

# Comparison of Agricultural Machine Tool Needs in Food Crop Farming on Direct Surveys and Integrated Planting Calendar Information Systems

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## ABSTRACT

This study aims to compare the needs of agricultural machinery in rice farming through direct surveys and integrated Planting calendar information systems. This research was conducted in July-September 2020 in Boalemo Regency. The number of respondents in the study was 54 farmers. Based on the study's results, it is known that agricultural machinery is very necessary. This is stated by 91% of respondents stating they always use agricultural machinery in their farming business. Agricultural machinery, *hand tractors*, *power thesors*, and *combine harvesters* are included in the high category that farmers often use with percentages of 9, 8.15%, 85.19%, and 72.22%. Rice *transplanters* are still in the low category 40.74%, due to small land ownership and lack of socialization. The use of agricultural machinery can save costs, reduce labour, and speed up work. Based on the calculation of the adequacy status of *the hand tractor*, *rice transplanter*, and *power thesers* is appropriate. However, in the *combine harvester* there is a difference in a calculation, manually, the status is less, and in the interactive application the status is saturated. This is due to differences in available tools, and delays in *updating* data on the planting calendar. So it is necessary to regularly input and repair existing data on the word. Analysis of the B/C ratio of *hand tractor*, *rice transplanter* and *power thesers* is  $>1$ . 0, will the business of agricultural machinery is profitable and feasible. While *the combine harvester* value B/C ratio  $<1$ . 0, the exploitation of agricultural machinery is detrimental and not feasible.

**Keywords:** agricultural machinery, Planting calendar, necessities, farming, rice

## INTRODUCTION

The use of agricultural tools and machinery has now become the main need for farmers to carry out agricultural business activities such as tillage, planting, harvesting and post-harvest. Farm workers are increasingly expensive and difficult to obtain because many choose non-agricultural jobs considered more promising than agriculture [1]

High population growth resulting in massive conversion of agricultural land will have an impact on food crisis, so human needs will not be met unless accompanied by environmentally friendly technological advances. So there is no choice but to hire agricultural machinery services to manage their agricultural business. Agricultural machinery is one approach to empower farmers, improve the

quality and added value of agricultural products, and increase the productivity and efficiency of agricultural businesses [2].

Efforts to boost production require careful planning based on accurate climate forecasts, such as accelerating planting in some locations, especially those with high rainfall. In directing this effort, planning tools are needed, through the Agricultural Research and Development Agency developed the Planting calendar in 2007, which was later refined into an Integrated Planting calendar. In 2013, an SMS-based integrated Planting calendar information delivery system and Android-based applications were developed [3].

The advantage of this integrated planting Planting calendar is that it makes it easier for users, especially farmers and extension workers, to get information on the beginning of the planting season *online* at each sub-district level covering 7,042 sub-districts, 514 districts, and 34 provinces. In line with that, data information on areas prone to flooding, drought, and attacks by plant-disturbing organisms (OPT) was also obtained, as well as recommendations for varieties, seeds, fertilizers, and agricultural machinery that must be prepared before the next planting season begins [4].

Agricultural equipment (machinery) in Boalemo Regency, such as *hand tractors*, has often been used, but *rice transplanters* are still very lacking. Many are still planting manually, and some use *tabel*. Power threshing machines and combine *harvesters* are two examples of agricultural machinery that have not been maximally utilized. However, along with the development and government programs aimed at achieving food self-sufficiency, these tools have begun to be utilized.

## MATERIALS AND METHODS

This research was conducted in Boalemo Regency, precisely in five sub-districts, namely Mananggu, Botumoito, Dulupi, Paguyaman and Wonosari. The five sub-districts are centres for rice and other food crops. The study was conducted between July and September 2020.

The Boalemo Regency Government for the 2017-2022 period has established one of the regional flagship programs, namely: increasing the productivity of rice and corn-based agriculture with an *integrated farming* system. This is stated in the map of agricultural land use directives in Boalemo Regency. So far, the use of agricultural technology in Boalemo Regency has increased yearly, especially the use of agricultural machinery, which has become an empowerment program from the government to achieve maximum production.

The condition of agricultural land in Boalemo Regency is mostly non-rice fields. Rice fields there are only in five locations, namely Mananggu District, Botumoito District, Dulupi District, Paguyaman District and Wonosari District [5]. Through the "agricultural revitalization" program, local governments strengthen the people's economy for potential groups by placing agriculture as a top priority. The agricultural sector has a lot of potentials because it has many productive lands, and the potential of paddy fields in 2020 was recorded at 4,940 ha [6].

Based on data from the Boalemo Regency Agriculture Office, the average rice production in the last five years is 59,936.2 tons, with an average productivity of 51.11 kw/ha [7]. Basically, production still has a great opportunity to increase if all aspects of farming are handled as well as possible, of course by using agricultural machinery. So it needs to be studied later whether the adequacy of agricultural machinery is following its needs, either through direct calculations or using integrated interactive Planting calendar applications.

