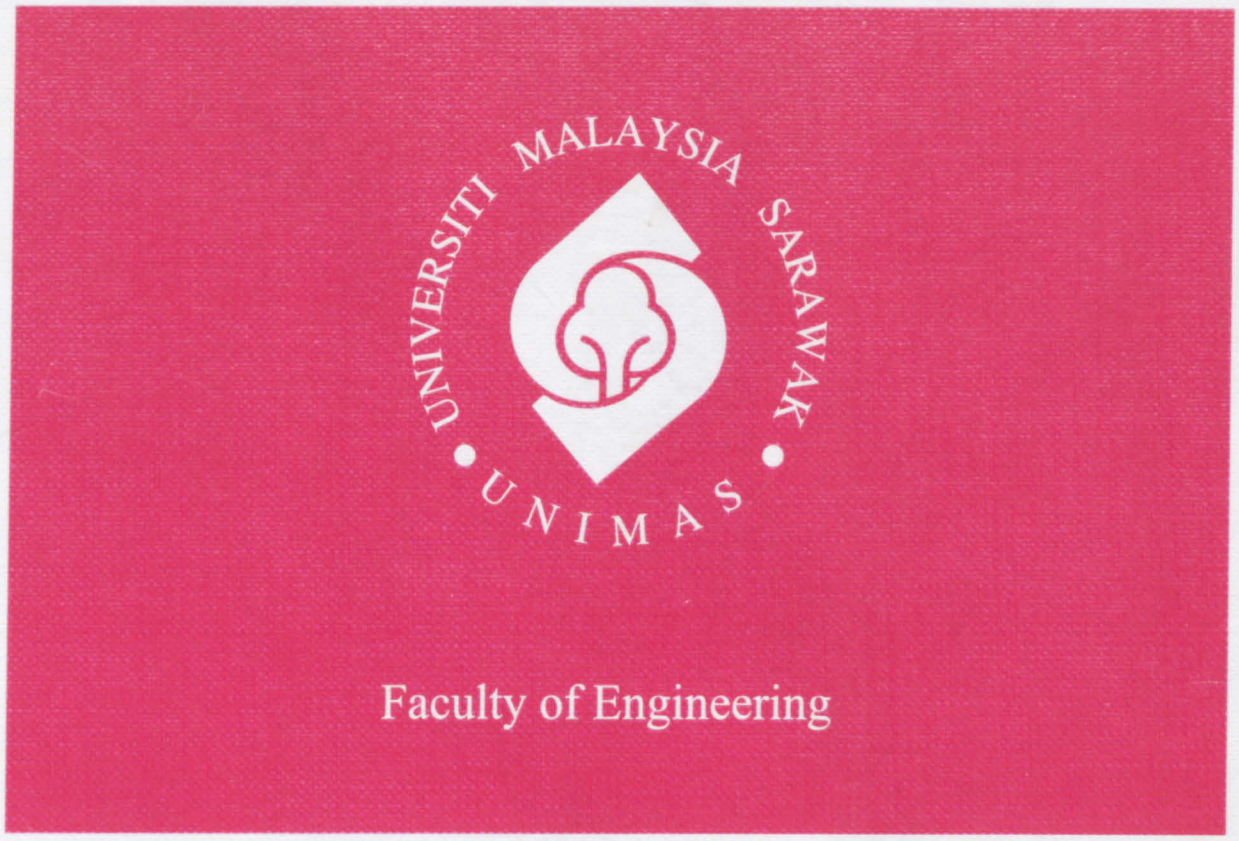

DESIGN AND FABRICATION OF RICE MILLING MACHINE FOR PADDY FARMERS AT SAMARAHAN, SARAWAK

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This project is submitted in partial fulfillment of the requirement for the degree of
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APPRECIATION

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ABSTRAK

Mesin pengisar padi telah digunakan oleh penanam padi di seluruh dunia dan ia juga turut digunakan oleh penanam padi di kawasan Samarahan, Sarawak. Mesin pengisar padi ialah suatu cara yang menjimatkan untuk menukarkan padi kepada beras. Oleh itu, tujuan kajian ini adalah untuk meningkatkan, merekabentuk, membina dan menguji prestasi mesin pengisar padi yang dicadangkan berbanding mesin yang sedia ada di Samarahan.

Sebuah mesin pengisar padi yang dapat berfungsi direka bentuk, dibina dan diuji untuk mengisar padi. Dua buah kipas dengan 12V dipasang pada mesin yang dicadangkan sebagai sistem menampi. Sebuah sistem penapisan juga turut dipasang untuk meningkatkan prestasi mesin.

