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Economic potential of tractor hire business in Riau Province, Indonesia: A case study of small tractors for small rice farms

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Abstract: This study attempts to evaluate the potential of hand tractor hire business to increase the owners' income. The type of small tractors studied is used to promote the small rice farms' mechanization. A survey of 56 tractor owners in four regencies of Riau Province was conducted to carry out this evaluation. Approximately 68% of the total annual costs are variable costs and the largest single item is labor cost. Most tractors offering custom hire service are profitable with an average of 23.13 ha per annum. The received profit would be higher if drivers are provided by the owners. The breakeven point that justifies economical ownership of the small tractors is at 17.35 ha under Riau conditions. The owners require 6.5 years to retrieve the capital cost on the tractors and to obtain about 10% of return on the investment. The annual use of tractors should be increased to reduce costs or to augment profit. The use of tractors for customer hire services should be encouraged for augmenting farmers' income and enhancing tractor ownership in the province.

Keywords: tractor hire business, small tractor, annual use, tractor costs, breakeven point

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1 Introduction

Agricultural machinery has become increasingly important to carry out farm work in Riau Province Indonesia and has shown much progress since the 2000s. Tractors are the main farm machines used by farmers for tillage operations instead of manual tools or animal-drawing implements. In rice growing farms in most areas in Riau Province, small-scale two-wheel tractors (power tiller) are very popular among farmers due to its adaptation to the local economic conditions and management scales, where small-scale farming is dominant. On the other hand, the use of large tractors is still limited in Riau Province. A research conducted by Duff (1986) revealed that the small (2-wheel) tractors offed substantial economic advantages over the large (4-wheel) tractors.

Of the 835 tractors that were available in Riau Province in 2005, 798 (96%) were small tractors (less than 15 hp), which increased more than three times from 284 in 2000 (Food Crops Agricultural Service, 2005; 2006) while the number of four-wheel tractors (ranging from 15 to 50 hp) decreased during the same period (Figure 1). In terms of density, the number of the small tractors per 1,000 ha of cultivated area has increased from 2.3 in 2000 to 6.6 in 2005. Nevertheless, the number is still inadequate to achieve full mechanization stage that requires about 100 tillers / 1,000 ha (Herdt, 1983). The most common model used by farmers is Yanmar, dominated by 8.5 horsepower.

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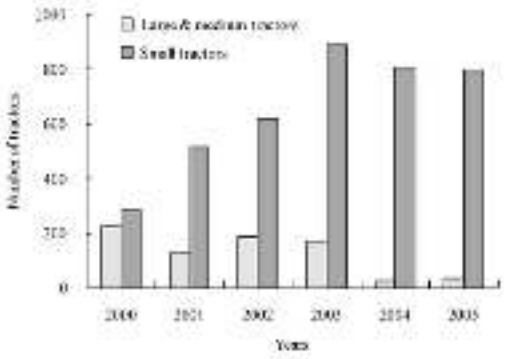

Figure 1 Development of small, large and medium tractors in Riau Province

In most cases, the management of tractors on small-scale farms is often under capacity and uneconomical. As reported by FAO (1996), most farmers in developing countries cannot afford to use the tractor exclusively on their own farms due to small farm scale owned. Since tractors are not possible to be utilized to their full capacity on a single small-scale farm, small farmers are forced to look for a collective use of the tractors such as private contractors, machinery cooperative, machinery ring, national machinery station and tractor hiring (Gego, 1986). The use of the small tractor for custom hire service which has been widely practiced in many developing countries (Chancellor, 1971, 1986; Kolawole, 1972; Wattanacharya, 1983; Duff, 1986; Balangkari and Salokhe, 1999) has also become one of the popular methods adopted by small farmers in Riau Province, Indonesia, because such method enables the owners to utilize the full capacity of the tractors and to realize the economic value of the ownership of the tractors. The other very important benefit in the future will be that custom hire services can be the main way to make tractors available for other farmers without buying the machines and are an opportunity for the owner to make one's living on the business. As reported by Balangkari and Salokhe (1999) in Coimbatore District India and Kolawale (1974) in Savanna Zone of Western Nigeria, for example, the farmers loaned tractors to other farmers to earn extra income. Learning from the above success and experience, provincial government through food crop service has recommended the owners to use their tractors for custom hiring in order to not only get additional income but also encourage the development of using tractor rice farming in the province.

