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Analysis of the Suitability of Quick-Type Hand Tractors and Power Requirements for Wetland Cultivation in Lima Puluh Kota Regency, West Sumatra Province

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Abstract: In Lima Puluh Kota Regency, there are many models and types of hand tractors used by farmers to cultivate rice fields. However, it is necessary to identify which models and types of hand tractors are most suitable for use on agricultural land. The aim of this study was to determine the suitability of the hand tractors used, covering the technological (technoware), user (humanware), management (organoware) and information delivery (infoware) aspects. This study was conducted in 11 sub-districts in Lima Puluh Kota Regency. The research locations were selected using a purposive sampling method. The equipment used in this study comprised Quick-type hand tractors fitted with Kama (4.5 hp), Ratna (6.5 hp) and Yanmar (8.5 hp) engines. The first stage of data collection involved conducting a survey of relevant agencies. The second stage was a field survey. The third stage involved direct performance testing carried out under various rice field conditions. Each sub-district was represented by two farmers' groups owning Quick hand tractors with three types of engines: Kama, Ratna and Yanmar. The research results showed that the highest working capacity for rice field cultivation using a rotary plough was found in Payakumbuh sub-district with the Yanmar hand-operated tractor, at 0.075 ha/hour. Meanwhile, the lowest effective working capacity was found in Koto Tinggi sub-district with the Kama hand-operated tractor, at 0.022 ha/hour.

Keywords: Agricultural mechanization; Hand tractors; Technological parity

Introduction

The application of agricultural mechanization basically is the introduction and the using of mechanical is to perfrom out agricultural operations. In other word, the Agricultural goal of Mechanization is to increase production per unit of energy and improve product quality (Sims & Kienzle, 2016; Loon et al., 2020; Sulaiman et al., 2025). Limited labor in agriculture will restrict farmers' ability to prepare their optimization land, it makes production and farmer income in one harvest season to be very low. This is in line with Paman (2024) and Prihatiningnur et al. (2025) that the general objectives of agricultural mechanization are to increase land productivity, labor productivity, reduce production costs, and reduce production cost. To decrease those problems, Lima Puluh Kota Regency implemented agricultural mechanization by using agricultural machinery and equipment, named hand tractors, in soil cultivation so that work can be completed well and production can be increased. Rudi Prasetyo et al. (2020) explained that the provision of agricultural machinery and equipment in the farming process has ability to increase production, productivity, and the cropping intensity index (IP) of rice, as well as increase production by 6% to 8%. One important application of agricultural mechanization technology is the using of agricultural machinery as a substitute for human and animal labor at various stages of rice

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farming, such as soil cultivation which need many employees, time, and cost (Paman et al., 2014).

Scientifically, this policy is match with the basic principle of selective agricultural mechanization which is selective in terms of the tools or machines using and also selective regarding the area where it will be imply. In applying these tools and machines, extra assessment is needed so that the use of agricultural machinery and equipment give great benefits both technically and economically. Beside tools and machines that are suitable for the conditions of an area, another thing to pay attention is the quantity in a particular region, whether it has met or exceeded the need (Qiao, 2017; Sulaiman et al., 2018; Pratomo et al., 2025).

The hand tractors need in an area with extensive rice fields, such as in Lima Puluh Kota Regency, makes research on the number of hand tractors required based on the area size that can be cultivated using hand tractors in the farming process is very urgent, because almost all sub-districts with paddy rice agriculture use hand tractors with rotary implementation, moldboard plow, harrow, and hydro tiller implements. So far, there is no data on the need for hand tractors in each sub-district, where if there is a shortage of tractors it will a problem for the land preparation schedule, in opposite thing if there are too many, many working hours of hand tractors will be wasted which economically is not good to tractor owners (Prabawa et al., 2011; Mislaini & Fahmy, 2017; Aldillah et al., 2025).

Another important thing is to determine the type and model of hand tractor used and the amount of power required for soil cultivation in each paddy field in every sub-district in Lima Puluh Kota Regency. According on field conditions, many hand tractors of different types and models are found, such as Kama, Ratna, and Yanmar brand hand tractors with different implements as well. These needs to apply Selective Agricultural Mechanization so that the accuracy in applying or using agricultural machinery and equipment will back up in the application of alsintan in the field. The more the investment value planted in the procurement of alsintan, the more it must be followed by careful, structured, and gradual planning, in accordance with the principle of selective agricultural mechanization (Handaka & Prabowo, 2013).

