

COMPARATIVE COST ANALYSIS AND PERFORMANCE OF SELF - PROPELLED AND TRACTOR - MOUNTED LAWN MOWER

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ABSTRACT

The cost implications and performance of using self-propelled and tractor-mounted mowers in keeping the lawns of three different organizations were compared and studied in this research. The aim is to justify the use of petrol or diesel-dependent farm machinery for the routine work of lawn mowing. Questionnaires, personal visits, and field measurements were employed in collecting data for the research work. Main data were collected from the maintenance, works, and services departments of each organization. The number of lawn mowers, frequency of use, cost of labour, cost of fuel, and cost of maintenance in three organizations were analysed and compared. The result shows that despite the higher cost of fuel, labour, and maintenance of using tractor-mounted mowers when compared with self-propelled type, the organizations use tractor-mounted mowers more because of larger coverage and non-availability of labour required to operate self-propelled mowers.

KEYWORDS: Mowers; Cost; Self - Propelled; Tractor – mounted; Lawn

INTRODUCTION

A lawn mower, sometimes referred to as a mower, grass cutter, or lawnmower, is a device that cuts grass to a uniform height utilizing one or more rotating blades or a reel. Although the mower's construction may have fixed the height of the cut grass, it is usually changeable by the operator using either a single master lever or a lever or nut and bolt on each wheel of the vehicle. The mower's blades can be operated manually, or it can have an electric motor that plugs in or runs on a battery (Bhateja et al., 2020). In the latter case, the wheels are mechanically fixed to the cutting blades, causing the blades to spin when the mower is pushed forward.

An internal combustion engine, usually consisting of one cylinder, is the most often used self-contained power source for lawnmowers. Smaller mowers frequently have no propulsion at all, needing human strength to move across a surface; "walk-behind" mowers, on the other hand, are self-propelled and simply need a person to follow and assist them.

Bigger lawnmowers are often either "walk-behind" models that run on their energy or, more frequently, "ride-on" models that allow the user to steer and ride atop the mower. According to Ajewole et al. (2024) and Wu et al. (2020), a robotic lawn mower, often known as a "lawn-mowing bot" or "mowbot," is made to run totally on its own or, less frequently, with the assistance of a remote-control operator.

There are various kinds of mowers, and each is appropriate for a specific use and scale. For modest residential lawns and gardens, the smallest models—non-powered push mowers—are appropriate. For larger residential lawns, push mowers with electrical or piston engine power are utilized (though there is some overlap). While commercial riding lawn mowers (like zero-turn mowers) can be "stand-on" types and often have little in common with residential lawn tractors, they are made to mow large areas at high speed in the least amount of time. Riding mowers, which can occasionally resemble small

tractors, are larger than push mowers and are suitable for large lawns. Large grassy areas like municipal parks and golf courses are the ideal application for the largest multi-gang (multi-blade) mowers, which are attached to tractors (Springfels, 2014).

Types of mower

At the appropriate cut height, a stationary, horizontal cutting blade is mounted on a cylinder or reel mower (Figure 1). This is covered by a rapidly rotating blade reel that pushes the grass past the cutting bar. The set of rotating blades depicts a cylinder, and each blade in the blade cylinder spins in a helix around the reel axis. A well-adjusted cylinder mower yields the cleanest cut of any mower, which speeds up the healing process (Okokpujie et al., 2017; Hessayon, 2007). A properly calibrated cylinder mower cuts as cleanly and precisely as it would with a pair of scissors. A well-trimmed grass is more resistant to disease, weeds, and parasites and grows stronger, thicker, and more robust. Shredded leaves from a cylinder mower are less likely to leave a lawn discolored yellow, white, or brown. Although the cutting motion is sometimes compared to that of scissors, the spinning cylinder's blades do not always need to come into contact with the horizontal cutting bar (Hessayon, 2007).

