Design of Mini Grass Chopper Machine as a Solution to The Problem of Goat Food Resistance in Micro-scale Farm

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Abstract. The existence of micro-scale goat farmers, with fewer than 15 goats, helps stabilize the rural economy through job creation and income distribution. However, the potential of micro farmers' resources is underdeveloped, which causes the economic added value of goat farming to be low. Goat farming on a micro-scale is generally carried out by families who mainly work as small farmers with limited financial capabilities and small amounts of installed electricity, and who rely on their husbands to meet their economic needs. In addition to the problem of human resources, the basic problem is the lack of availability of feed all the time. The availability of abundant feed in the rainy season is difficult to utilize during the dry season. Utilization of feed preservation technology is difficult to achieve due to limited financial capabilities, and it is not economically feasible to procure grass chopping machines as the initial process of feed preservation. Existing machines are generally suitable for use by larger-scale farmers with high procurement, propulsion, and operational costs. With this condition, every day the farmer must look for feed for the needs of that day. This has narrowed the space for micro-farmers to be able to develop other creative businesses, increasing income. Equally important, farmers will face difficulties in determining rest days for family activities and other social activities. In this applied research, the solution is formulated by designing a mini grass chopper machine that is suitable for meeting the needs of micro-scale goat breeders with the criteria that the machine is easy to operate by men or women, has small propulsion, is easy to maintain, and is inexpensive to procure.

Keywords: Chopper, Grass, Feed resistance, Micro-Scale FarmFirst Section

1. Introduction

Sheep and goats are small ruminant livestock species that have high economic value and are highly favored by the community. Consumption of sheep and goat products in the form of meat, milk, leather, and by-products is increasing every

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year[1]. In addition to the domestic market, the international market is also very open for the marketing of sheep and goats. This is a very potential opportunity for Indonesian sheep and goat breeders to increase the value of the benefits of these goats. However, until now, sheep and goats have not been able to provide maximum benefit value because most of their management is still a subsystem that has not paid attention to the proper technical provisions[2].

The existence of micro-scale goat farmers, with fewer than 15 goats, helps stabilize the rural economy through job creation and income distribution. However, the potential of micro farmers' resources is underdeveloped, which causes the economic added value of goat farming to be low[3].

Goat farming on a micro-scale is generally carried out by families who mainly work as small farmers with limited financial capabilities and small amounts of installed electricity, and who rely on their husbands to meet their economic needs. In addition to the problem of human resources, the basic problem is the lack of availability of feed all the time. The availability of abundant feed in the rainy season is difficult to utilize during the dry season. Utilization of feed preservation technology is difficult to achieve due to limited financial capabilities, and it is not economically feasible to procure grass chopping machines as the initial process of feed preservation. Existing machines are generally suitable for use by larger-scale farmers with high procurement, propulsion, and operational costs. With this condition, every day the farmer must look for feed for the needs of that day. This has narrowed the space for micro-farmers to be able to develop other creative businesses, increasing income. Equally important, farmers will face difficulties in determining rest days for family activities and other social activities. In this applied research, the solution is formulated by designing a mini grass chopper machine that is suitable for meeting the needs of micro-scale goat breeders with the criteria that the machine is easy to operate by men or women, has small propulsion, is easy to maintain, and is inexpensive to procure[4]–[6].

2. Design Methods

2.1 Design Preparation

Design is an innovative and highly iterative process. It is also a decision-making process. Decisions sometimes have to be made with too little information, sometimes with the right amount of information, or with an excess of partially contradictory information[7]. The process of designing this mini chopper uses a flow diagram as shown in figure 1.

Digital prototyping helps manufacturers to virtually simulate a product and its associated lifecycle phases, such as product manufacture, assembly, and functionality, before the product is physically realized[8]. This gives manufacturers an excellent opportunity to visualize and anticipate aspects of the physical performance of a design with less reliance on costly physical experimentation. Physical prototying and testing are still requirements, especially for complex products. However, the clear current industry trend is toward reducing physical testing by replacing suitable aspects with virtual testing and verification[1]. The digital verification results are compared with the experimentation results; this validates and certifies the computational code embedded in a digital prototype. Thus, a validated digital prototype can be utilized for verifying

the physical performance of the product manufactured in the globally dispersed supply chain.

