Performance of agricultural machinery services business in Tojo Una-Una District Central Sulawesi

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Abstract. Advanced technology has entered the agricultural sector in an effort to streamline the agricultural production. Mechanization, one of advanced technology has contribution to increase productivity and resource’s efficiency in agriculture. However, there is a need government’s intervention to accelerate it. One of mechanization program by government is Agricultural Machinery Services Business (UPJA) which applied in farmer group level in Indonesia. The study aims to know the financial and work performance of UPJA in Tojo Una-Una Central Sulawesi especially for four wheel tractor with 85 House Power (HP) and 95 House Power (HP). The data were collected purposively from the UPJA program receiver and related stakeholder. Financial and work performance analyses were used to value the UPJA performance. The results show that UPJA business in farmer group level for both 85 HP and 95 HP tractor power were economically feasible with RC ratio of 1.27 and 1.15 consecutively. Tractor 95 House Power (HP) was more efficient compared to 85 House Power in land efficiency management with values 62% and 54%. The theoretical field capacity (Kt) tractor 85 HP was the same with tractor 95 HP about 0.403 ha/hour, while the effective field capacity (Ke) of tractor 95 HP was higher compared to 85 HP.

1. Introduction
Mechanization has a very strategic role and potency because of its contribution to increase productivity and efficiency of resources use in agriculture. The correct and appropriate implementation of mechanization will make a positive contribution to the development of agribusiness systems and businesses which are competitive, respectful, sustainable [1]. The profit of farming using agricultural mechanization technology increased 81.61% compared to manual technology [2]. The full use of agricultural mechanization technology in rice farming also increased production by 33.83%, also saving manpower and production costs. Targets of agricultural machinery in food crop are to increase planting index, to accelerate planting time, and decrease labour cost. Mechanization also poses as alternative solution of labour scarcity. In the end, it will increase the productivity and farmer’s welfare [3]. By considering this strategic role and potency, government intervene the development of agricultural machinery.

The relatively expensive price of the agricultural machinery and distribution of the agricultural machinery are some of the problems faced by the use of agricultural machinery [1]. Moreover, individual ownership of tractor tends to be uneconomical therefore small scale farmers tend to choose safer option by hiring it [4]. One form of government intervention was agricultural machinery development through the agricultural machinery service business (UPJA), so that farmers are able to
access and use agricultural machine without buying or owning machinery which are unaffordable. The UPJA has function to provide agricultural machinery services to farmers such as soil cultivation and other mechanization processes. UPJA as business organization make optimal use of agricultural machinery in accordance with economic principles and in order to provide optimum business results from the utilization of such machinery. The application of mechanization was not optimal yet, and UPJA was one program that might accelerated it [5]. UPJA has potency stimulate modern agriculture and economic at a time. Moreover, UPJA as solution to a small land owned by farmers which caused difficult access to technology, capital, and market [6].

Some mechanization in agriculture cultivations are soil cultivation planting, harvesting, and post-harvest. The benefit of mechanization in soil cultivation is that the structure and porosity of the soil change properly. In addition, soil cultivation can improve the physical properties of the soil so that it can ensure a balance between water, air and temperature in the soil. The machinery also varied in types and sizes. Selection of the type and size of agricultural machinery is generally related to the area and types of plants or commodity. The success of the development of agricultural mechanization depends on the conditions of the agro-climate, economic system and culture that are in line with the economic opportunities for the application of agricultural tools and machinery [7].

UPJA in Tojo Una-Una district use four wheel tractors for dry land especially for corn commodity. Tojo Una-Una is one district in Central Sulawesi which mainly developed corn commodity in dry land therefore UPJA develop four wheel tractors which are suitable for dry land. The types of tractor machine were 85 and 95 House Power (HP). The correct choice of machinery will be affected to the optimum use of agricultural machinery [3]. It is stated that the in comp ability of machinery with the need of farmer lead to suboptimal machinery use. Other cause of the suboptimal was the size of machinery with agro ecosystems, the lack of professional operator, the efficiency of machinery operation, the low management skill of UPJA.