A gasoline engine or electric motor can be added to a cylinder mower to power the cylinder, the wheels, the roller, or any combination of these. A typical arrangement on electric-powered machines for residential lawns is for the motor to power the cylinder while the operator pushes the mower along. The electric models can be corded or cordless. On petrol machines, the engine drives both the cylinder and the rear roller. Some variants have only three blades in a reel spinning at great speed, and these models can cut grass that has grown too long for ordinary push mowers (Simons, 2017).

Rotary mowers (Figure 2) were not developed until engines were small enough and powerful enough to run the blades at sufficient speed. Many people experimented with rotary blade mowers in the late

1920s and early 1930s and Power Specialties Ltd. introduced a gasoline-powered rotary mower. Kut Kwick replaced the saw blade of the "Pulp Saw" with a double-edged blade and a cutter deck, converting the "Pulp Saw" into the first ever out-front rotary mower (Sinha & Mathur, 2020).



Figure 1. A non-motorized multiple-blade reel push mower



Figure 2. A rotary mower (viewed from underneath), with a mulching blade that rotates

Tractor-pulled mowers (Figure 3) are usually in the form of an attachment to a tractor. The attachments can simply function by the movement of the tractor similar to manual push cylinder mowers, but also sometimes may have powered moving blades. They

are commonly mounted on either the side or the back of the tractor (El-Ashkar, 2019; Jang et al., 2006). Riding mowers (Figure 4) or ride-on mowers (U.K. and Canada) are a popular alternative for large lawns. The operator is provided with a seat and controls on the mower and rides on the machine. Most use the horizontal rotating blade system, though usually with multiple blades. A common form of ride-on mower is the lawn tractor. These are usually designed to resemble a small agricultural tractor, with the cutting deck mounted amidships between the front and rear axles (Hafeze, 2023; Scott, 2005).



Figure 3. Tractor pulled mower

More attachments for riding lawnmowers include rototillers/rotavators, snow plows, snow blowers, yard vacuums, and sometimes even front buckets or fork-lift tines (which, in this context, are more appropriately referred to as "lawn tractors" because of their multipurpose nature). They feature many gears, frequently up to five or six, and variable top speeds, which allows them to tow other devices (Liao et al., 2021).

A robotic mower is contained by a border wire around the lawn that defines the area to be mowed. The robot uses this wire to locate the boundary of the area to be trimmed and in some cases to locate a recharging dock. Robotic mowers are capable of maintaining up

to 5 acres (20,000 m²) of grass. Robotic lawnmowers are increasingly sophisticated, are usually self-docking, and contain rain sensors, nearly eliminating human interaction for mowing grass. Multiple robotic mowers can be used to mow an even larger area (Enogaling, 2023).



Figure 4. Robotic mower

Electric mowers (Figure 5) are further subdivided into corded and cordless electric models. Both are relatively quiet, typically producing less than 75 decibels, while a gasoline lawn mower can be 95 decibels or more (Scott 2005). Corded electric mowers are limited in range by their trailing power cord, which may limit their use with lawns extending outward more than 100–150 feet (30–45 m) from the nearest available power outlet. There is the additional hazard with these machines of accidentally mowing over the power cable, which stops the mower and may put users at risk of receiving a dangerous electric shock. Installing a residual-current device (GFCI) on the outlet may reduce the shock risk. Cordless electric mowers are powered by a variable number (typically 1–4) of 12-to-80-volt rechargeable batteries. Typically, more batteries mean more run time and/or power (and more weight). Batteries can be in the interior of the lawnmower or on the outside. If on the outside, the depleted batteries can be quickly swapped with recharged batteries. Cordless mowers

have the maneuverability of a gasoline-powered mower and the environmental friendliness of a corded electric mower, but they are more expensive and come in fewer models (particularly the self-propelling type) than either. The eventual disposal of worn-out batteries is problematic (though some manufacturers offer to recycle them), and the motors in some cordless mowers tend to be less powerful than gasoline motors of the same total weight (including batteries) (Scott, 2005; Pirchio et al., 2019).