Maximum working capacity will provide great benefits and will reduce production costs. According to Amin et al. (2015), Darma et al. (2024), and Sudirman et al. (2024), the maximum work of alsintan will provide benefits both technically and economically. Conversely, if there is excess power in a hand tractor during soil cultivation, it will increase the cost of land cultivation because of high purchase price as well as higher operational and maintenance costs. The power requirement of a hand tractor is not only influenced by the size of the tools, but also by the type and condition of the soil which will ultimately affect the specific draft of the soil (Ranjbarian et al., 2017; Mattetti et al., 2022; Supriyadi et al., 2025).

To determine the number of hand tractors needed in each sub-district in Lima Puluh Kota and to determine the power suitability in paddy field cultivation, especially with the Quick brand, the author conducted scientific research on the use of Quick type hand tractors in the region, titled "Needs and Compatibility of Quick Type Hand Tractors for Paddy Field Cultivation in Lima Puluh Kota Regency, West Sumatra Province, Indonesia".

This research aims to obtain data on the actual number of hand tractors based on the existing agricultural land area so that the need for hand tractors can be met and the type of hand tractor used is in accordance with existing soil conditions. Information on data on the number of hand tractors needed in a region in each sub-district in Lima Puluh Kota Regency is very important for farmer groups or hand tractor owners, and the government so that hand tractor working hours can be more optimal. For the government, this information can also be used to determine policies to be carried out and as a basis for providing Alsintan assistance, also as helping in the application of agricultural mechanization in Indonesia, especially for paddy rice farmers in Lima Puluh Kota Regency.

Method

Research Location

This study was conducted in the district of Lima Puluh Kota. The research location was determined using a purposive method (Sugiyono, 2018; Mukhlis et al., 2019; Mukhlis et al., 2024; Asgaf et al., 2025). Based on that method, 13 Districts were selected.

Material

The equipment in this research is hand tractor with Quick type frame with Kama (4.5 hp), Ratna (6.5 hp) and Yanmar (8.5 hp) engine driving engine. The soil implantation implements are 20 cm wide and 40 cm wide, wide and 90 cm wide, 140 cm, power measurement tools (Prony Brake) and tachometer, distance gauge and others. The materials used are diesel fuel and oil for hand tractor engine lubricants.

Research Procedure

In the first phase of this research, the method of data retrieval is done with two stages namely, the first survey to the relevant offices to obtain data of wetland area of each sub-district and the number of current hand tractor conditions. The second stage is a field survey to obtain data on the number and types of "Quick hand" tractors available in Lima Puluh Kota District with the implications, the determination of farmer groups to directly test the working capacities of wetland farming, calculate the value of the specific draft of soil treatment by using moldboard plow and harrow rotor as well as calculating the equivalence of tractor power in soil processing. In each sub-district represented by 2 farmer groups representing the type of hand tractor with 3 types of driving engines, namely Kama, Ratna, and Yanmar.

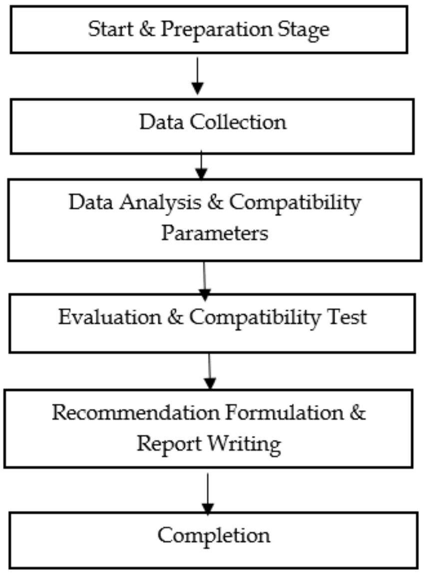

Figure 1. Hand tractor equivalence research flowchart

Hand Tractor Needs

To determine how much the hand tractor needs of each sub-district can be searched for by reducing the available land area by the area employed by existing hand tractors divided by the ready-to-plant tractor-ready working capacity by 1 hijacking with the moldboard plow and 2 times the renewal with harrow rotor (Mardinata & Zulkifli, 2014; Setiawan et al., 2022). While how many hand tractors to place in each sub-district can be searched with the following formula:

$$JT = \frac{fk \ x \ A}{Ka \ x \ t} \tag{1}$$

Where: JT = number of tractors (units); Fk = correction factor; A = the area of land available at the study site (ha); Ka = effective working capacity ready to plant (ha / hour); t = available time (hours).

