ kg}$$

To validate the equations and generate Table 2, some MATLAB code was used as shown below

```
x1=12.5;
x2=32.5;
A=x1+x2;
Ba = [27:0.45:36];
B = [3.5:0.06:4.7];
%% R = Rate of Threshing machine
R = Ba/A;
%% Ba = The total rice output %%
Ba = R*A;
%% The rice Husk %%%
C = A-(Ba+B);
```

Finally, if the total input of paddy rice is 45 kg, and if rice output **Ba** and ground rice **B** are known, and then we could find the rate threshing machine **R** and rice husk **C**, we can find the total rice output of both persons means **x₁** and **x₂**, as shown in Table 2.

Table 2. Calculation of Total Output of Rice and Ground Rice

Threshing machine R	Rice output Ba	Ground rice B	Rice husk C
0.60	27.00	3.50	14.50
0.61	27.45	3.56	13.99
0.62	27.90	3.62	13.48
0.63	28.35	3.68	12.97
0.64	28.80	3.74	12.46
0.65	29.25	3.80	11.95
0.66	29.70	3.86	11.44
0.67	30.15	3.92	10.93
0.68	30.60	3.98	10.42
0.69	31.05	4.04	9.91
0.70	31.50	4.10	14.50
0.71	31.95	4.16	13.99
0.72	32.40	4.22	13.48
0.73	32.85	4.28	12.97
0.74	33.30	4.34	12.46
0.75	33.75	4.40	11.95
0.76	34.20	4.46	11.44
0.77	34.65	4.52	10.93
0.78	35.10	4.58	9.40
0.79	35.55	4.64	8.89

In above table, shows that the better the capacity of the threshing machine of rice husk, the better the quality of rice, and the better the quality of ground rice, we started with 0.5 and increased capacity of the threshing machine to 0.89, as well, as the level of the total rice output **Ba** from **Ba**= 27 to 35.55, then the total output of ground rice with started from **B**= 35 to 4.64. As shown in Table 2. In this study, we found that the amount of rice obtained from the threshing machine, which works at 69% capacity of the threshing machine, **Ba**=31.05, and **B**=4.04, varies from threshing machine to threshing machine as also rice, ground rice and rice husk.

4. Conclusion

Based on those equations we use we get the amount of rice from paddy rice with less probability of errors. This result is based on several Mathematical equations that are not used in this field before. The equations are helpful in order to get precise results accordingly. But the problem is we don't get a good amount of rice. Additionally, this study shows the amount the ground rice that we get from the machine that converts the paddy rice and ground rice to rice. The rice husk remains as the residue of the paddy rice, we can use the rice husk again as food for birds. Getting these results are complex because the capacity of each threshing machine is different. To confirm the equations and result in the table, some MATLAB code was employed. In this study, some suggestions are made to help those who are working on this subject, such as using another approach, changing the scope of the work, and how to reuse the rice husk in paddy rice to compare their work with this proposed method.

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