Together with the increasing number of small farmers performing the custom service and the massive effort of the provincial government to popularize its use, there is a need to evaluate the economic potential of such operation method in Riau Province. The primary purpose of this study is to evaluate the potential of tractor hire business to create economic advantages for the owners. Specific objectives are to examine costs and profitability of the business, to determine a number of hectares which the tractor is economically justified, and to estimate the time needed for the investment to pay for itself.

2 Methodology

Data for this study were collected by field visits during October to December 2005 from four regencies in Riau Province, namely Kampar, Kuantan Sengingi, Rokan Hulu and Siak. Two villages which are of the most importance in terms of rice production and the largest number of tractors used for custom hiring were selected from each regency. Fifty-six tractors which were usually provided for custom hire service were purposively selected and the owners were personally interviewed. The data was obtained both in the dry season and the wet season for land preparation of paddy fields.

The collected data include year of purchase, initial purchase price, hectares of tractor use, costs of tractor operations (operator wage, repair and maintenance, fuel, oil, and lubricant costs), and rates of service charge. The data are tabulated and then analyzed using descriptive and simple regression techniques including percentages and means.

Costs which are calculated in this study consist of fixed and variable costs and are expressed in cost per year and cost per hectare. The fixed costs are only depreciation and interest. Other fixed costs, such as insurance, taxes, and shelter, are excluded from analysis for a number of reasons. The housing, for example, is not considered here because most tractors are not kept in houses in Riau province.

The annual depreciation cost is calculated by using

the straight-line method for the eight-year usage life according to the common economic life of the tractors that was found in the survey areas. The salvage value of the tractor is assumed to be 10% of the initial purchase price (Kepner et al., 1978; Jacob et al., 1983; Bukhari et al., 1988). The interest rate is set to 8%, representing the current average rate for capital interest calculation. The variable costs are operator wage, repair and maintenance, fuel, and lubricant costs. The repair and maintenance costs (henceforth referred to as repair costs) are the expenditure for replacing parts and regular repair required by labor and maintenance needs. All costs are calculated into Indonesian Rupiah in which 1 U.S. dollar is equivalent to Rp 8,500 based on the average of exchange rate in 2005.

3 Results and discussion

3.1 Cultivated area versus number of tractors

Approximately 18% of Riau's geographical area is used for food crop cultivation, of which 1.8% is wetland area, the main type of land for growing rice. In Table 1, averages of annual cultivated area, number of tractors available, and number of tractors required were calculated based on data collected during 2000–2005. Most of the cultivated area (76%) was handled by hand tools (e.g. hoes) and animal-drawn implements and only about 24% was cultivated using hired tractors. Mechanizing the entire cultivated area requires about 2,348 tractors. The figures were predicted under the assumption that the average tractor capacity was about 40 ha. These predictions create a wide opportunity for tractor owners in providing custom hire service in Riau Province.

Table 1 Relationship between annual cultivated area and the number of existing tractors

Years	Annual cultivated area (ha)	Number of 2-wheel tractors available	Estimated area tilled by tractor		Tractor Requirements (unit)
			ha(*)	%	
2000	121,876	285	11,400	9.35	2,702
2001	105,680	516	20,640	19.53	2,126
2002	123,258	420	24,800	20.12	2,481
2003	127,359	889	35,560	27.92	2,255
2004	120,772	807	32,280	26.73	2,212
2005	121,208	798	31,920	26.33	2,274
Average	126026		26100	24.13	2348

Source: Food Crops Service of Riau Province, 2005.

(*) Assuming that the tractor capacity is 40 ha year^{-1}.

3.2 Tractor ownership and operator

There are two ownership systems of tractors: individual and cooperative/joint ownerships. Both individual and cooperatives owners are farmers and provide tractor hire service to other farmers and members, respectively, by contractual work. Fifty per cent of samples are individual farmers and the others are cooperatives. The individual-owned tractors were newly purchased from dealers using farmers' own saving or credit loans with low interest rate from local government banks, while cooperatives owners receive the tractor from government aid through a farm mechanization scheme for small rice farmers.