Figure 5. Cordless electric lawn mower

Internal combustion engines are used to power the majority of rotary push mowers. These engines run on gasoline (petrol) or other liquid fuels and are often four-stroke engines because of their higher torque and cleaner combustion (although some older types had two-stroke engines as well). Typically, lawnmowers employ single-cylinder internal combustion engines. Four to seven horsepower is the typical range for power. The engines typically have a carburetor and must be started by a manual pull crank; however, some models—especially the larger riding and commercial mowers—come with an electric starter. Some mowers have a throttle control on the handlebar with which the operator can adjust the engine speed. Other mowers have a fixed, pre-set engine speed. All

are equipped with a governor (often centrifugal/mechanical or air vane style) to open the throttle as needed to maintain the pre-selected speed when the force needed to cut the thicker or taller grass is encountered (Hessayon, 2007).

Gasoline mowers (Figure 6) have the advantages over electric mowers of greater power and distance range. They do create a significant amount of pollution due to the combustion in the engine and their engines require periodic maintenance such as cleaning or replacement of the spark plug and air filter and changing the engine oil. Growing awareness of the air pollution caused by small gas engines has resulted in some state-level legislation pushing consumers to choose machines with different power sources (Wikipedia, 2021).



Figure 6. Gasoline rotary lawn mower

The robotic lawn mower mechanism of solar-powered mowers is based on a microprocessor and sensor design. This solar-powered robotic lawnmower charges its battery while it is being used to cut the lawn or even by hand. The lawn's humidity level was measured using a humidity sensor, and impediments were avoided using ultrasonic sensors. Human involvement with the gadget in use was detected using a passive infrared sensor (PIR). An Android smartphone was used to take the necessary pictures of the lawn. This design is meant to serve as a green substitute for the widely used but potentially

harmful gas-powered lawnmower (Tanimola et al, 2014).

Efficiency of lawn mower

Mowing height represents an important parameter that can strongly influence harvested yield and forage nutritive quality (Stanisavljević, 2019). Chen et al (2024) found that alfalfa mowed at 10 cm above the ground surface decreased the yield by up to 38% with respect to the yield collected from alfalfa crop mowed at 5 cm. Their conclusion was confirmed by (Savoie et al, 2011). who also noted that alfalfa mowing at higher heights increases further weed growth and competition for growing space, sunlight, water, minerals, fertilizers if applied, etc. in subsequent alfalfa growths. The final consequence of this competition is manifested through a more rapid reduction in alfalfa plant size with respect to low-height mowing. However, according to the same authors, in addition to higher yield, low cutting height provides lower quality feed. Therefore, alfalfa mowing height should be carefully chosen to meet the current market and environmental conditions.

A lot of other factors, such as the timing of cutting, affect mowing output and quality. In contrast to the moderate cutting schedules that apply 7 or 8 cuts in the flatlands and the conventional schedule of 3 or 4 cuts in the intermountain regions, a more profitable schedule is closely linked to market conditions. Essentially, yield is prioritized during periods of low crop prices, while quality also takes center stage during periods of high market prices. According to Orloff and Putnam (2010), the ideal farmer mowing schedule would be modified to accommodate the demands of the market.

The two fundamental types of cutting mechanisms used in all current mowers are rotary (disk or drum) and cutter bar (oscillatory). In Rotz (2005). The cost of operating rotary mowers is often higher for a given cut width and requires more power and fuel; but, because of their increased mowing capacity, the total cost of lawn care for both main varieties of mowers is identical. The rotating drum mower required much

more power and fuel, according to Stanisavljević et al. (2005).

MATERIALS AND METHODS

The methodology employed in this research is the design of a questionnaire that was administered to higher institutions in Ado Ekiti such as Afe Babalola University, Ekiti State University, and The Federal Polytechnic Ado-Ekiti. The questionnaire contains questions for getting data on both self-propelled and tractor-mounted mowers. The data collected for each type of mower includes the number of mowers available, frequency of usage, cost of fuel, labour, and cost of maintenance.

RESULTS AND DISCUSSION

The comparison of the number of self-propelled and tractor-mounted lawnmowers in the three organization is shown in Figure 7. It shows that among the number of lawnmowers used by the three organizations, EKSU uses self-propelled lawnmowers the most. This implies that the number of self-propelled lawnmowers used in the organization is more compared to others.