Empat ujian utama telah dilakukan. Ujian pertama menunjukkan kepentingan dan keberkesanan padi yang dijemur sebelum dikisar, didapati kaedah ini dapat meningkatkan keberkesanan sehingga 46%. Ujian kedua telah menunjukkan hubungan jarak diantara kedudukkan pisau dan silinder bersirip mempengaruri keberkesanan pengilinggan, untuk mesin ini jarak yang terbaik ialah pada kedudukan 4mm. Data dari ujian ketiga menyokong sistem penampi yang dicadangkan berfungsi dengan kelajuan 3m/s dan Berjaya mengurangkan RM3.91 kos menampi harian. Keputusan dari ujian yang keempat menunjukkan bahawa sistem penapis juga berfungsi dengan baik, ia berjaya menapis kesemua hampas yang tertinggal selepas proses menampi.

ABSTRACT

The rice milling machine has been used by the farmers all over the world and is also practiced by the paddy farmers in Samarahan, Sarawak. The rice milling machine is an economical mechanism to turn a paddy into rice. Thus, the purpose of this study is to improve, design, fabricate and test the performance of a proposed rice milling machine against the existing rice milling machine in Samarahan.

An active rice milling machine was designed, fabricate and tested to mill the paddy. Two fans with 12V were installed to the proposed machine as the winnowing system. A sieve system was also installed to increase the machine performance.

Four major tests were performed. The first test highlighted the importance and effectiveness of the paddy to be dried before milled, it was discovered that by drying the paddy before milling can increase the successful rate of milled rice up to 46%. The second test has show the relationship of the gap distance between the blade and the ribbed cylinder to the paddy milling efficiency, for these proposed rice milling machine, the desire blade distance for Hill Paddy is 4 millimetre gap between the blade and the rotating ribbed cylinder. Data from the third test support that the proposed winnowing system was successfully operated with an acceptable speed rate of minimum 3 m/s and is cutting RM3.91 the daily winnowing cost. Result from the fourth test showed that the sieving was functioning properly, it's successfully filter the entire husk that still remain after winnowing.

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CHAPTER 1

INTRODUCTION

1.1 Background

Rice (*Oryza Sativa* L.) is a staple food consumed by over half the world population. The total world production of unmilled rice (paddy) is around 592 million tonnes (Mt). Ninety percent of this total is grown in developing countries, mostly in Asia, while Latin America and Africa produced 3.8 and 2.8 percent, respectively (FAOSTAT, 2001).

It is estimated that by 2025, 10 billion people will depend on rice as a main food and the demand will reach about 880 Mt. Many Asian countries and international institutions agree to the strengthening of national programmes for policy and financial support to research, seed production and extension of hybrid rice (FAO, 2001). In fact, there has been an expansion of area under high-yielding varieties (HYV), and in 1998 more than 90 percent of irrigated areas in Asia were under HYVs (Evenson, 1998). Methodology on the impact of the improvement of productivity on postharvest operations has been developed by FAO for several crops including rice (Phan, 1998). As HYVs are increasingly used, the post-harvest system

must be improved, including infrastructure development and also the dissemination of technologies, allowing small and medium farmers to prevent food losses and consequently to achieve the food security which is a priority of FAO in its fight against hunger.

The rice post-harvest system requires improvement in the use of resources for research and development, particularly with regard to the level of post-harvest losses. These losses are attributed to a combination of factors during production and post-production operations (De Padua, 1999).

The process to turn the paddy into rice is called milling process. The process started with drying the paddy as shown in Figure 1.1, the paddy is dried to reduce the grain moisture content (MC) for husking process (International Rice Research Institute, 2007). As the result, the amount of rice loss when husking will be reduced.

Figure 1.1: Paddy being dried under the sun (IRRI, 2007)

When the paddy is husked, the rice outer hull is removed but still retains the bran layers that give it a characteristic tan color and nut-like flavor which is called brown rice as shown in Figure 1.2.

Figure 1.2: Brown rice

White rice as shown in Figure 1.3 is produced when the remaining part of the bran and germ is fully removed from the brown rice. Brown rice is edible but chewier texture than white rice. Cooking time of brown rice is longer than milled rice (white rice).

Figure 1.3: White rice

1.2 Milling

Paddy or the rice grain consists of the hull or husk (18-28%) and the caryopsis or brown rice (72-82%). Brown rice consists of an outer layer (pericarp, tegmen and aleurone layers) called bran (6-7%), the germen or embryo (2-3%), and the edible portion (endosperm 89-94%) (Chen *et al.*, 1998).