The need for hand tractor power in wetland processing is the required power required to cultivate the paddy field with the moldboard plow in the first soil treatment, harrow rotor I for second tillage and harrow rotor II for third tillage. The measurement of power requirement is performed by determining the position of the hand-held tractor gas openings and measuring the speed of the engine's rotation in the circumstances, and then after the soil processing is completed under the same conditions the hand tractor pulley is paired with the prony brake pulley to determine the torque on the tractor axis obtained from the reading number on the prony brake. The power on the tractor axis can be calculated by the following equation:

$$P = \frac{6{,}28 \ x \ Tr \ x \ n}{60} \tag{2}$$

Where: P = power axis tractor (watts); Tr = torque on the axis of prony brake (Nm); n = speed of proto brake axis (ha)

Comparability of Soil Processing Power

Power equivalence is a value for determining whether a suitable tool or machine is used to perform soil processing based on the required power. Usually, the power provided is greater than the power required, this is done will in certain circumstances sometimes the required power is greater. To determine this power clashing class can be seen in Table 1.

Table 1. The Equivalence Value of Soil Cultivation Power with Hand Tractors

Percentage of Soil Cultivation Power to Tractor Power (%)	Class of Equivalent	Explanation	Percentage of Soil Cultivation Power to Tractor Power (%)
> 50	T4	Very Worth	> 50
40 - 50	T3	Worth	40 - 50
30 - 39	T2	Somewhat Equal	30 - 39
< 30	T1	Not Equal	< 30
Percentage of Soil CultivationPower to Tractor Power (%)	Class of Equivalent	Explanation	Percentage of Soil CultivationPower to Tractor Power (%)

The power available from this hand tractor should not be too big of the required power because the big engine price is much more expensive, the operational cost is also more expensive and besides that big power will be more difficult to operate. A good power suitability is if the rate power required for soil treatment is more than 50 percent of the power available on the hand tractor. In case of low power equivalence, it can substituted for lower-powered engines or increase the size of the plow or harrow rotor used in larger sizes.

Result and Discussion

Identification of Hand Tractors Used

Identification of hand tractors includes type, number and specific class of tractors based on power size, type of soil cultivation implement, work capacity, and comfort level of its operatoration. Based on the results of field surveys in each sub-district, the number of hand trapsors available in the data of Statistics Agency of Lima Puluh Kota Regency in 2015 is not appropriate in the present condition because of the change in the number of each sub-district.

The largest number of hand tractors found in Harau sub-district is 432 units, both types of quick and other types. In this subdistrict, 388 units of quick hand tractors, 2 heavily damaged and 44 others in which 3 were heavily damaged. Lime IX and Base sub- districts are the least number of hand tractors, each with 22 tractors of various types.

Performance Testing Type Hand Tractor Quick

From the results of data collection on the number and condition of hand tractors in the District of Lima Puluh Kota consisting of 13 sub-districts, then each sub-district has been determined the area of paddy fields and tractors to be tested performance and power represents the type of quick type tractor with 3 engine driving the engine Kama powered 4.8 hp (3.6 kW), Ratna engine with 6.5 hp (4.85 kW), and Yanmar 8.5 hp (6.34 kW) engine with existing paddy conditions in the sub-district. For 1 sub-district is represented by two groups of farmers with 3 types of quick hand tractors with the driving power as mentioned above.

