



AMERICAN JOURNAL OF AGRICULTURAL SCIENCE, ENGINEERING, AND TECHNOLOGY (AJASET)

ISSN: 2158-8104 (ONLINE), 2164-0920 (PRINT)

VOLUME 7 ISSUE 1 (2023)



PUBLISHED BY: E-PALLI PUBLISHERS, DELAWARE, USA

Crushing Power of a Corn Cob Chopping Machine for the Manufacture of Animal Feed at the Cinagarabogo People's Livestock Centre, Subang Regency, Indonesia

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Article Information

Received: January 03, 2022

Accepted: January 16, 2023

Published: January 19, 2023

Keywords

Corn Cob, Disc Mill Machine, Ruminant Feed crusher

ABSTRACT

Process of making animal feed at the People's Husbandry Centre (SPR) Cinagarabogo Subang Regency is one of the producers of ruminant animal feed for cattle. The ruminant feed made from corncob waste is distributed to cattle breeders in Subang Regency. The manufacture of animal feed made from corn cobs is still done conventionally, so that the fulfillment of ruminant feed needs is often hampered. This study aimed to design a disc mill machine that is used to crush corn cobs. The research method started from observing, sketching, making 2D and 3D designs, and conducting expert validation. Based on the research, it can be concluded that the design made has been declared valid with a score of 87% or was in the proper category. Further recommendations that the design is feasible to proceed to the manufacturing process.

INTRODUCTION

Since 2005, the Indonesian government has planned to be self-sufficient in beef, namely imports of no more than 10% of the total national consumption. However, beef self-sufficiency has not yet been achieved with various problems faced. The alternative to meet the needs of beef consumption is through imports, but the import price is cheaper than the price of local beef, making it a tough competitor for farmers as the main producers of local beef. The development of beef cattle in quantity has had a very real impact on increasing people's income in improving their welfare. Development that still relies on the power of community animal husbandry makes this business in general still managed traditionally. The purpose of maintenance, which is still a side business of farming activities, causes market demand has not become the main consideration for livestock businesses. In these conditions, it is very difficult to encourage the community to achieve an economical business scale in the livestock business (Fathurohman *et al.*, 2017).

The development of animal husbandry, especially in beef cattle, has been carried out for generations and shows quite good development, including in groups. In general, the community has livestock, especially sheep and beef cattle with the motive of keeping as a side business and for savings, this is very possible because natural conditions, the availability of grass and the attention of the local government to the development of beef cattle are very supportive (Fathurohman *et al.*, 2022).

The Government of the Republic of Indonesia through the Ministry of Agriculture in 2015 issued a livestock area program under the name Sentra Peternakan Rakyat or commonly known as SPR. SPR is an association of smallholder breeders with the aim of realizing different breeders. SPR has been formed for about 2 years. There have been many programs implemented by SPR ranging

from improving group administration, training, and assistance from both the central and local governments. In 2017 the central government's assistance program for SPR was no longer provided, making the programs that had been running less effective (Ditjen, 2015)

One of the livestock areas in Indonesia is the Cinagarabogo livestock area of Subang Regency. For approximately 2 years running a livestock area business, selling through offline and online. According to information obtained from livestock groups belonging to the region, competition in animal husbandry is getting tougher, so breeders are constantly trying to survive and even develop. Many organizations are growing rapidly because they can create the right business model. Business model canvas (BMC) successfully transforms the concept of a complex business model into a simple one (Fathurohman & Baharta, 2020)

More than 90% of local beef supply comes from small-scale farms, so production efficiency is low or the cost per unit of production is high. If the number of imports is not controlled, it will result in the price of local beef in the market being depressed with cheap import prices so that farmers lose out. If this happens in the long term and with limited capital, it will make farmers not eager to do beef cattle business (Widiati, 2014).

The development of cattle in quantity has been able to have a very real impact on increasing people's income in improving their welfare. The development, which is currently still based on the strength of people's livestock, has made this business managed traditionally. The purpose of maintenance which is still used as a side business from farming activities has caused market demand to have not become the main consideration for livestock business. In this condition, it is very difficult to encourage the community to achieve an economic scale of business in the livestock business (Fathurohman, 2019).