The rice milling operation is the separation of the husk (dehusking) and the bran (polishing) to produce the edible portion (endosperm) for consumption. Although a theoretical mill recovery would be between 71 and 73 percent, in practical it is possible to obtain between 68 and 70 percent from a good variety of paddy.

Milling losses can be reduced by adopting small-scale modern rubber roll sheller and introducing parboiling of paddy before milling. Table 1.1 shows the advantages of parboiled rice.

Table 1.1: Advantages of parboiled rice (Lantin R., 1997)

Advantages
Milling or dehusking is easier and costs less
Milled rice has fewer brokens and is nutritious
Increased head and total rice out-turn
Rice is more resistant to storage insect pests
Bran contains more oil
Less starch lost in cooking and can be keeps longer

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1.3 Sarawak's Climate

Sarawak enjoys a tropical climate with fairly uniform temperatures throughout the year. Temperatures range from 32 degrees during the day to 22 degrees at night. Rainfall is common throughout the year, averaging 200-250cm a year. Most of the rain falls during the wet season that lasts from November to February (About Sarawak, 2009).

1.4 Project Background

Kampung Meranek and Kampung Tembirat are located in Samarahan Division (Wikipedia, 2009). Paddy farming started in the middle of November where the raining season started in Sarawak and it will be matured and harvested in early April. This paddy farming activities is done in small scale and mostly run in the family. The harvested paddy is stored and is used until the farming season. The paddy farming activities can save their income by cutting the rice allocation up to RM100 per month.

1.5 Problem Statement

Interview were conducted with two farmers in Samarahan, Haji Adnan bin Abdullah from Kampung Meranek who is also the owner of the paddy milling machine and Jumat bin Gendom. The purpose of the interview is to investigate the current method used for milling paddy and identify the problems faced by them.

Currently, they are practising the one step milling process by using Steel Hullers Machine as shown in Figure 1.4.

Figure 1.4: Steel Hullers Machine

This method causes some problems with rice produced. The rice produced is shattered and mix with husk. Furthermore, they also have to use a fan to remove the husk from the rice (winnowing) as shown in Figure 1.5. For that reason they have to use two difference types of power sources, a diesel engine to power the paddy milling machine and electric power to rotate the fan for winnowing.

Figure 1.5: The use of fan to remove husk from the rice

The uses of difference power supply will create a high operation cost for the farmer. With the low income, they cannot afford to purchase high-tech milling machine. It is also not economical to spend on such expensive milling machine as the product value is low and produced in small quantity. By using separate power supply, it also creates a high possibility for incomplete process due to breakdown from one of the power supply.

The milling machine have a high percentage of dust combined with processes white rice, because of this, the farmer have to winnowing all the processes rice to separate the dust from the white rice, thus create an extra operation cost and extra work. The winnowing process are difficult to manage due to the task to insert the processing rice after milling process which require the farmer to step on a chair.

For itself, the purpose of this study is to design a paddy milling machine that will potentially solve the problems faced by the paddy farmers in Samarahan. For this conclusion, the proposed machine should meet the requirements as follows:

1) Technology available locally

   The materials and equipment are available in the local market.

2) Low cost

   The farmers afford to purchase the proposed.

3) Simple design and maintenance

The machine must have a simple design and ease of use so that it can be easily maintained and repaired by the farmers.

1.6 Objectives

Setting objective for the project is important because it serves as a guide lines to the project. Therefore, a clear understanding of the problem statement is needed in order to perform the requirements of the project. Objectives of this project are:

1) To evaluate the milling method used by paddy farmers in Samarahan.
2) To overcome the problems related to the current paddy milling method; shattered rice, high machine cost and high operation cost.
3) To design, fabricate, simplify process operation and test the milling machine.

CHAPTER 2

LITERATURE REVIEW

2.1 Milling of Food

Milling is the act or process of grinding. Milling separates the fine, mealy parts of grain from the fibrous bran covering. A food mill usually is made of stainless steel or aluminum (Wikipedia, 2009). In prehistoric times grain was crushed between two flat stones. Later a stone with a rounded end was used to grind grain in a cup-shaped stone; this led to the development of the mortar and pestle. The more advanced peoples began to use the quern, a primitive mill in which the grain is placed on a flat, circular lower millstone and ground by revolving a similar upper millstone to which a handle is attached (Answer.com, 2009).

2.2 Rice Milling

The objective of milling rice is to remove the husk and bran layers and produce an edible, white, high-quality rice kernel. Depending on customer requirements, milled rice should have a minimum of broken kernels, be well polished, and be free from impurities. Using good-quality paddy in a well-maintained mill operated by a skilled miller will produce high-quality head rice. Poor-quality paddy will always result in poor-quality milled rice, irrespective of type of rice mill and