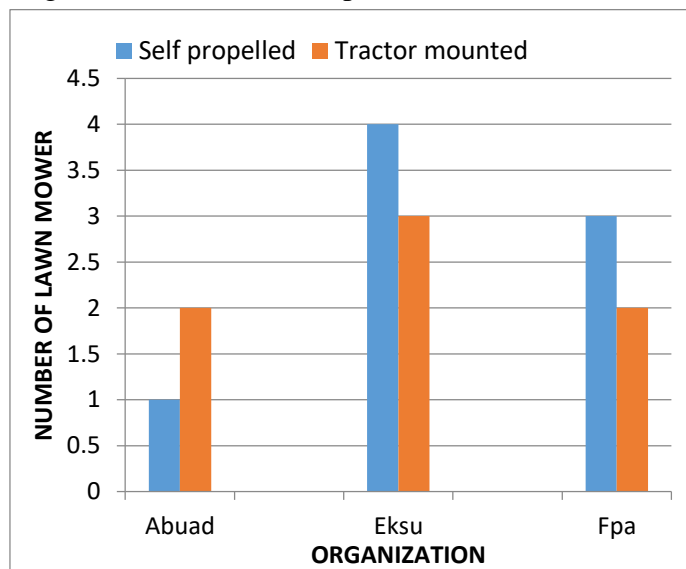


Figure 7. Number of lawnmowers used by the organizations

The comparison of the frequency of use of self-propelled and tractor-mounted mowers in the three organization is shown in Figure 8. The frequency of use of lawnmowers shows that the frequency of use

of mower used by the three organizations, the FPA is the highest by using frequency of use of mower. Also, the frequency used in the organization is more compared to others.

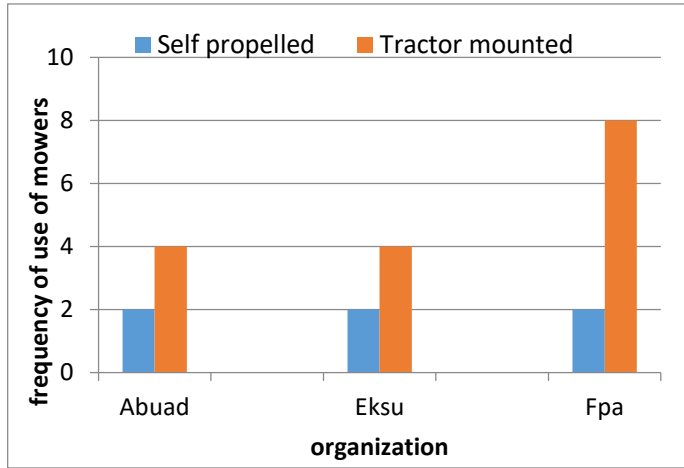


Figure 8. Frequency of use of mower

The comparison of the cost of fuel self-propelled and tractor mounted in the three organization is shown in Figure 9. It shows that the cost of fuel used by the three organizations, that the ABUAD is the highest of the cost of fuel. In other words, the number of self-propelled lawnmowers used in the organization is more compared to others.

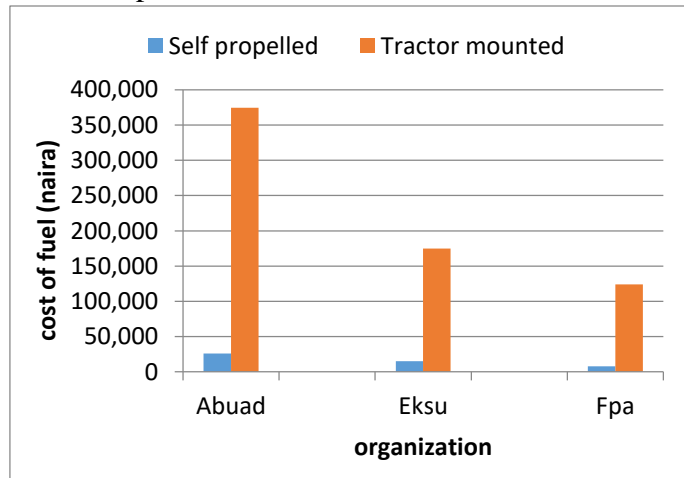


Figure 9. Cost of fuel

The comparison of the cost of labour operation of self-propelled tractor-mounted lawnmowers in the three organizations is shown in Figure 10. The cost of labour/operation used by the three organizations, that of ABUAD is the highest by using a self-propelled

lawn mower. Also, the cost of labour/operation used in the organization is more compared to others.