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LITERATURE REVIEW

The People's Husbandry Centre (SPR) which was launched in early 2016 is expected to make Subang district a national and regional beef supporter, according to the Decree of the Minister of Agriculture. In West Java Province, out of 27 regencies/cities only four regencies are the sites for SPR. of the four districts, in Subang there are two SPRs and three other areas one SPR each. Two SPRs in Subang, namely Kasaliang, cover the areas of Kasomalang, Cislak, Tanjungsang. Then SPR Cinagarabogo covers the Cipunagara and Cibogo areas. The People's Husbandry Centre (SPR) Cinagarabogo produces ruminant feed which is then sold publicly to farmers in Subang Regency. This feed is made manually with corncobs as the main ingredient. Generally, the use of a disk mill machine can help the process of making ruminant feed. The disk mill machine has the main function of chopping and crushing grains into flour (Efendi & Suhartono, 2018).

Added by the components of the disk mill machine has several main components, namely (1) a hopper, made of iron plate in the shape of an inverted pentagon measuring 27 x 20 x 21 cm, (2) a shell / cage consisting of four rotating blades with a size of 3 x 2 x 2 cm, eight cylindrical knives with a diameter of 1.5 cm, and 24 static knives measuring 2 x 2 x 1.5 cm, (3) one channel for dispensing flour from an iron plate measuring 15 x 6 cm, (4) a three-phase drive engine with a power of about 2.2 kw, and (5) a transmission system using a belt (Rangkuti *et al.*, 2012). The use of disc mill machines is very useful in agriculture and plantations (Nandiyanto *et al.*, 2020). Added (Nandiyanto *et al.*, 2020) disc mill machines are very suitable for crushing foodstuffs in a finer form. The performance of the cutting knife can make the process of refining corncobs more effective for ruminant feed (Kruszelnicka *et al.*, 2021). Fulfilling the target of making feed for all cattle breeders in the Subang area makes it necessary to design a disc mill machine to assist the process of making ruminant feed at SPR Cinagarabogo. The design is the beginning before the tool enters the manufacturing process (Nauval *et al.*, 2018). added (Efendi & Suhartono, 2019) that the design can be started from a hand sketch which is then described in the autodesk inventor application so that an image with 2D and 3D schemes is found. The results of previous research, from (Jibrin *et al.*, 2013), concluded that design and manufacturing are very much needed in the process of making an effective corncob crusher machine in agriculture.

MATERIALS AND METHOD

This research is a type of development research. Data collected through observation and documentation methods. The data were then analysed descriptively qualitatively. The stages of the research are as follows in Figure 1.

The research stages started from collecting data related to the disc mill machine, which was followed up with

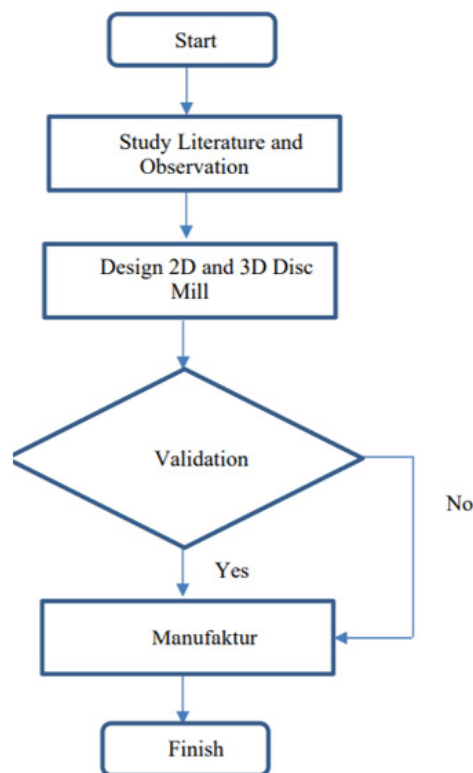


Figure 1: Research Stages

observations at SPR Cinagarabogo, then the research team made 2D and 3D sketches through the autodeks inventor application, image validation was carried out by experts, then entered the data analysis stage.

RESULT AND DICUSSION

Study Literature and Observation

The literature study was carried out by the research team in collecting several publications regarding the design of a disc mill machine for corn cobs. Then continued with observations at the People's Husbandry Centre (SPR) Cinagarabogo. Interviews were conducted with the head of the SPR to seek information regarding the need for tools that can assist the process of making ruminant feed there.