In order to be able to grow and develop independently, the utilization of agricultural machinery at the farm level must be technically, socially and economically feasible through the management of agricultural machinery with an economic scale and market orientation, the model UPJA management that is able to develop independently and sustainably in rural areas very needed. Based on this, research was carried out with the aim to know and evaluate the feasibility of UPJA in Tojo Una-Una Central Sulawesi which is reviewed technically and economically.

2. Methods
The study used primary and secondary data. Primary data were collected by survey on UPJA program receiver and related stake holder, using purposive sampling method. The surveys collected data such as UPJA organizational management, group financial management, the service scale, and technical aspects such as operating time, machine specification, and cost revenue. Meanwhile, secondary data were obtained through related stakeholder, which were conducted by collecting data on the potential for agricultural machinery development and policies to support the development of mechanization. The study conducted in Tojo Una-Una District from June to August 2020.

Data and information obtained from the field and secondary data were analysed descriptively by tabulation and calculation methods based on the formulas. The tabulation system is used to examine the analysis of operational costs for machinery by the UPJA. There are two measurement of performance namely business performance and work performance. The work performance of UPJA using Theoretical Field Capacity, Efficiency Field Capacity and Efficiency of Land Management.

2.1. Theoretical field capacity (Kt) tractor
The equation used to count theoretical field capacity of land management [8]:

\[ Kt = WxV, \text{ha/hours} \]  
(1)
• Kt = Theoretical Field Capacity (ha/hours)
• W = Working Width (plow width) (m)
• V = Work Speed (m/sec)

Kt = Conversion m²/sec to ha/hours (1 m²/sec = 0.00036 ha/hours)

2.2. Effective field capacity (Ke) tractor

The equation used to calculate effective field capacity [8]:

\[ Ke = \frac{A}{T}, \text{ha/hours} \]  

\[ E = \frac{Ke}{Kt} \times 100\% \]  \hspace{1cm} (3)

• Ke = Effective field capacity (ha/hours)
• T = The total used (hours)
• A = Land area of the total done (ha)

2.3. Efficiency of land management (E)

The equations used to count on the efficiency of land management of land management [8]:

\[ E = \frac{Ke}{Kt} \times 100\% \]  \hspace{1cm} (3)

• E = work efficiency (%)

For business performance we calculated of the revenue cost ratio of UPJA Business using modification of formula [9]:

\[ RC \text{ ratio:} \frac{\sum \text{Recent value of Revenue}}{\sum \text{Recent value of cost}} \]  \hspace{1cm} (4)

Revenue Cost Ratio Analysis is a comparison of recent value of revenue and recent value of cost in the meantime investment.

3. Results and discussion

Evaluation of the work performance aims to evaluate the work process whether it is effective and efficient. The efficiency of the work process of the planting tool is observed from the Value of Theoretical Work Capacity (Kt) and the Value of Actual Work Capacity (Ka). The value of Theoretical Field Capacity (Kt) and Effective Field Capacity (Ke) and land management presented in Table 1. Efficiency of Land Management (E) shown on Table 1.

| No | Parameters                              | Rate          |
|----|-----------------------------------------|---------------|
| 1  | Theoretical Field Capacity (Kt) Tractor | 0.403 ha/hours|
| 2  | Effective Field Capacity (Ke) Tractor   | 0.219 ha/hours|
| 3  | Efficiency of Land Management (E)       | 54 %          |

Based on Table 1, the values Ke of tractor 85 HP was lower compared to the value of Kt. The field capacity was theoretical 0.403 ha/hour while the effective field capacity was 0.219 ha/hour. The calculation of the value was influenced by the time and land management. It was affected by the width of plowing which cannot be optimal due wide results of plowing when doing cultivation of the land. To the process of land management, grasses that grow in the surface of the ground also affecting work of plow. It used to allow the coagulation congestion on the fins wheels. Skills become mainly support.
for the operators besides the working system instrument. The performance of operator must be reliable to give a good result on good working and efficiency.

The value of soil tillage field efficiency from the results of data analysis showed that the results were 54%. The efficiency value of the tool is good, because the conditions of tillage in dry land have an efficiency level of 57.634%. The efficiency value of various types of soil wetness can be classified based on soil conditions, namely dry conditions 57.634%, wet conditions 34.038%, and in flooded conditions 23.769% [10]. This difference is due to different land conditions. It is also caused by the large amount of time lost due to slips, overlaps, congestion and turning times. Based on other research results, the efficiency value is influenced by the type of soil and soil structure being processed. Besides that, the efficiency of tillage can also be affected by the skill of the operator, congestion that occurs during tillage and the condition of the tractor.