Tractor operators are the owners, owners' relatives, or hired operators. Double operators are the most common in survey areas. Approximately 60% of tractor operators are hired operators who are remunerated on a hectare basis. They are usually contracted during land preparation for growing rice and there is no job order for them during off-season. The problem with hired operators is that they are hard to find during the season due to the very limited number of capable operators in survey areas, particularly skilled or trained ones. Therefore, the tractor owners sometimes offer higher pay for skilled hired operator to find them in time.

3.3 Tractor utilization

Most tractors worked seasonally according to local cropping system of rice with an average of 52 days each season (ranging from 25 to 57 days). The variation of working days between tractors is due to differences in local climatic conditions that directly affect the length of the season. The working hours average about 7 hours/day with an average capacity of about 0.1 ha/hour.

The tractor work focused on land preparation of paddy field, including plowing and puddling operations. Tractor owners only offered services to carry out those operations during rice cropping season. There is no demand of hire service for other operations or in other seasons. The tractors are stored in the shed, porch, or parked in the open area when not working.

Table 2 shows that total annual use of tractors averages 23.13 ha (ranging from 7 to 40 ha). There is

large variation of annual use among farmers due to the differences in field and infrastructure conditions, skill of the tractor operators, frequency of tractor breakdowns and time required to repair, and the desire of farmers themselves. The interviews with farmers revealed that the field and infrastructure conditions are the major factors that influence tractor annual use.

Table 2 Average annual use per tractor by individual and cooperative farmers in wet and dry working seasons

Items	Number of farmers	Cultivated area /ha	Percentage
Individual farmers	28	23.80	
Own farm		1.27	5.3
Hire service		22.53	94.7
Cooperative farmers	28	22.38	
Member		17.49	78.2
Hire service		4.89	21.8
Individual farmers	28	23.80	
Wet season		15.41	64.7
Dry season		8.39	35.3
Cooperative farmers	28	22.38	
Wet season		15.45	69.0
Dry season		6.93	31.0
Total	84	23.15	

In many cases, the owners could only operate the tractor in a limited radius due to fragmented fields and inadequate access to users' fields due to consequence of poor infrastructure conditions. This conditon held down the amount of the annual use particularly from contractual works. On the other hand, some owners, particularly in good infrastructure areas, had more annual use by travelling long distance (ranging from 3 to 5 km) to other villages.

Most of the total annual use of farmers' cooperative (78%) was from member farms and the remaining 22% was non-member farms. It means that they provide tractor service primarily to group members and only serve non-member farmers when there is surplus capacity. The individual farmers focused on tractor service for other farmers. Approximately 95% of the annual use was for custom services and only about 5% was for the owners' farm. It was also found that few individual farmers provided the custom services when they have completed their farm work on their own farms.

Most of the annual use for individual farmers (65%) and cooperative farmers (69%) worked during wet season and the remaining 35% and 31% were during dry season, respectively. It means that the total cultivated area which is seeded with rice or other crops is less than 100% during dry season. In Siak Case, Khan (1996) reported that only 60%–70% of the cultivated area is possible for planting rice crop in dry season due to lack of water from rainfall as well as irrigation. The planted area and cropping intensity for rice crop can be increased to be 70%–90% and by 200%–300% by improving drainage and irrigation conditions, which would consequently increase tractor use especially in dry season.

3.4 Annual costs of tractors and functions

The annual costs of the tractor operations were calculated to be Rp 6, 99 million (U.S. $823) in average with a range from Rp1, 43 million (U.S. $169) to Rp 8, 90 million (U.S. $1,047). The variable costs jointly account for about 62% of the total costs and the remaining 38% are fixed costs. The relative importance of the annual cost items is presented in Table 3. Labor is the largest (38%) single cost of the total costs, followed by depreciation (27%) and fuel cost (13%). Repair costs which are frequently the largest costs in other developing countries (Henderson and Fanash, 1984; Bukhari et al., 1988) were found to contribute to only about 9% of the total costs. The smaller repair costs are found here because that most tractors (63%) had been operated for less than six years, when not many serious breakdowns occurred. Interviews with the tractor owners revealed that they commonly did not use the aged tractor for hire operation due to lower power and high rate of breakdowns. The cost of fuel accounted for about 14% of the total costs. This cost can vary depending on the locations of fuel purchase. The price is lower at gas stations than that from fuel suppliers within villages whose price follows the increase of the world oil price. The results also indicate that the largest variation (86%) occurs in the repair costs as shown by the value of the coefficient of variation (CV). It may be due to differences in tractor age, annual use, operator skill, maintenance management, and field conditions.