The research team saw sheet consisting of detailed design drawings, materials, sizes and punctuation marks on the disc mill machine design. Questions obtained from the results of discussions with the Head of SPR regarding the need for machines that support the process of making ruminant feed. Item consists of 25 questions. The results of the data are processed quantitatively using a Likert scale 5.

This stage is the first step in making tool designs which will later provide a clear picture for the manufacturing department in making the conceptualized machine. This design describes the size, type of material and working procedures. The design process uses the autodesk inventor application. This design is in accordance with the needs obtained during an interview with the head of the People's Husbandry Centre (SPR) Cinagarabogo.

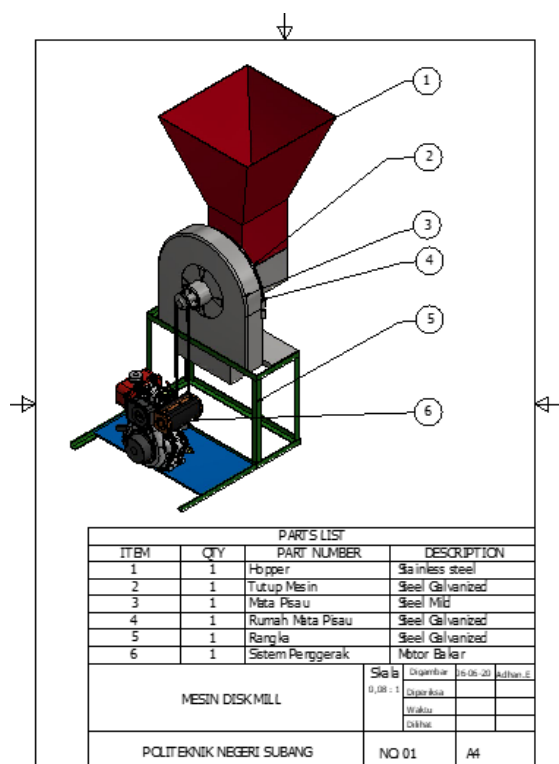


Figure 2: Disc Mill Design 2D

In the process of making 2D sketches, it was found that some components were made of stainless steel. This is because based on the needs analysis, the machine will be used to crush corn cobs in ruminant feed, so a strong machine is needed in the process.

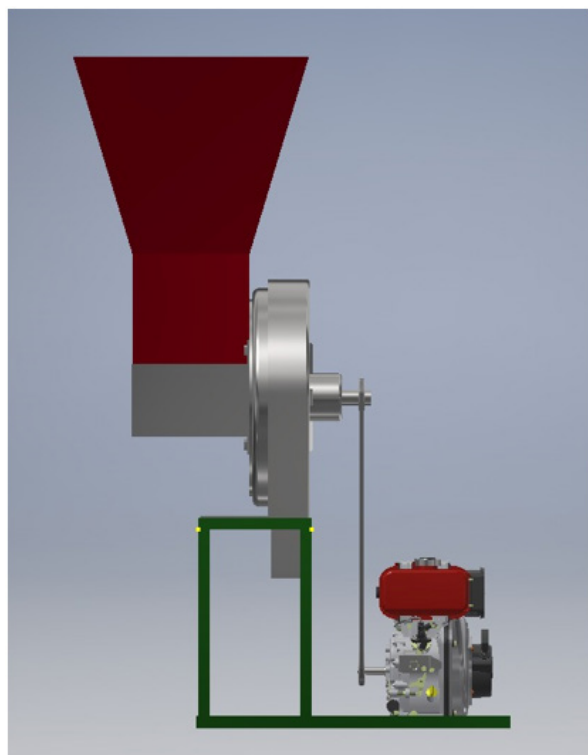


Figure 3: Disc Mill Design 3D

In the next stage, the research team created a 3d image of the disc mill machine. Also made a detailed description of each component in the disc mill machine. Drawings of components and types of materials used will facilitate the manufacturing process in making machine prototypes.