**Table 2.** The results of the large land management and efficiency tractor TR4 95 HP

| No | Parameters                           | Rate            |
|----|--------------------------------------|-----------------|
| 1  | Theoretical Field Capacity (Kt) Tractor | 0.403 hectare/hour |
| 2  | Effective Field Capacity (Ke) Tractor  | 0.250 hectare/hour |
| 3  | Efficiency of Land Management (E)     | 62%             |

Based on Table 2 it can be seen that the Ke value is low compared to the Kt value. It can be seen that the results of the calculation of the field capacity of tillage for theoretical field capacity and effective field capacity are different where the theoretical field capacity is 0.403 ha/hour and the effective field capacity is 0.250 ha/hour. From the results of calculating the low Ke value, it is influenced by soil conditions during processing. Soil conditions determine the type of tools and tractors used and affect the working capacity of tillage [11]. Dry soil provides a relatively higher resistance to traction than wet soil. In addition, the pattern of land management can be affected based on conditions and size of processing in order to be more effective and efficient. In order to carry out soil processing, it is necessary to use certain processing patterns according to the size of the land used so that time during deflection is not wasted during soil processing and obtains effective and efficient processed products [12].

Performances of tractor also supported by operator’s skill. The work must employ a reliable operator that would give the results of good working and efficiency. The land processing related with some lost time for operation in the corner of land, therefore qualified operators will give better work [11]. The efficiency value of the tillage field from the results of data analysis showed that the results were 62%, the level of work efficiency of the tools was still relatively good where the efficiency level was more than 50% [13]. This is because cultivation area, tillage speed and tillage duration cultivation greatly affect the level of work efficiency. The efficiency of a tractor depends on the theoretical field capacity and the effective field capacity, this has been proven because the efficiency obtained is more than 50% [14].

The second performance’s evaluation is financial performance. The financial importance of financial performance evaluation regard closely tied to the sustainability of the business. UPJA as solution in providing affordable agricultural machinery generally has difficulty in getting profit as requirement for sustainability of the business. In other words, the businesses provide facilities to the farmers but must economically feasible. The feasibility of UPJA Tojo Una-Una is shown in Table 3.

The RC ratio is needed to evaluate the feasibility of a business. Performance of tractor 85 HP power is less efficient in land management but more economically in financial (Table 3). The reason of the condition is that the cost per hectare for mechanization is the same between 85 HP and 95 HP (Table 3) while the operation cost for four wheel tractor 95 HP is higher. The feasibility of UPJA business is feasible in both 85 and 95 HP even though in small number. The reason of the small number ratio of cost benefit was the low price of rental which made the revenue also low. Comparing with other area, the cost of tractor operation per hectare is IDR 1 500 000 up to IDR 1 700 000, while in Tojo Una-Una is IDR 1 200. However, the higher cost will also have effect on the ability of payment...
from farmer. The minimum costs of rental become a policy recommendation in sustainability of the business. The set of minimum cost become win-win solution for sustainability of the business and the adoption of mechanization.

The fuel consumption was affected by some factors such as tillage duration. Velocity of the machinery and fuel consumption has strong relationship [15]. A faster tractor will consume more fuel and more power to move which happened to tractor 95 HP. The four wheel tractor 95 HP technically more efficient than 85 HP, however the 85 HP is more economical except there will be differentiation on rental price. The efficient operational cost has significant contribution to the UPJA management. Based on UPJA development strategy in Sinjai District using the SWOT analysis, the variables which are very influential and have a big contribution in the management of UPJA are the initial investment and the ability to reduce operational costs [16].