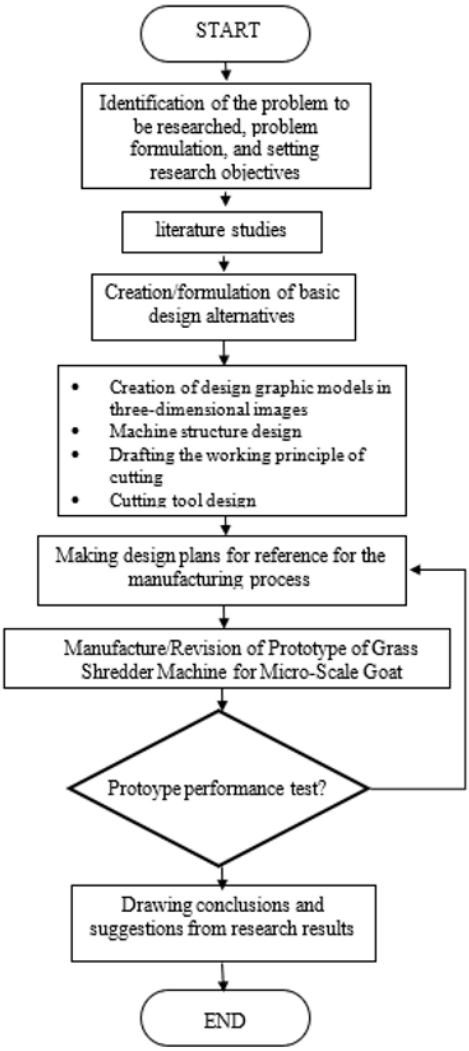

Fig. 1. Flow diagram of designing mini grass chopper

2.2 Mini Grass Chopper

An elephant grass chopper is a tool used to assist ruminant husbandry (cows, horses, buffalo, goats, and sheep) in terms of providing food. In general, the grass chopper consists of a motor that functions as propulsion, a transmission system that functions as a power transfer system, and a casing that serves to protect the engine components, the frame axis, and the chopper blade. The thing that must be considered in making the elephant grass chopper is how to make a strong engine and frame. The blade is sharp until several cuts are made. The machine or animal feed chopper must function opti-

mally according to its functions and needs. These are the things that must be considered most[9].

Research on the design of the elephant grass chopper has been carried out, which is planned for a feed requirement of 400 kg/day. drive unit with a power of 5.5 hp and a rotational speed of 3600 rpm. The counting process is carried out by involving vertical and horizontal knives. The counting machine produced a chopper with dimensions of 860 mm x 600 mm x 1,220 mm.

The use of a high-powered motor becomes less appropriate for the needs of micro-scale goat breeders, who typically only have a 450-watt or 900-watt electrical power source installed in their home. This emphasizes the importance of researching grass-chopping machines with small power so that they are suitable for micro-scale goat breeders[10].

In previous studies, the results of the design of the grass chopper machine produced were driven by an electric motor with enough power to produce a large chopping capacity of grass to meet large feed requirements. The results of this design are not very suitable for the needs of micro farmers who only need a grass chopper with a small capacity.

3. Design of Mini Chopper

The design of a mini chopper was proposed using outer and inner cutter mechanisms. Figure 2 shows that the chopper design uses the inlet and outlet for shredding grass.

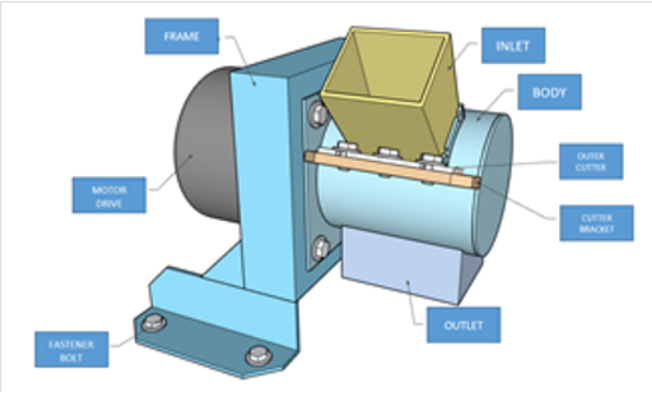

Fig. 2. Design of mini chopper

Using the mechanism of outer and inner cutters, the chopper was expected to be as strong as possible to cut even a branch of elephant grass. The inlet was designed to fit on grass and medium-sized branches. A plane cutter as the inner and outer cutter was used. The frame was designed as compact as possible to accommodate the space used by the chopper

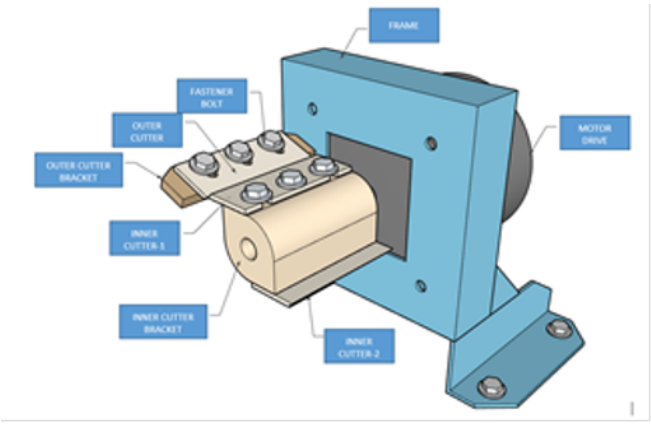

Fig. 3. Design of mini chopper(without body and inlet)