Effective Working Capacity of Moldboard Plow

Tests were conducted on paddy fields with a total area of rice fields between 300 m2 to 600 m2 in accordance with the state of the field plot being tested. The effective capacity of the moldboard plow shows different values according to the type of paddy field and its condition (Alizadeh & Allameh, 2013; Amponsah et al., 2017). Working capacity of paddy field with the biggest plow is in Payakumbuh sub district with Yanmar tractor engine driving force that is 0,075 ha/ hour, while the lowest effective working capacity is in Koto Tinggi sub-district with Kama tractor engine that is 0,022 ha/ hour. When compared to the first tillage capacity using this plow as a whole, the tractor with Yanmar's engine is much higher than that of Ratna and Kama. The lowest capacity of the moldboard plow with Yanmar driving engine is in Koto Tinggi and Situjuh Limo Nagari sub-districts which are 0,040 ha/ hour and 0.041 ha/hour. Effective work capacity of medium value is located in Lareh Sago Halaban sub-district is 0,068 ha/hour. The difference in the value of effective field capacity is influenced by wetland conditions is the specific draft where the larger the specific draft the lower the working capacity of piracy, as shown in Figure 1.

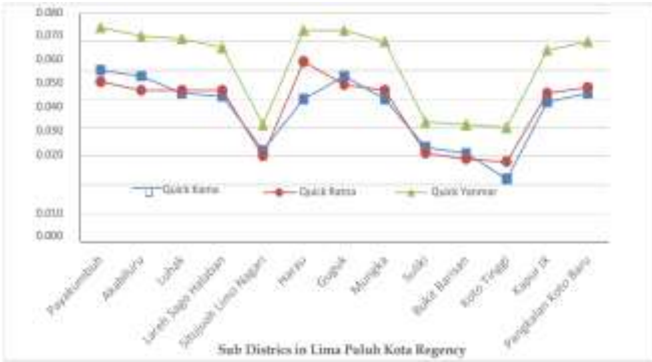

Figure 2. Capacity of moldboard plow in wetland cultivation

The capacity of the soil tillage with Yanmar's tractor engine is greater in value compared to the Kama and Ratna engine tractors because of the width of the plow and the greater speed of forward. With a larger power size, this tractor can attract larger moldboard plow, where the width of its plow is 40 cm, while other tractors have a wide plow width of 20 cm. For Kama and Ratna engine of hand tractors, the working capacity is not much different but in general this working capacity has the same pattern in which the area of harder soil draft produces smaller effective working capacity.

The effective work capacity of moldboard plow with engine “Kama” in the Payakumbuh sub-district is 0.06 ha/hour, while the lowest is in Koto Tinggi sub-district is 0,022 ha /hour, meanwhile Ratna's hand tractor engine has the largest working capacity in Payakumbuh sub-district with 0,058 ha/hour while the lowest value in Koto Tinggi sub-district is 0,03 ha/hour. The occurrence of this small capacity difference due to the ability of operators in the field and replication factor but the work capacity of both hand tractors is almost the same value.

Effective Working Capacity of Harrow Rotor I

The second rice field cultivation is soil cultivation using harrow rotor implement, in this case it is called Harrow rotor I cultivation. The working capacity of soil cultivation with Harrow rotor I shows a bigger value when compared to the cultivation of the soil with the moldboard plow, which is due to its specific draft smaller and bigger size harrow rotor I implications. In Figure 3 it can be seen that the highest work capacity is found in Harau sub-district with Yanmar's engine of 0.215 ha /hour and the lowest value is in Koto Tinggi sub-district with Kama engine of 0.103 ha/hour (Figure 2).

