Design and Development of Rice Leaf Cutter

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Abstract
This paper aimed to design and develop of rice leaf cutters to increase efficiency of the group of rice farmers, at Ban Nang Noi, Tao Ngoi, Sakon Nakhon Province. By cutting the old rice leaf using lawn mower. The cutting of rice leaf has an average time of 54.80 minutes per Rai. In comparison with rice leaf cutters, the average cutting time was 23.90 minutes per Rai. Farmers can reduce their working time by up to 43.61% . Design and development based on the theory of building combine harvester. The horizontal vibration value is in the same direction as the combine harvester. The cost of rice production can be reduced by 640 Baht per Rai.

Keywords Rice leaf cutter, Combine harvester, Vibration

LITERATURE REVIEW
Design and development of the rice leaf cutter can be performed by using the theory to design combine harvester. The direction of rice cutter combined with harvester likely reduces the size and weight to be given access to agricultural areas [4]. The design of the cutter and cut transmission by reducing vibration during operation thus increasing the efficiency of harvesters [5]. The design of the transmission system must be related to the rotation speed so that the rice can be cutting regularly [10]. And a good crankshaft design with regard to speed can reduce vibration as well as increase efficiency for the combine harvester [7]. Based on the theory and research to apply the design and development of the rice leaf cutter to reduce the time to cut.

INTRODUCTION
Thailand is an agricultural country where people engage in agricultural occupations. With 34% of the households working in agriculture and 93% of them located in rural areas [1]. The highest number of crops is rice. For consumption and export rice area is about 11.3% of the country. Rice is one profession that generates revenue for the country. With this reason farmers are trying to produce more in order to suffice the demand. With economic problems the cost of farming is higher. Most farmers have turned to paddy-sown field. Due to the process of making uncomplicated less cost. Farmers are experiencing weed problems. Rice is not fully grown and yield less.

Rice Farmers Group, Ban Nang Noi, Tao Ngoi, Sakon Nakhon Province. Nowadays, it is mainly made paddy-sown field and used lawn mower cut rice leaf and weed. During the weeds begin to grow and flower or 1-2 months after sowing to break the cycle not to spread grass the rice grows evenly and high yield [2-3]. But uses of lawn mowers to cut the leaf it is heavy and vibration. The center of gravity is not balanced. When cutting rice leaf the machine must be to swing. Pose a danger during operation and fatigue while working. The researcher has the idea to develop a small rice cutter to be effective. Applying the concept of design from a combine harvester. With less vibration and lightweight for easy mobility reduce vibration and balance. Increase Performance reduced working time reduces cutting time and increase rice yield [4].

METHODOLOGY
Study on the design and development of rice leaf cutters. The vibration design of the cutter blade is minimized as the vibration is the cause of the damage especially in the combine harvester [9]. Which can cut rice leaf regularly. And to fit the physique of the farmers the main components are as follows.

1. The structural characteristics of rice leaf cutter shape with dimensions as shown in Fig 1. And the section cutting blade designed to tilt angle of 45 degrees down below and limited in length because the vibrations will be correlated with the length of the blade cut [6]. Use the materials stainless steel because does not rust light weight and have straps to fit user behavior as shown in Figure. 1.

Figure 1. Dimension of structure
2. The power pack uses a lawn mower 4-stroke engine consumes less oil as shown in Fig. 1 fit to the structure of the machine to balance the front-back.

3. The cutting blade is made of aluminum for weight reduction and designed to reduce the vibration of cutting blade unit by decreasing the variation of cutting blade weight [13] and to be cut perpendicular to the rice crop and driven by gear and chain to prevent slipping loss [5]. Crankcase design to reduce the vibration as much as possible which is related to the speed round [10-11] as shown in Figure 2. And the selected speed 300 rpm because if the revs in the cutting at 250 rpm will cut rice leaf infected rice leaf all missing blades and if the speed at 400 rpm is too much vibration occurs [8] as shown in Figure 3 and also reduce the vibration of the cutting blade [6-7]. The working of the cutting blade is associated with a system of sliding mechanisms by virtue of bows crank as shown in Figure 3 so that the maximum cutting efficiency. Calculation of rotation speed and value ratios by using the equation (1) and (2).