An electric motor drive with a power of 300 W was proposed to be used on this design. A low-watt electrical motor drive was used to accommodate the household electrical power source installation, which generally used 450 W and 900 W. Using DC current for the electrical motor drive

A DC electric motor, or DC motor, is a device that converts electrical energy into kinetic energy or motion (motion). This DC motor can also be referred to as a direct current motor. As the name suggests, DC motors have two terminals and require direct current (DC) to drive them. This DC electric motor is usually used in electronic and electrical devices that use a DC power source, such as mobile phone vibrators, DC fans, and DC electric drills. In principle, a DC electric motor uses electromagnetic phenomena to move. When an electric current is applied to the coil, the surface of the coil which is north will move towards the south pole of the magnet, and the coil which is south will move towards the north of the magnet. At this time, because the north pole of the coil meets the south pole of the magnet or the south pole of the coil meets the north pole of the magnet, there will be mutual attraction, which causes the movement of the coil to stop[9].

Using the mechanism of an inner cutter that rotates about the outer cutter makes strong clamping and cutting force possible. The inner and outer cutters are made of solid steel HSS, which is commonly used in planner machines. The clearance angle on the inner and outer cutter was acting as a jaw and cutting media.

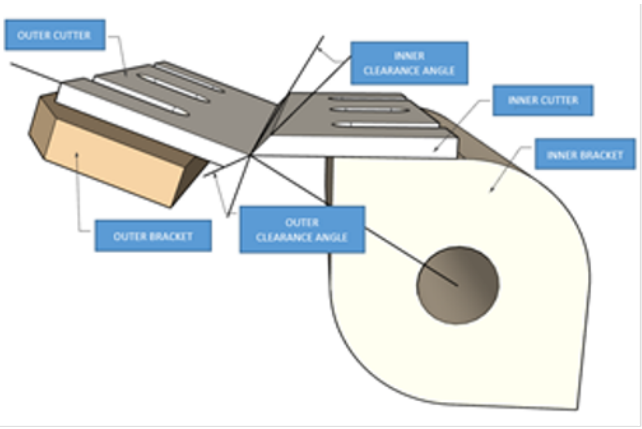

Fig. 4. Inner and outer cuuter mechanism

Clearance angle is a free angle that serves to concentrate the puncture force that arises in a small area near the cut edge. The wedge angle is the angle from the side of the two inclined planes which serves to separate the gram from the workpiece. The throw angle is the angle when the chip leaves the workpiece in a direction away from the cutting edge. The cutting angle is the angle required to cut the workpiece.

Clearance angle on inner and outer cutter were used to prevent excessive cutting load during operation. Specific angle on clearance section was designed to accommodate such as problems.

Profiled steels were used as body and frame in this design. Cutter or blade cover were used around as protective case. Protective case was used to protect cutter when the machine was on. As a safety device, this protective case equipped with abundant clearance to prevent the grass that were chopped to get stuck[11].

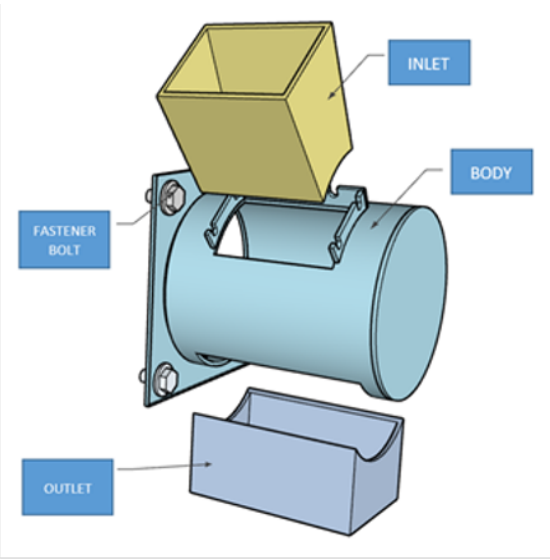

Fig. 5. Frame construction

As shown in Figure 5, the construction of the frame was designed to be as compact and safe as possible. Using steel tube as a cutter or blade cover to make sure the product (grass) and cutter operate as safely as possible. The inlet for inserting grass products was designed to ensure the ease of putting grass products into the machine. The outlet or tray for products was designed to contain chopped grass so that the chopped grass does not fall and be scattered.

The design of the mini grass chopper proposed above has met the rules in the process of designing a work aid product. The tool products in question are jigs and fixtures for basic daily work. where the basis for designing jigs and fixtures was able to increase productivity, parts were interchangeable, skill reduction, and cost reduction[12].

4. Conclusion

Grass chopping machines are the key to feeding resistance from livestock. This paper has presented how design of mini grass chopping machines were proposed. Based on fundamental of designing jig and fixtures for daily basic work. The purpose of designing the mini grass chopper was to accommodate the needs of micro-scale breeders and was adapted from several aspects, including:

- Designed as compact as possible.
- Reliability of the chopper knife as best as possible.
- Interchangeability of each part.
- Easy to maintenance.
- requires minimal power.

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