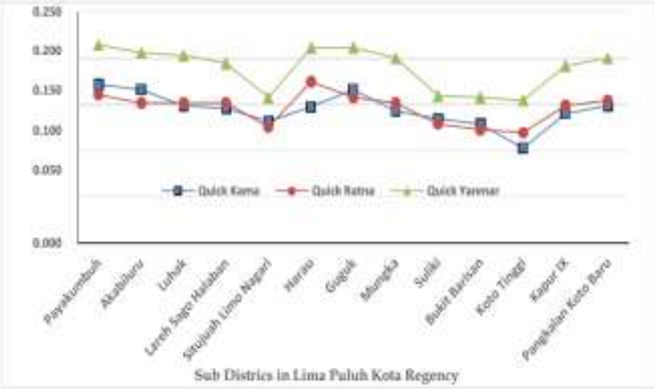

Figure 3. Work capacity of wetland cultivation with harrow rotor I

The capacity of the tractor with Yanmar's engine on the second tillage is much greater than that of other engines because the width of Harrow rotor I is also greater, namely 140 cm compared to the width of the two other driving engines are 140 cm width, in addition to the average forward speed of this Yanmar engine also slightly larger on this hand tractor. The lowest working capacity of Harrow rotor I Yanmar's hand tractor engine is in Koto Tinggi sub-district of 0.155 ha/hour which is in line with the lowest moldboard plow capacity in Koto Tinggi sub-district. When compared to the first tillage capacity using a moldboard plow, so the processing capacity of the soil tillage with Harrow rotor I is much larger, this can happen because the soil specific draft is much lower and the tractor advanced speed is also slightly larger.

In Figure 3, it can also be seen that the work processing capacity of Harrow rotor I of Kama and Enjin Ratna's hand engine tractors shows a value that is not much different where the effective working capacity of the Kama tractor engine is found in Payakumbuh sub-district at 0.172 ha/hour and the lowest in Koto Tinggi sub-district is 0.103 ha /hour. For Ratna engine hand tractor, the highest and lowest effective working capacity is also in the same sub district as the Kama engine hand tractors with the respective values of 0.161 ha/hour and 0.120 ha/hour. If we look at other sub-districts between Kama and Ratna's engines in some engineering districts Kama has a higher work capacity while in other sub-districts it has lower work capacity so it can be said that this small difference is due to operator and repeat factors only.

Effective Working Capacity of Harrow Rotor II

The capacity of the third soil tillage of wetland or the effective work capacity of Harrow rotor II can be seen in Figure 3, which has the same pattern as the soil cultivation with the molboard plow and the soil cultivation with Harrow rotor I ie in areas where the lower specific soil draft will have a higher work capacity. The highest effective working capacity of Harrow rotor II is in Payakumbuh sub-district with Yanmar's driving engine of 0.312 ha/hour while the lowest working capacity is in Koto Tinggi sub-district with Kama's driving engine of 0.124 ha/hour.

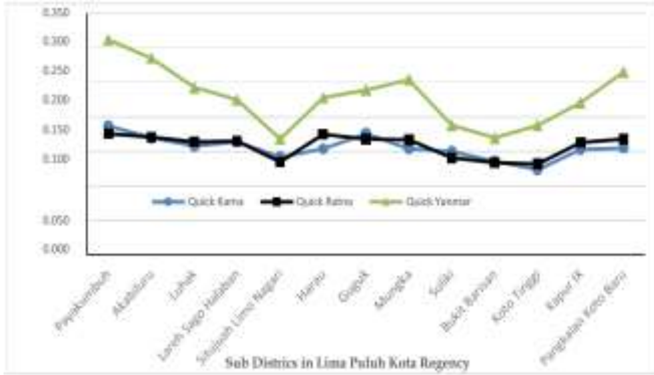

Figure 4. Work capacity of wetland cultivation with harrow rotor II

The capacity of the third tillage work with Harrow rotor II for hand tractors with Yanmar driving engine is much greater when compared to the Kama and Ratna engine. lowest working capacity is in the sub-district of Situjuh Limo Nagari at 0.168 ha/hour. It is seen that the value of this third tillage work capacity is slightly different when compared to the first soil cultivation, here it can be seen for some sub-districts with the first and second soil cultivation capacity value with Yanmar engine the lowest value is in Koto Tinggi subdistrict but on the third cultivation with Harrow rotor II the lowest value is located in the sub-district of Situjuh Limo Nagari which is 0.168 ha/hour. This can happen because in the third tillage the value of the specific draft of the soil is small because the soil is soft so that the soil which at the time of the previous processing is lower in its working capacity but not much different can have a larger third tillage work capacity.

From the results of testing the performance of soil cultivation by using this quick hand tractor shows that the working capacity of first soil cultivation with moldboard plow is smaller than the second soil cultivation with harrow rotor II and third soil cultivation with harrow rotor II. It can happen because at the time of first soil cultivation, the soil condition is still hard compared to second soil cultivation and and third soil cultivation.