In this study, *the random* sampling method was used as a sampling method. The following formula, derived from [8]. is used to determine the number of samples:

$$n = \frac{NZ^2S^2}{Nd^2 + Z^2S^2} \dots\dots\dots(1)$$

Description :

- n : Number of respondents  
 N : Total number of farmers  
 Z : Degrees of trust (90% = 1,645)  
 S<sup>2</sup> : Sample variants (5% = 0,05)  
 d : Degree of deviation (5% = 0,05)

Based on the calculation of the formula above, the number of respondents in this study was 54 people out of a total population of 29,455 people.

This study used primary data and secondary data. Primary data is information obtained directly from the field through direct interviews with questionnaire tools to respondents. In comparison, secondary data is supporting information from related institutions, journals, *proceedings*, scientific magazines, and other library sources.

The analysis used in this study was quantitative descriptive. This analysis provides a general overview of the data that has been collected or the findings of the observations that have been made. In this case, statistical analysis is used to describe quantitative data.

## Manual Analysis of Agricultural Machinery Requirements

The need for agricultural machinery is arranged based on the physical volume of existing work minus the volume of work that can be completed with available human labor and agricultural machinery, with the following equation [9] :

$$UT = \frac{Ls - Lg}{Kap} \dots\dots\dots(2)$$

Description :

- UT : Unit agricultural machinery needed for an activity in a region (unit/th)  
 Ls : Available harvest/production area to be worked on (ha/th or ton/th)

Lg : Harvest/production area can be cultivated by an available power source (ha/th or ton/yr)

Kap : Working capacity of agricultural machinery (ha/th or ton/th)

## Agricultural Machinery Needs Analysis Using Planting Calendar Interactive Application

The Planting calendar application has a menu to calculate agricultural machinery needs interactively (Balitbangtan, 2020). To find the needs of agricultural machinery (agricultural machinery) using the e-agricultural machinery application in the following ways:

1. Open the Alsin interactive application on the Planting Calendar website.
2. Enter the regional data.
3. Enter planting area and crop production data.
4. Click Calculate.

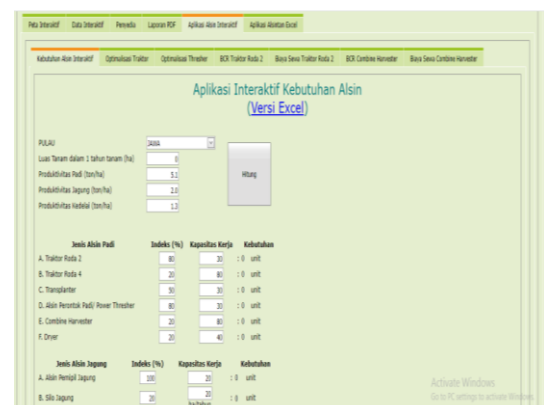


**Figure 1.** Interactive Application Planting calendar

Description :

1. Mechanization index :  
 Presentation of the area of land that can use the alsin.
2. Working capacity :  
 The working capacity of alsin in one year to achieve BEP in its economic life.

## ***Analysis of Operating Costs of Agricultural Machinery and Its Feasibility***

B/C ratio analysis is conducted to determine whether the farm is profitable or detrimental. The B/C ratio is the comparison between costs and revenue. The value of B/C ratio is obtained by referring to the formula obtained from (Sari et al., 2014) below:

$$\text{BCR} = \frac{\text{Total Acceptance}}{\text{Total Cost}} \dots\dots\dots(3)$$

The theB/C ratio must meet the following criteria :

1. The value of the B/C ratio > 1, meaning that farming is said to be profitable and viable.
2. The value of the B/C ratio < 1, means that the farm will lose money and not be feasible.
3. The value of B/C ratio = 1, means that the farm is in the break-even point (BEP).

## **RESULTS AND DISCUSSION**

### ***Characteristics of Sample Farmers in Boalemo District***

Based on the study's results, 92.59% of farmers are still in productive age (15-64 years), meaning that with this productive age, it will be easier for them to recognize new developments and assimilate new progress more quickly. This is in line with the opinion of [10] that age affects the ability to absorb innovations. A person will have a strong desire, motivation, skills, and responsibility to run his business when at a productive age.

Improving the education of farmers is good enough. Farmers with only primary school education are already under 50% of the population. Referring to the opinion of [10] that the higher the education, the faster they receive innovations. So it can be concluded that farmers have a high absorption or catchability of innovations. Therefore, when new technological innovations are introduced, farmers quickly respond to information because no one is illiterate anymore.