Validation

In the design validation stage the tool was carried out by Mr. Agus Haris Abadi, S.Pd., M.Pd who was a validator in the field of design to carry out inspections and the feasibility of the corncob crushing machine that had been previously designed by researchers to find out whether the tool could be used. the next process is manufacturing machine manufacturing, or the design revision process still must be carried out because there are still several things that need to be reviewed again, with notes that have been provided by the validator. In the validation stage of this engine design, four revisions have been made which were checked by the validator. the implementation of the revision given by the validator is in the form of withdrawing information contained in the tool components and providing information on the height, width, and length of the machine design. This is done to make it clear when the manufacturing department reads the working drawings. Validation adjusts the drawing rules, selection of materials and sizes, as well as the suitability of punctuation in 2D designs. The validation results state that the image gets a score of 87% or is in the proper category.

The assessment covers the clarity of the design, the appropriateness/accuracy of the design, the merging of documents, the view of the projection/drawing, the feasibility of the design. The Likert scale can be seen in Table 1.

Tabel 1: Indikator validasi						
No.	Indicator	Scale				
		1	2	3	4	5
1	Clarity of design				V	
2	Appropriateness/ accuracy of design				V	
3	merging documents				V	
4	Views of projection /drawing				V	
5	design feasibility				V	

Manufacturing

In this stage, researchers carry out the manufacturing process. This process begins with the process of measuring, cutting, welding, and assembling. Making machines based on validated drawings. The tool making process guide uses work preparation as a reference in the stages of making a disk mill machine.

The work process begins reading work preparation (WP). The materials used in the manufacture of the corn crusher machine frame are galvanized hollow 37 mm x 37 mm 1.2 mm thick, 2 mm thick stainless-steel plate, 0.8

mm thick stainless-steel plate, and 10 mm long stainless-steel pipe with a diameter of 25.5 mm. 1mm thick. After the tools and materials are prepared, measurements are made on the materials according to the design drawings using a roll meter and an angled ruler.

After the measuring and marking process is complete, carry out the process of cutting the material to form the parts using a hand grinder and a cutting disc. Cutting based on the dimension line that has been made. After all the material is cut to size, then make an angle of 45°. The cutting results are then refined on the sharp edges so as not to harm. Manufacturing documentation can be seen in Figure 4.



Figure 4: Measurement, cutting and assembly Disc Mill Machine

The next process is joining the materials by welding. Welding is carried out using a SMAW welding machine and using RD 260 electrodes. Before welding is carried out, first adjust the current of the welding machine according to the diameter of the electrode used, then do a tack weld as a temporary connection before doing long welding. Welding a long 750 mm galvanized hollow and a 600 mm long galvanized hollow which has been made at an angle of 45° at the ends to form 90°. The corncob disc mill machine can be seen in Figure 5.



Figure 5: Disc Mill Machine

Performance Testing

Performance tests show that the machine can crush corn cobs for the manufacture of ruminant feed with a capacity of 25 kilograms of corn cobs/1 hour. The disc

mill machine that has had its filter repaired and its cooling system run again for 1.5 hours non-stop, the results obtained are that the machine can work, and the engine temperature has decreased.

The results obtained from repairing this disc mill machine are:

1. The filter can be reused as seen from the result that the resulting components are evenly small.
2. The engine temperature has decreased quite well, seen when checking the engine performance test using the same tribological tool during the initial observation. The machine is started and floured, and the engine



Figure 6: Crushed Corncobs from the Machine

temperature remains between 53 to 65 degrees Celsius.

3. The disc mill machine becomes cleaner after repair and cleaning.

The results of this test were carried out at the the People's Husbandry Centre (SPR) Cinagarabogo feed manufacturing warehouse. Some of the shortcomings are related to the fineness of the results of crushing the corncobs, so that it requires repeated crushing processes.



Figure 7: Engine Temperature Testing

CONCLUSIONS

Based on the research, it can be concluded that the design made has been declared valid with a score of 87% or is in the proper category. Further recommendations that the design is feasible to proceed to the manufacturing process. The limitation of this research is making tool designs using the Auto Cad (CAD) application, the manufacturing process includes making frames,

stands, and other necessary components. Tool testing is carried out twice, namely laboratory scale testing and field testing, this study was also limited to one type of corncob available at SPR Cinagarabogo and treatment during the dry season. The social impact of this research is that breeders, especially in Subang Regency, can utilize corn cobs which are usually thrown away as animal feed, besides that breeders are able to utilize simple but effective technology. Suggestions for further research using corncobs with different levels of water content and carried out in the rainy season.

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