Working Capacity of Ready to Plant

The effective capacity of ready to plant cultivation is the hand tractor working capacity to prepare the paddy fields to be planted by doing one moldboard plow tillage with two soil tillage with harrow rotor, so that the ready-to-plant working capacity is much lower than one soil tillage. The effective capacity of ready-to-plant planting is the area of processed soil divided by the time of tillage with a moldboard plow and twice with harrow rotor implement. The value of effective work capacity of soil preparation is obtained from the value of data cultivation of wetland with moldboard plow, harrow rotor I, and harrow rotor II which magnitude as in Figure 5.

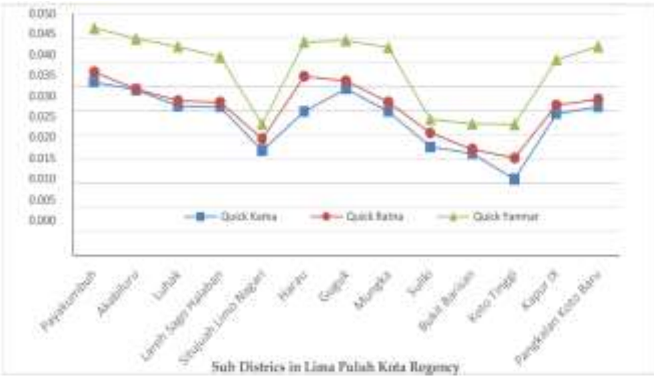

Figure 5. Work capacity of ready to plant cultivation

The maximum working capacity is the highest ready-to-transplanting rice field in Payakumbuh sub-district, which is 0.047 ha/ hour with Yanmar engine hand tractor, while the lowest working capacity is in Koto Tinggi sub-district with Kama engine of 0.016 ha /hour as shown in Figure 4. Due to the effective work capacity ready for planting is the value obtained from the previous soil cultivation then the tendency of its value is also almost the same with the previous soil cultivation, ie the hard ground conditions or the greater soil spesific draft will have a lower effective working capacity.

The Number of Hand Tractor Requirement

The need for hand tractors is calculated on the basis of the number of planting seasons (Planting Index) in a year and the effective capacity of ready to plant cultivation of the hand tractor. The need number for quick hand type tractors with Kama, Ratna and Yanmar power source for each sub-district can be seen in Figure 6.

Assuming the number of working hours in a day for 7 hours and a week work 6 days, in a month work 4 weeks and in a year can work for 4 months, then in a year the hand tractors work for 672 hours. In Figure 6 it is seen that the number of hand tractors required corresponds to the existing area of wetland in each sub-district. The greatest number of tractor needs is found in Harau sub-district while the minimum number of tractors required is in Pangkalan Koto Baru sub-district. It also shows that the hand tractor requirement is inversely proportional to the effective working capacity of ready to plant tractors cultivation where the number of Yanmar tractors engine is the least needed. In Harau sub district, the need for hand tractor with Yanmar's engine is 213 units, while the engine tractor is Ratna 253 units and Kama 315 units, while for the Koto Baru Pangkalan sub-district, Yanmar is 19 units, Ratna 29 units and Kama 39 units.

