Solar Corn Sheller Machine Design Based on Ergonomics Principles

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Abstract
The existing sheller machine on the market still uses diesel fuel and electricity, even though diesel fuel has increased. Solar is a non-renewable energy. In addition, there is a new modification of the corn sheller machine with solar power to replace diesel fuel. The fuel replacement is focused on the utilization of sunlight. This corn sheller machine can replace the use of fossil raw materials and electricity with solar power and obtain faster, more ergonomic product results. The data required in this study are body dimension data or shoulder height anthropometry in an upright standing position to determine the height of the corn sheller that will be done standing when the farmer does the corn shelling process. With the existence of a solar-powered corn sheller machine, it is expected to be more productive than before. The transition to the use of environmentally friendly (pollution-free) corn sheller machines so as to reduce air pollution that previously used motor engines with fossil fuels, namely diesel, corn farmers can understand about work comfort, are able to operate environmentally friendly corn sheller machines and can carry out maintenance procedures for solar corn sheller machines.

Keywords: corn sheller, solar power, ergonomics

Abstrak

Kata Kunci: pemipil jagung, tenaga matahari, ergonomi

1. Introduction
Creating an object or tool that can help make it easier to do the activity of expressing ideas and ideas[1]. Design is a process used to realise or describe a design using various techniques according to the needs in order to draw a clear design form[2]. The application of anthropometry or the science of the dimensions of the human body and ergonomics in the work environment can affect the operator's work comfort, which was originally with working conditions too hunched over now in a standing position[3]. This approach is used to bring together what consumers want so that producers can use it to fulfil consumer desires. Thus increasing the chances of fulfilling customer satisfaction[2]Maize is the second food crop commodity after rice, according to the calculation of the Ministry of Agriculture, maize production in the last 5 years has increased by an average of 12.49% per year. In 2018, maize production is estimated to reach 30 million tonnes of dry shells (PK). Juwiring Village, one of the villages in Kendal, is a maize producer, irrigating its fields depending on rainfall. After the farmer harvests rice, the land is planted with maize. In one year, corn can be harvested three times. Post-harvest the corn is dried in the sun and then separated from the stalks using a corn sheller machine. The cost of separating the corn from the stalks is Rp.20,000
per sack, for one sack usually contains 20 to 25 kg. The current sheller machine still uses fossil fuels and electricity. The fossil fuel used is diesel for each sack of approximately half a litre. Solar energy is non-renewable and will one day run out. It is necessary to modify the corn sheller machine using solar power to replace fossil fuels. With this design, farmers no longer need to pay for corn shelling and are environmentally friendly. With the semi-automatic machine, the process of cleaning the intestines every one kilogram becomes thirty minutes. In this design, we pay attention to the aspects of labour anthropometry and percentiles[4][5].With the use of solar power will replace diesel and electricity and faster production results[6][5], sheller machines are more ergonomic than solar corn sheller machines in previous studies where farmers operate corn sheller machines by squatting so that for a long time will cause fatigue[7][8].

2. Material and Methods

Research Methods

The research conducted designs a machine that initially this corn sheller machine is used by farmers in a sitting or squatting position. The development carried out by the corn sheller machine by standing upright ergonomically from anthropometric data, so that farmers can enter more corn than the previous position because the width for entering corn is made wider [9].

Required data

The data needed in this study is Anthropometric data of shoulder height in an upright standing position because when farmers carry out the corn-picking process, it is done by standing [10].

Data collection method

Collecting data by making observations, namely in this observation, namely observing directly when carrying out corn-picking activities in a squatting position, then conducting interviews to find out the complaints experienced by workers when carrying out corn-picking in a squatting position and collecting body dimension or anthropometric data by measuring body height when standing upright[10][11].

Research Steps

The steps of the research flow are as shown in Figure 1[12].

Fig. 1. Research Steps
3. Results and Discussion

Data Collection

To obtain data on body dimensions or anthropometry using measurements of farmers who carry out the piping process of a total of six people. Measurements are made on the body dimensions of sitting shoulder height. The purpose of taking this data is to obtain primary data. The following is Table 1 Anthropometric data of workers [13]:

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Gender</th>
<th>Age</th>
<th>Body Height (cm)</th>
<th>Shoulder Height Position Standing Upright (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Ali</td>
<td>L</td>
<td>55</td>
<td>170</td>
<td>126</td>
</tr>
<tr>
<td>2.</td>
<td>Sob</td>
<td>L</td>
<td>56</td>
<td>158</td>
<td>120</td>
</tr>
<tr>
<td>3.</td>
<td>Bu</td>
<td>L</td>
<td>58</td>
<td>160</td>
<td>120</td>
</tr>
<tr>
<td>4.</td>
<td>Su</td>
<td>L</td>
<td>29</td>
<td>158</td>
<td>120</td>
</tr>
<tr>
<td>5.</td>
<td>Mus</td>
<td>L</td>
<td>25</td>
<td>162</td>
<td>125</td>
</tr>
<tr>
<td>6.</td>
<td>And</td>
<td>L</td>
<td>26</td>
<td>158</td>
<td>122</td>
</tr>
</tbody>
</table>

Table 1 above is anthropometric dimension data that is directly related to the design of the corn sheller machine, namely the height of the shoulder standing upright[14].