Table 3 Relative importance of annual cost items of tractor operations

Item	Annual cost /Rp	C.V* /%	Percentages of fixed or variable costs/%	Percentages of total costs/%
Fixed costs	2,631,436 (USD 310)		100.00	-
Depreciation	1,891,607 (USD 223)	13	71.88	27.04
Interest	739,829 (USD 87)	13	28.12	10.58
Variable costs	4,365,086 (USD 513)		100.00	-
Repair	340,513 (USD 75)	86	11.68	9.16
Labor (operator)	2,633,438 (USD 310)	38	60.35	37.65
Diesel fuel	956,751 (USD 113)	51	21.93	13.68
Oil and lubricants	132,910 (USD 16)	52	5.05	1.89
Total costs	6,996,522 (USD 823)	-	-	100.00

Note: *C.V- Coefficient of Variation

The repair, variable, fixed, and total costs of the different annual use rates are depicted in Figure 2. The curves describe in the form of data points which relate to the above cost items per hectare to annual hectares of use. The curves show the same trend and are negatively correlated. It is clear that as tractor annual use increases, the repair and variable costs per hectare tend to slightly decrease. This finding is in agreement with Butterworth and Nix (1983) who state that repair costs per hectare might fall to some extent with increased annual use. As a result, it is a relatively cheap operation of the tractors since the high rate of use means lower operating costs. The fixed and total costs per hectare show a quick decline with an increase of annual use. This result suggests that there is a great potential to reduce fixed and total costs by increasing annual hectares of use. It is because the costs spread over the number of hectares and later cost per hectare would be lower.

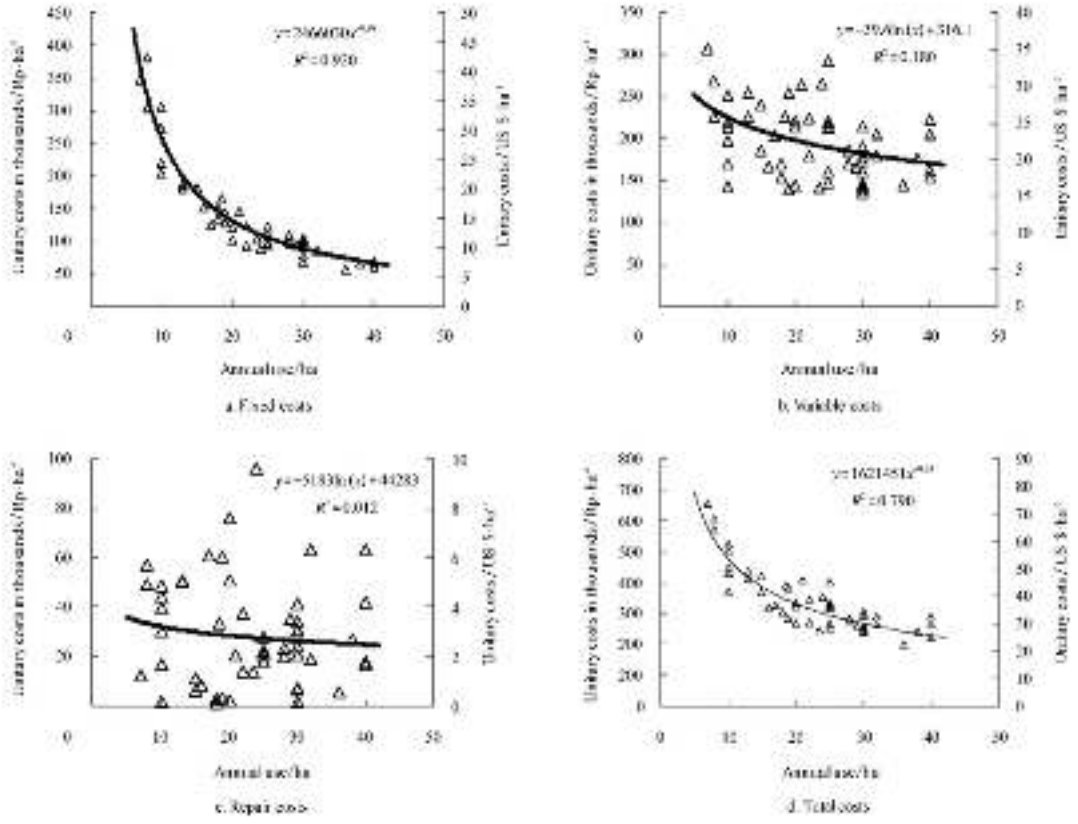

Figure 2 Relationships between four cost components per hectare and annual use of tractors