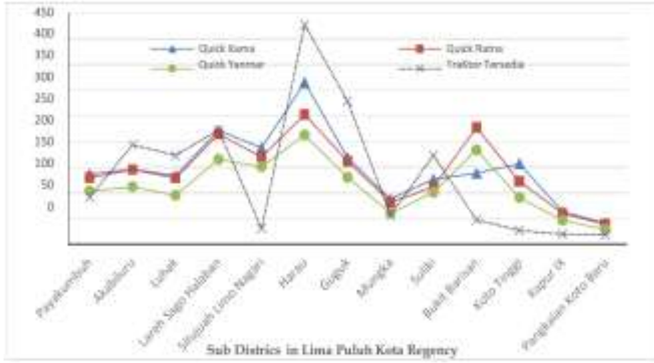

Figure 6. The number of hand tractor needs and available hand tractor

When viewed on the condition of hand tractors that exist at this time then some sub- districts the number of existing tractor excessive compared to the needs that should be whereas in other districts the number of existing tractors is less than the need. Harau sub-district is a very large hand tractor excess condition where the requirement is 315 units for Kama engine while the number available with various hand tractor brands is 427 units this difference will be greater if the tractor is with Yanmar driving engine, where the need is only 213 units. Other sub-districts with excess number of hand tractors are Akabiluru, Luhak, Guguk and Suliki sub-districts, while Payakumbuh, Lareh Sago Halaban and Mungka sub-districts require the number of hand tractors with available tractors not so much different, while Situjuh, Bukit Barisan, Koto Tinggi and Kapur IX the number of existing tractors is less than the need where Bukit Barisan sub-district shows the biggest difference where the number of available tractors is 48 units, while the amount of hand tractor requirement with Yanmar, Ratna and Kama engine respectively; 138 units, 184 units and 228 units. This condition is unfavorable for hand tractor owners because with no operation of the hand tractor optimumly will increase the cost of wetland cultivation and if the wage received is lower so that it will cause the loss. For that case it is needed appropriate policy of local government and farmer group in overcoming the problem.

Comparability of Soil Processing Power

The correspondence of hand tractor power in soil processing is an important factor in terms of technical work and economic value. If the tractor has less power than the need so that the tractor could not work properly, but if the size of the power is greater than it should be so it will be heavier and in terms of economical cost of land cultivation is greater because the price of the engine is more expensive and fuel cost and maintenance is also greater.

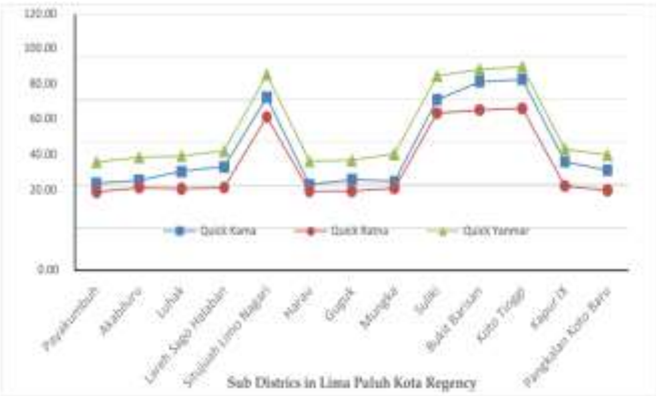

Figure 7. Equivalence value of hand tractor power with moldboard plow implement

Figure 7 shows the highest equivalent value of hand tractor power in the first wetland cultivation using moldboard plow in Koto Tinggi sub-district is namely 95.48% with Yanmar engine while the lowest value is in the quick type with Ratna engine in Payakumbuh sub-district is 36.86 percent. In general, for hand tractor with Yanmar driving engine a power equivalence value for soil cultivation is above 50 percent, but for hand tractors with Kama and Ratna engines showing a lower level of power correspondence from 50 percent. For the corresponding suitability class (T4) the Kama's hand tractor is located in the sub-districts of Situjuh Limo Nagari, Suliki, Bukit Barisan, Koto Tinggi and Kapur IX, while in the equivalent class (T3) are located in Payakumbuh, Akabiluru , Luhak, Lareh Sago Halaban subdistricts, Harau, Guguk and Mungka. Ratna's hand tractor engine indicates the corresponding value of the sub-districts of Situjuh Limo Nagari, Suliki, Bukit Barisan and Koto Tinggi, while in other sub-districts the equivalent score is less than 40 percent or inclusive (T2).

When compared between Ratna and Enjin Kama engines, the Ratna engine has more power over because they use the same size plow while the Yanmar engine uses a bigger wider plow. To increase the value of power equivalence in sub-districts with a low equivalence value, it can be increased by replacing the size of the plane with larger moldboard plow.

The equivalence of power for soil cultivation with Harrow rotor I implements is the plot of the plowing with the plow as in Figure 8, where this is because the power requirement to process the soil using Harrow rotor is much smaller than that of the plow.

The greatest value of power equivalence with this harrow rotor implemen is found in Koto Tinggi sub-district with Yanmar engine which is 56.38 percent while the lowest value is in Harau sub district with Ratna engine which is 24.21 percent. The equivalence of the second tillage power to harrow rotor I for the Yanmar engineering tractor shows the corresponding equivalence class (T4) in the sub-districts of Sitta Limo Nagari, Suliki, Bukit Barisan and Kapur IX, while in other sub-districts included in the rather appropriate class (T2).