Data Processing

The anthropometric data of corn farmers obtained in Table 1 is then calculated to get the average amount, the following is Table 2 of the average amount of anthropometric data[15]:

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Gender</th>
<th>Age</th>
<th>Shoulder Height Position Standing Upright (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Ali</td>
<td>L</td>
<td>55</td>
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<td>6.</td>
<td>And</td>
<td>L</td>
<td>26</td>
<td>122</td>
</tr>
</tbody>
</table>

Table 2. Calculation Results of Average Anthropometric Data

Percentiles

In the design of corn sheller machines there are several percentiles that are commonly used including the 5% percentile, 50% percentile and 95% percentile. The percentile used in this design uses the 50th percentile meaning that measurements are carried out on 50% of the average population. For the design of this machine[3].

Tool Design and Manufacture

The height of the corn sheller machine is based on anthropometric data that has been processed and some related tool sizes as in Table 3 below.

<table>
<thead>
<tr>
<th>No.</th>
<th>Design Size</th>
<th>Anthropometric Data</th>
<th>Percentile (%)</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Panel Height</td>
<td>Shoulder Height Upright Standing Position</td>
<td>50</td>
<td>Users of medium to tall stature can reach or use the corn sheller machine</td>
</tr>
</tbody>
</table>

For the size of the machine height according to the results of table 3, namely the height of the shoulder standing upright position as shown in Table 4 [6]. Based on Table 2 and Table 3 the dimensions of the machine design are as shown in Table 4.
Table 4. Solar corn sheller machine design size and material

<table>
<thead>
<tr>
<th>No.</th>
<th>Part Name</th>
<th>Size (cm)</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Machine Height</td>
<td>100</td>
<td>Stainless Steel</td>
</tr>
<tr>
<td>2.</td>
<td>Machine Length</td>
<td>85</td>
<td>Stainless Steel</td>
</tr>
<tr>
<td>3.</td>
<td>Machine Width</td>
<td>50</td>
<td>Stainless Steel</td>
</tr>
</tbody>
</table>

Materials and Ingredients

Materials or materials that will be used in the design of corn sheller machine[16]:

- Solar Panel
  Is a device in which there are solar cells that convert light into electricity. How solar panels work when sunlight comes into contact with solar panels and semi-conductor materials will absorb the sunlight.

- Solar panel control
  Electronic equipment used to regulate the direct current charged to the battery and taken from the battery to the load. Solar charge control regulates overcharging or excess charging because the battery is full as well as excess voltage from the solar panel.

- Solar panel socket
  A device that connects the cable and the solar panel so that the electric current delivered can be perfectly channeled to the cable. Connector covers the positive and negative currents of electricity generated by solar panel modules.

- Battery
  An energy storage device that is charged by the DC flow from the solar panel. Besides storing DC power, batteries have the function of converting chemical energy into electricity. Basically, there are two types of batteries, namely, primary batteries and secondary batteries.

- Wheels
  Facilitate the corn sheller machine when moving places.

- Dynamo
  A device that converts electrical energy into rotary motion energy (converting electrical energy into motion energy).

- Belt pulley bearing
  Play a role in supporting the performance of the v-belt. Its main function is to maintain the tension of the v-belt in which there is a bearing to rotate the car compressor, alternator, and water pump.

Corn Sheller Design

The following are the design drawings of the corn sheller machine from the side, from the front and from the back.

![Fig.2. Dimensions of the maize sheller machine](image-url)
From Figure 2 – 4, the design of the corn sheller was that the hole for inserting the corn cobs was positioned at the bottom now the position is at the top so that farmers can insert corn cobs more easily.

4. Conclusion

The conclusion that can be drawn from this research is that with the existence of this solar corn sheller machine, the corn farming community is more empowered, namely by increasing production yields from the previous results of spending on shellers worth Rp. 20,000,-, to be reduced. The transition to the use of environmentally friendly (pollution-free) maize sheller machines can reduce air pollution. The maize farming community in Juwiring village, Cepiring sub-district, Kendal district understands about work comfort with training and socialisation so that farmers are able to operate environmentally friendly maize sheller machines. The making of the corn sheller machine uses materials made from stainless steel.

5. References