In order to derive function for each cost item above, least squares regression method was used to determine the best fit function. The repair, variable, fixed, and total costs are taken as dependent variable (y) and annual use rates as independent variable (x). Simple functional relationships, such as linear, polynomial, exponential and

power equations have been tried. The derived functions which gave the best result are presented in Table 4.

Table 4 Annual cost functions derived from collected data

Cost items	Form	Equation	r^2
Fixed costs	Power	$y = (2.47x^{-0.08})10^6$	0.92
Total costs	Power	$y = (1.62x^{-0.2})10^6$	0.79

The variation of the curves is visible. A power function gave a well-fitted result, accounting for 92% and 79% of the observed variations in fixed and total costs per hectare, respectively. The result indicated that there is a significant contribution of increased annual use on decreasing fixed and total costs. A logarithmic function could explain only 1% and 18% of the observed variation in repair and variable costs per hectare, respectively (Figure 2b and 2c). The very low r^2 value suggests that annual use of a tractor is not a major determinant for either repair or variable costs per hectare.

3.5 Service charge, revenue, and profitability

The tractor owners mostly offered job contracts to neighbor farmers. The tractor owners and hired farmers planned and agreed on the contractual work in advance (at the beginning of the season). Tractor service rate was calculated on a hectare basis as a common standard practiced by most farmers in the survey areas. The rate took into account the conditions of the field being worked at, distance and size of field plots, weed growth on the field, and prevailing rate of local wages. The level of competition among tractor owners may affect the rate of service charge. These conditions differentiate the service charge among owners.

The charge rates for service ranged from Rp300 thousand (USD 35) to Rp 450 thousand (USD 53) with an average of Rp 348 thousand (USD 41) for both plowing and the puddle work. The charges are lower than the government's recommended charge rate of Rp 500 thousand (U.S. $59) per hectare primarily due to low economic ability of hiring farmers and competition among the tractor owners. The charge for the service is usually paid in two stages: a 50% installment before starting the service and the second half after completing the work. The installment is intended for the purchase of fuel, oil and other cash costs by the tractor owners. In some cases, the hiring farmers failed to pay off the payment at the second stage (50%) after completion of the work, but the full amount could be paid off after harvest. Nevertheless, there is not an additional charge for late payment.

Revenue, which was estimated by multiplying the amount of annual use (including service on others' farms and work on the owners' farm) and the service charge were presented in Table 5. In this analysis assumption was made that the rate of service charge for the owners' own farms is the same as that of custom hire service. The annual revenue was derived from the operation averages Rp 7.92 million (USD 932) which ranges from Rp 3 million (USD 353) to Rp 14 million (USD 1647). The variations are caused primarily by difference in the number of job contracts and in service charges between owners.

Table 5 Average revenue and profitability of tractor operation

Item	Value (Rp year^{-1})	C.V., %	Percentages of Revenue %
Revenue (gross income)	7,920,089 (USD 932)	39	
Total costs	6,994,522 (USD 823)	25	88.31
Return on Labor	3,559,089 (USD 419)	93	44.94
Return over variable costs	3,557,205 (USD 418)	49	44.91
Profit (net income)	925,567 (USD 109)	186	11.69
Break-even area (ha)	17.23		
Payback period (a)	6.20		
Rate of return on investment %	10.02		

Profit, which is estimated from the differences between revenue and total costs (Riggs et al. 1986), averages Rp 926 thousand (USD 109) annually or about 12% of the revenue. The variation in the profit is extremely high as indicated by the value of coefficient of variation (CV). According to the survey, about 34% of tractor samples did not make profit because of either lower annual use or higher costs. This suggests that the owners should increase the annual use by travelling to other villages to find new customers and eventually receive more profit. Nevertheless, the owners who operate the tractor themselves receive more return from labor wage. According to Table 5, the return received by the owners is an average of Rp 3.56 million (USD 419) or about 45% of the revenue. This result implies that the owners should operate tractor themselves to receive more

return from the operation. Furthermore, another alternative that can be received by tractor owners from the operation is to save over variable costs which accounts for Rp 3.55 million (USD 418).