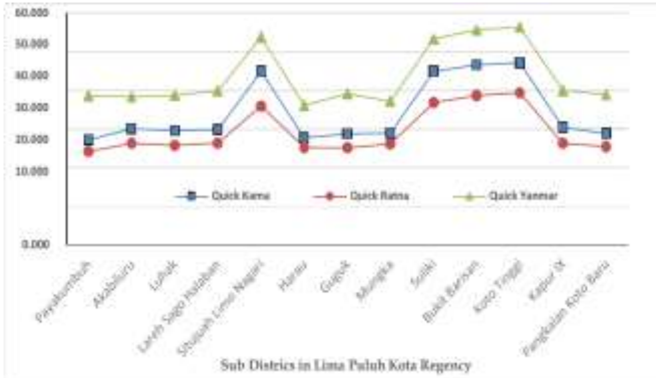

Figure 8. Comparability of wetland cultivation with harrow rotor I

For hand tractors with Kama engines, the highest equivalence value is in Koto Tinggi located in the sub-districts of Sitta Limo Nagari, Suliki and Bukit Barisan, while in other sub-districts included the class is somewhat appropriate (T2). Meanwhile, Ratna's hand tractor engine is the lowest equivalent tractor compared to Yanmar and Kama. The highest power equivalence is found in Koto Tinggi sub-district (39.39%), which belongs to the same class (T2) class as the sub-districts of Sitta Limo Nagari, Suliki and Bukit Barisan, while in other sub-districts, including unsuitable classes or equivalence from 30 percent.

The wide of Harrow rotor on Yanmar's engine is more appropriate than other engines, while Kama and its engine Ratna's equivalence power value in second tillage using harrow rotor I has a lower equivalence class that is in the class below T4, especially for Ratna engine value lower than the Kama engine because the power is larger while the same harrow rotor size so that the excess power is greater. To increase the value of this power equivalence can be done by enlarging the width of harrow rotor work as well as increasing its effective work capacity.

Conclusion

Capacity of land processing with largest singkal plow is in Payakumbuh district with value 0.075 ha/

hour with Yanmar engine, while the lowest working capacity is in Koto Tinggi sub-district with a value of 0.022 ha/hour. With the bigger the draft so the processing capacity with the singkal plow will be lower or inversely proportional. The actual working capacity of cultivation of rice field is ready to plant with 1 time plow singkal and 2 times renewal with Harrow rotor the biggest is in Payakumbuh with Yanmar engine that is 0.047 ha/jam while the lowest working capacity is in Koto Tinggi sub-district with Kama engine power source that is 0.016 ha/hour. The largest tractor requirement is in Harau sub-district which is 315 units of Kama fast engineering while the lowest in Pangkalan Koto Baru is 41 units with Kama type. Harau Sub district has the biggest hand tractor excess yaiu with total available 427 units. Other sub-districts are also excessive number of hand tractors such as Akabiluru, Luhak, Harau and Suliki sub-districts, while some other sub- districts lack the required number of tractors such as Sitta Limo Nagari, Bukit Barisan, Koto Tinggi, Kapur IX and Koto Baru sub-districts. The highest value of land processing capacity with the largest singkal plow is in Koto Tinggi sub-district with Yanmar's driving engine, which is 5.48 percent and the lowest is in the Payakumbuh sub district with Ratna's driving engine of 36.86 percent. The equivalence value of the processing power of the soil with the singkal plow is generally in a very suitable (T4) and appropriate (T3) class for hand tractor with Yanmar driving engine, while for Kama and Ratna engine tractors some of the sub-districts are in the appropriate class (T2) and not suitable (T1). The equivalence value of second soil processing power using Harrow rotor is generally lower when compared with the soil processing using the plow singkal. The highest power equivalence is found in Koto Tinggi sub-district with Yanmar energy source which is 56.38 percent while lowest power equivalent is in Payakumbuh sub district with Ratna engine which is 24.21 percent.

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Author Contributions

Z.N.: Developing ideas, data collection, analyzing, writing, reviewing, and responding to reviewers' comments; I.W., S.L.: supervising data collection, analyzing data, reviewing data and writing.

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Conflicts of Interest

The authors declare no conflict of interest.

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