**Table 3.** Cost and revenue four wheel tractor 85 HP and 95 HP in Tojo Una-Uma district in one hectare operation

| No | Items                              | 85 HP          | 95 HP          |
|----|------------------------------------|----------------|----------------|
| 1  | Initial value of tractor           | IDR 548,000,000| IDR 675,000,000|
| 2  | Final value of tractor (10% of initial value) | IDR 54,800,000 | IDR 67,500,000 |
| 3  | Fixed Cost                         | IDR 195,714    | IDR 241,071    |
|    | Cost of depreciation               | IDR 195,714    | IDR 241,071    |
| 4  | Variable cost                      | IDR 675,109    | 743,743        |
|    | Tools and machine repair cost      | IDR 65,971     | IDR 74,607     |
|    | Lubricant cost                     | IDR 14,000     | IDR 20,000     |
|    | Fuel cost                          | IDR 450,000    | IDR 485,000    |
|    | Operator cost                      | IDR 145,137    | IDR 164,136    |
|    | Total cost                         | IDR 870,823    | 984,814        |
| 5  | Revenue per hectare                | 1,200,000      | 1,200,000      |
| 6  | RC ratio                           | 1.27           | 1.15           |

**Note.**
- Economic life of tractor is 10 years
- Depreciation using a flat-rate depreciation method.
- One hectare was operated in 7-8 hours (one day work)

As one of business organization UPJA is urged to be improved in order to get the efficiency. Some research result shows that UPJA in some area in Indonesia which were assistance by the government to farmer groups through a revolving fund program, does not always provide benefits for farmer group members in terms of several factors. One of the reasons is that the rental value from farmer group was the same with non-farmer group rent four wheel tractor from private rental. The evaluation in some area, there were underdeveloped due to the low rental capacity of farmers, so if the UPJA is forced it will be uneconomical. For areas where the ability to rent farmers is still low, government intervention is needed in the form of assistance in the form of facilities such as provision of agricultural machinery, construction of machinery repair units, and provision of capital. However, for certain areas where farmers have the ability to rent agricultural machinery, UPJA in these areas will be able to develop into an independent and professional UPJA, so that there is no need for greater government intervention.

The problems associated to development of UPJA also related to human resource and capital resource. As business organization UPJA need a good management, however as business in farmer group level, in some cases the human resource less capability to manage a business. Therefore, the UPJA need to be managed professionally in each system. The Agricultural Machinery Service Unit
(UPJA) is a combination of 1) Service Provider subsystem, 2) Service User / Farmer sub-system, 3) Workshop sub-system and 4) Capital/ Funding sub-system. All the system need to be developed in order to develop UPJA [17].

Technically, the efforts to strengthen farmer groups may involve many stakeholders, such as the Ministry of Agriculture at the centre to the regional agriculture offices and field extension officers. The involvement of many parties is a government step so that the focus of assistance to farmers is greater. The urgency of assisting farmers in running government programs is very vital because the presence of assistants plays an active role as a communicator, facilitator, advisor, motivator, educator, organizer, as well as a dynamist [18].

To the government to provide assistance to farmers through UPJA both in terms of capital which will help in the procurement of agricultural machinery and in terms of extension that will help farmers in learning the latest agricultural machinery and help manage UPJA cash to seek new machinery, and play a role in improving utilization machinery and the development of the amount to support the productivity improvement program. Ability and skills have a significant effect on performance of UPJA [19]. The result shows that some UPJAs are not yet business-oriented, not yet managed based on economies of scale (economics of scale), and not yet market oriented (market oriented) which become general problem in UPJA development [20].

4. Conclusions and recommendations

Theoretical work tractor capacity 85 HP on fields was 0.403 ha/hour working capacity of 0.219 ha/hours, meanwhile the theoretical work capacity of tractor 95 HP on rice fields of 0.403 ha/hours and field capacity of 0.250 ha/hours. Based on the calculation on tractor 95 HP more efficient used because of field capacity of 0.250 ha/hours. Work efficiency of tractor 85 HP of 54% and tractor 95 HP of 62 %. Based on the calculation on the efficiency of land management more effective namely tractor 95 HP of 62 %. It affected several factors, one of the skill operators, their land, and a tractor. The feasibility of UPJA in Tojo Una-una both 85 HP and 95 HP are feasible. However, the higher cost in 95 HP made the feasibility in tractor 95 HP is lower compared to 85 HP. UPJAs are not yet both fully business-oriented and professionally managed as the limited of human source and facilities.

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