The interview results found that the land cultivated by farmers, which was between 1.1 to 3 ha, amounted to 46.3% of the total sample farmers. The remaining 53.7% of farmers own <1 ha of land. So it can be concluded that the average production of each farmer is included in the high production category. Argues that every decision of farmers in running their farming business will be influenced by the area of land they cultivate. People with smaller land areas tend to use new technologies to increase productivity [10].

Regarding the number of dependents, the number of family members of each farmer is generally still low. So that the land cultivated by

each petani still fulfils the burden on the pet and family. 70.37% of farmers have 1-3 dependents. Based on this data, the amount of labour that can be utilized in farming is quite available by utilizing family members as additional labour. The number of family members also affects the family's economic condition, meaning that more family members mean more costs are spent, and vice versa.

### ***Agricultural Machinery Requirements Analysis***

The use of agricultural tools and machinery, the availability of labour, and the most commonly used agricultural machinery are all taken into account in the descriptive analysis of agricultural machinery needs in rice farming. Here's the full analysis:

#### **Manpower Availability**

Based on the study, 89% of respondents stated that labour for tillage was available, and only 11% stated that it was difficult to obtain. 81% of respondents said a workforce was available for planting, while 19% said it was difficult. 76% of respondents stated that human resources for plant maintenance were available, while 24% stated that it was difficult because their work had started to be somewhat less at the time of care. 74% of respondents said labour for harvesting was available, while 26% said it was difficult. Generally, soil processing, planting, maintenance, and harvesting labour is still included in the easy category, and labour is available when needed. However, sometimes, it isn't easy to get and usually has to stand in line.

### Use of agricultural machinery

Based on the data obtained, 91% of respondents answered "yes" to whether they always use agricultural machinery in their farming, and only 9% answered "no," indicating that using agricultural machinery is necessary. The following are some reasons to use agricultural machinery: saving costs, reducing labour, and speeding up work.

### Types of Agricultural Machinery Most Widely Used

Based on the results of interviews, the most frequently used agricultural machinery by farmers in the field are *hand tractor* 98.15%, *power thresher* 85.19%, *combine harvester* 72.22%, and *rice transplanters* 40.74%. The use of *ice transplanters* is still low due to limited land and lack of socialization. In each growing season,

sample farmers have used a lot of agricultural machinery. With the utilization of agricultural machinery, The farmers assume the level of their rice production is increasing.

### Comparison of Agricultural Machinery Needs Based on Manual Calculations and E-Agricultural Machinery Integrated Planting calendar

The use of agricultural machinery is part of innovation to support efforts to achieve the target of the rice production intensification program. Its application is not only to overcome the problem of lack of labour in agricultural activities that drain energy (tillage, planting and harvesting) but also to improve the quality of yields (especially during the rainy season harvest) so that the bargaining power of farmers in Marketing of its production can increase [11].

**Table 1.** Analysis of agricultural machinery needs based on manual calculations of the Boalemo District in 2020

| The need for agricultural machinery     | Hand Tractor     | Rice Transplanter | Combine Harvester | Power Thresher      |
|-----------------------------------------|------------------|-------------------|-------------------|---------------------|
| Plan                                    | 205              | 24                | 41                | 3,996               |
| Available                               | 341              | 30                | 20                | 101                 |
| Disadvantages of agricultural machinery | 136              | 6                 | -21               | -3895               |
| Adequacy                                | 166,34%          | 125,00%           | 48,78%            | 2,53%               |
| <b>Status</b>                           | <b>Saturated</b> | <b>Saturated</b>  | <b>Less</b>       | <b>Very lacking</b> |

Source: Primary & secondary data analysis in 2020

**Table 2.** Analysis of agricultural machinery needs based on the application of agricultural e-machinery Integrated planting calendar of Boalemo Regency in 2020

| The need for agricultural machinery     | Hand Tractor     | Rice Transplanter | Combine Harvester | Power Thresher      |
|-----------------------------------------|------------------|-------------------|-------------------|---------------------|
| Plan                                    | 233              | 20                | 37                | 4,949               |
| Available                               | 367              | 35                | 64                | 101                 |
| Disadvantages of agricultural machinery | 134              | 15                | 27                | -4848               |
| Adequacy                                | 157,51%          | 175,00%           | 172,97%           | 2,04%               |
| <b>Status</b>                           | <b>Saturated</b> | <b>Saturated</b>  | <b>Saturated</b>  | <b>Very lacking</b> |

Source : [http://Planting\\_calendar.litbang.pertanian.go.id/main.aspx?aktif\\_tab1=3](http://Planting_calendar.litbang.pertanian.go.id/main.aspx?aktif_tab1=3)

Based on the calculation adequacy manually and through the Planting calendar, *hand tractor* and *rice transplanter* with both methods, namely saturation. Then for the adequacy status of the

*second power thresher*, which is very less, it is still below 40%. While the *combine harvester*, in the manual calculation, the status is less at 48.78%, and in the interactive application Planting calendar, the

status is saturated. Based on the researchers' analysis, several factors cause this: changes in the number of equipment available, delays in *updating* data, and lack of coordination. So it is necessary to regularly input and improve the data on the Planting calendar and coordination between interested parties.