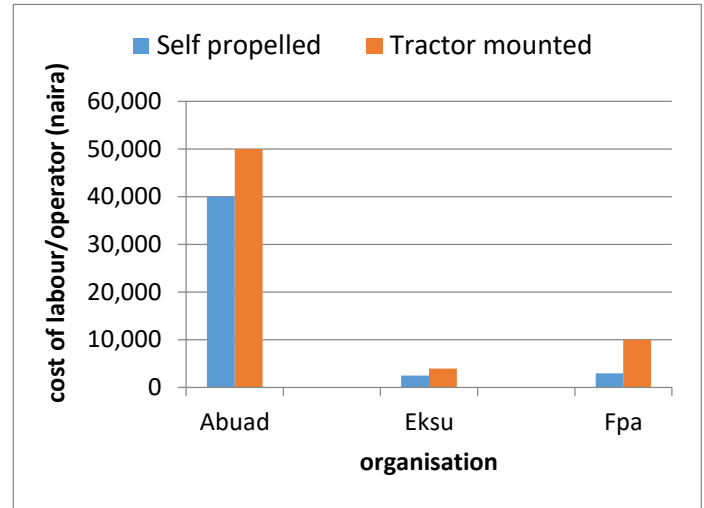


Figure 10. Cost of labour/operator

The comparison of cost maintenance self-propelled tractor-mounted lawnmowers in the three organizations in Figure 11. It shows that the cost of maintenance used by the three organizations, that of ABUAD is the highest by using self-propelled lawnmowers. This implies that the cost of maintenance in the organization is more compared to others.

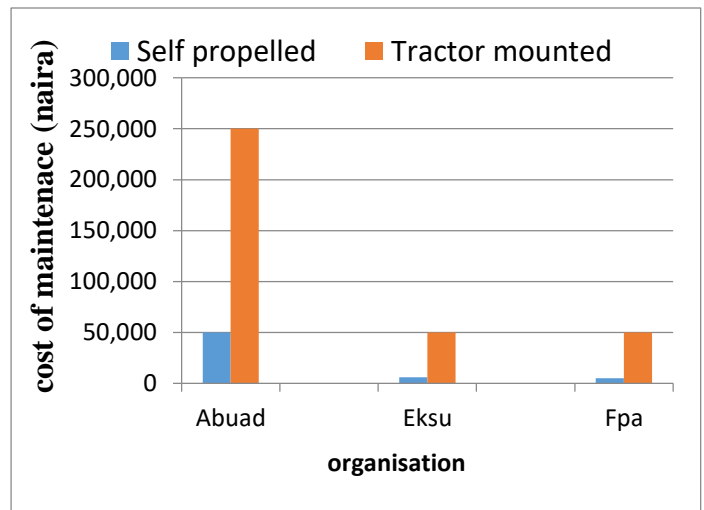


Figure 11. Cost of maintenance

CONCLUSIONS AND RECOMMENDATIONS

The study on comparative cost efficiency of self-propelled and tractor-mounted lawn mowers. The work was carried out by comparing the number of

lawnmowers frequency of use, cost of labour/operator, cost of fuel, cost of fuel, cost of maintenance in three organizations in Ado-Ekiti by administering questionnaires to the three organizations (FPA, EKSU, and ABUAD) respectively. The result obtained showed the following:

- i. The organization that use self-propelled lawnmowers are more than those that use tractor-mounted lawnmowers because of cost efficiency.
- ii. The cost of operation/labour is the same all through depending on the number used and frequency of use.

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