\[
d_1 n_1 = d_2 n_2 \quad (1)
\]

\[
i = \frac{n_1}{n_2} = \frac{d_2}{d_1} \quad (2)
\]

1. Researchers have designed a trial by summary in Table 1.

**Table 1:** Experimental design of rice leaf cutter

<table>
<thead>
<tr>
<th>Test area</th>
<th>Tester</th>
<th>Test time</th>
<th>Direction of cutting leaf</th>
<th>Number of tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prepare the rice planting area size 1 Rai of 10 plots of rice was planted. The rice cutting condition was determined for 2 months from the date of sowing.</td>
<td>Rice farmer, Baan Nang Noy Tao Ngai, Sakon Nakhon Province, 1 person, 35 years old.</td>
<td>Cut rice leaf from 8.00 am to 10.00 am, start cutting rice leaf at 8.00 am, stop at 1 Rai.</td>
<td>Cut along the y axis, cutting through the entire area and looping back.</td>
<td>The test is 10 times, 1 Rai total area of 10 Rai.</td>
</tr>
</tbody>
</table>

![Figure 2. Gear and transmission system design](image)

![Figure 4. Farmers Tester cut rice leaves compare with Lawn mower cut rice leaf](image)
Experiment with real users, the rice seedlings were tested by one rice farmer. The rice leaf cutting trial was presented in Figure 4. The rice cutter was used in the morning session between 8 a.m and 10 a.m. The time of cutting for 1 comparative the cutting using conventional lawn mowers.

2. Vibration tests the speed of cutting was increased by 50 cycles at 250 rpm, 300 rpm, 350 rpm and 400 rpm. To measure the vibration range of the cutter set in the horizontal axis by the VM-120 has an accuracy acceleration of 1.5% RMS. As shown in Figure 5. Measurement is in the Root Mean Square (RPM), which is mounted to the measurement location shown in Figure 6. Compares the results with the previous research [5].

Figure 5. Vibration meter kit VM-120

Figure 6. Vibration measurement

RESULTS

Comparative of cutting time by 1-Rai with 10 times was compared with rice leaf cutting by using a lawn mower. The difference in cutting time was found to be more efficient and time-saving than the traditional cut by using a lawn mower method.

Figure 7. Comparative the time when using rice leaf cutter and lawn mower

Figure 8. shows comparison of the vibration of rice leaf cutter in horizontal. The vibration value is less than the traditional tractor. But it is more valuable than the harvest [5] by similar the results of the reference machine construction with the theory of combine harvester.

Table 2: Cost of rice production

<table>
<thead>
<tr>
<th>Position of measurement</th>
<th>Vibration in horizontal</th>
<th>Vibration in vertical</th>
<th>Average = 54.80 min/Rai</th>
<th>Average = 23.90 min/Rai</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Cutting time per min/Rai</td>
<td>10</td>
<td>5</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 2 shows the cost of rice production based on the cost of rice production from the Department of Foreign Trade Ministry of Commerce at 21 January 2559 [12]. The cost of land preparation was 1 170 baht / Rai while the cost of rice
leaf cutting cost was 5,300 Baht / Rai. Reduce the cost of farming to 640 Baht / Rai.

CONCLUSION

The design of rice leaf cutter is based on the principles of reference and design of the theories and research related to the combine harvester. To test the efficiency of the rice leaf cutter was compared with the cutting rice leaves using a lawn mower. Figure 7 show rice leaf cutter can reduce the time to work it down. Farmers are easy to work and reduce fatigue. Figure 8 shown the measured vibration values compared to the vibration values of the combine harvester are likely to be in the same direction. Table 2 shows compared the cost of traditional rice cultivation without cutting leaf. The cost of rice leaf cutting can reduce the cost of rice production by 640 Baht per Rai and increase rice yields.

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