### Calculation of Operating Costs and Feasibility

Good management becomes increasingly important for the progress of a farm due to the

increasing area of farming and the increasing capital of agricultural machinery. Management determines how much it will cost, chooses the size and type of tools and scheduling for each job, then makes a good maintenance plan, and figures out when the machine needs to be repaired. The revenue is determined from the performance of the tool or machine. Then a feasibility analysis is carried out to determine the *break event point* (BEP) time.

**Table 3.** Analysis Operating Costs and Feasibility in 2020

| Data and Cost analysis        | Unit      | Hand Tractor | Rice Transplanter | Combine Harvester | Power Thresher |
|-------------------------------|-----------|--------------|-------------------|-------------------|----------------|
| <b>Data</b>                   |           |              |                   |                   |                |
| Tool price                    | (Rp/unit) | 25.884.000   | 60.834.800        | 314.212.500       | 12.921.000     |
| Economic lifespan of the tool | year      | 5            | 5                 | 8                 | 5              |
| Working capacity of the tool  | Ha/year   | 24           | 200               | 120               | 60             |
| Working days per year         | day/year  | 50           | 40                | 40                | 25             |
| Working hours                 | hours/day | 8            | 7                 | 8                 | 8              |
| Fuel Prices                   | Rp/l      | 9.400        | 7.850             | 9.400             | 9.400          |
| Fuel Needs                    | L/ha      | 2            | 2                 | 0,5               | 1              |
| Engine oil price              | Rp/l      | 46.500       | 46.500            | 46.500            | 46.500         |
| Engine Oil Requirements       | l/hour    | 0,03         | 0,05              | 0,04              | 0,02           |
| Rental Cost                   | Rp/ha     | 1.200.000    | 800.000           | 1.600.000         | 500.000        |
| <b>Cost analysis</b>          |           |              |                   |                   |                |
| Fixed cost                    | Rp/ha     | 212.683      | 60.834            | 504.048           | 43.066         |
| Variable cost                 | Rp/ha     | 534.131      | 323.984           | 784.750           | 294.868        |
| Operating costs               | Rp/ha     | 746.814      | 384.818           | 1.288.798         | 337.934        |
| Annual cost                   | Rp/year   | 17.923.536   | 76.963.600        | 154.655.760       | 20.276.040     |
| Gross Revenue                 | Rp/year   | 28.800.000   | 160.000.000       | 192.000.000       | 30.000.000     |
| Net income                    | Rp/year   | 10.876.464   | 83.036.400        | 37.344.240        | 9.723.960      |
| Pay Back Period/ BEP          | year      | 2,4          | 0,7               | 8,4               | 1,3            |
| BCR                           |           | 2,10         | 6,82              | 0,95              | 3,76           |

Based on the table above, it can be seen that the management of agricultural machinery services *hand tractor*, *rice transplanter* and *power thresher* is profitable with a B/C ratio value of  $> 1.0$ . Meanwhile, the *combine harvester* lost with a B/C ratio of  $< 1.0$ . If you see that the capacity of this machine is still not large, it needs to be increased again so that the business can be profitable.

The profit managed by the agricultural machinery service business based on working days (days/year), working hours (hours/days), and working capacity (ha/hour) is higher than the average. This can be seen from B/C ratio, which is overall  $> 1.0$  so that it indicating improvement in agricultural machinery services in Boalemo Regency.

## CONCLUSION

The use of agricultural machinery is necessary; this is stated by 91% of respondents answering "yes" to whether they always use agricultural machinery in their farming. Some reasons for using agricultural machinery are saving costs, reducing labour, and speeding up work. The adequacy of hand tractor and rice transplanter with both methods is saturation. As for the *power thresher*, it is still lacking. However, there are differences in the needs of *combine harvester* agricultural machinery. Based on the researchers' analysis, there are several factors that cause this, namely changes in the amount of equipment availability, delays in *updating* data, and lack of

coordination between parties. So it is necessary to fix these problems. Managing agricultural machinery services hand tractor, rice transplanter and power thresher, has been profitable with a B/C ratio of  $> 1.0$ . As for the *combine harvester*, the loss with a B/C ratio value of  $< 1.0$  so that the management of agricultural machinery services is detrimental and infeasible. Then there is an input and improvement of existing data on the Planting calendar regularly and improved coordination between interested parties so that the procurement of agricultural machinery with an integrated planting calendar reference can be right on target according to needs.

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