The annual tractor use required for economic viability was evaluated using break-even point analysis and the result is illustrated in figure 3. According to Butterworth and Nix (1983), the break-even area was calculated by dividing the fixed costs per annum by differences between the service charge and the variable costs. The analysis result indicates that the break-even area was 17.23 ha/year, while the actual average annual used in this study was 23.13 ha. After this point, any additional hectare of use would produce a profit. It is reasonable to conclude that tractors used for custom service, on average, make profit from their operations. The result suggests that the tractor annual use should be more than the figure to create economical reasons to operate a tractor under Riau conditions.

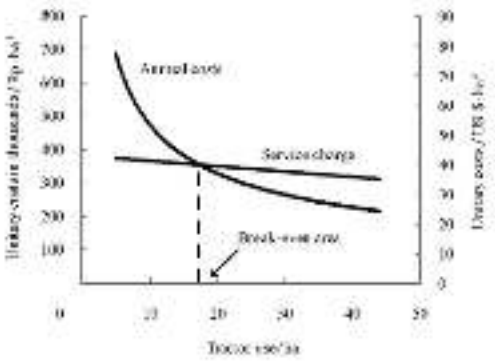

Figure 3 Break-even analysis using annual cost and service charge per hectare

This finding is lower than that derived by Duff (1986) who stated that the annual use should be 25.12 ha/year and 62.8 ha/year to reasonably own a similar tractor type under west Java and South Sulawesi conditions, respectively. He also found that the small tractor would achieve economic level in about 33 ha in Philippine and 5.8 ha in Thailand. These differences may be caused by the differences in maintenance management of tractors and field conditions among farm sites.

The breakeven area may be affected by changing a number of assumptions made in the analysis, such as costs and service charge. One of the most important assumptions which may be controlled by the tractor owners is the rate of depreciation. We assume that the tractors would last ten years (two years longer than assumption made in previous analysis), the annual fixed costs would reduce from Rp 2.63 million (USD 310) to Rp 2.25 million (USD 265) and the break-even area would then be 14.75 ha/year. This result suggests tractor owners to prolong economic life of the tractors by taking good care of them and maintenance practices in order to shorten break-even area and reduce costs.

Furthermore, this break-even analysis can also give an indication for farmers to decide whether to buy a tractor or to order tractor contractor service. The result implies that a farmer is more economic to purchase the machine if the annual use is above the area, conversely the contractor service is the less expensive for below the area.

Table 5 also presents the average payback period, i.e. the number of years that an investment takes to pay for itself (Butterworth and Nix 1983). The payback period was analyzed to be 6.5 years of the tractor operation. It means that the tractor investment would pay for itself after that payback period. The rate of return on tractor investment was also found to be about 10%. It is relatively good tractor investment for use in hire operation because the payback period is shorter than the expectation of most farmers who expect the tractor economic life to be eight years.

4 Conclusions

Most of the total annual costs of the Rp 6.99 million (USD 823) are contributed to by variable costs (68%) and labor cost is the largest single item (38%) of the total costs. The majority of the tractor hire business is profitable when operating in wetland paddy field in Riau Province. Tractor owners receive an average profit of Rp926 thousand (USD109) per annum under annual use of 23.13 ha and service charge of Rp 348 thousand (USD 41). The tractor owners got additional income of Rp 3.56 million (USD 419) from labor return for operating their own tractors. Under Riau conditions, the owners must use the tractors at least 17.23 ha per year for six and a half years to earn back the investment on the tractors

and profit about 10% of the investment. The annual use should be increased to reduce annual costs and to augment farmers' profit. The annual use can be increased by increasing cropping intensity and extending operating area to other villages by improving the infrastructures, such as irrigation and road. The use of tractors for custom hire service should be encouraged because that it is a source of farmers' income and one of the effective ways to develop private tractor ownership in the province.

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