ECONOMIC ASPECTS OF MACHINERY HIRE SERVICES MANAGED BY FARMER GROUPS IN KAMPAR REGENCY, INDONESIA

U. Paman, S. Inaba, S. Uchida

ABSTRACT. *Farm machinery hire services have become important business groups within a small farming community in Kampar Regency, Indonesia. This research evaluated the economic aspects of the machinery hire services managed by farmer groups with a focus on cost, revenue, profitability, and economic efficiency. A total of 20 machinery hire service groups located in seven districts of the region were purposely selected. Group managers and custom operators were interviewed to collect field data during the rainy (growing) season in 2012/2013. The results showed that the seasonal total work varied across hire service groups and depended on the number and type of machines owned. Seasonal costs among custom operators varied considerably. Depreciation and labor were the dominant fixed and variable costs, respectively. Although having a relatively low profit, the machinery hire service groups were profitable and efficient businesses under current levels of custom rates. The low seasonal total work, due to limited number and type of machines and short seasonal working time, is an important constraint on increasing profitability. Therefore, there is an opportunity to make the hire service groups more profitable and viable businesses by adding several different types of machines.*

Keywords. *Cost, Economic efficiency, Farmer groups, Machinery hire services, Profit, Revenue.*

The majority of small-scale farmers in developing countries have poor investment capacity for purchasing farm machinery due to low levels of agricultural production and financial return. Consequently, they will not be able to invest in agricultural mechanization without profitable agriculture (Kunihiro, 2013). Therefore, small farmers have mostly chosen to hire machinery services for various farm operations rather than owning and operating their own machinery. Machinery hire services have helped many small farmers to transform smallholder agriculture (Houssou et al., 2013) and mechanize agricultural work without investing in high-cost machinery (Singh et al., 2013). The method is also an effective way for having short-term control of farm machinery (Kamboj et al., 2012). Currently, small farmers, therefore, have increasingly depended on custom hiring services of farm machinery to accomplish their farm operations and have encouraged agricultural development at the farm level.

The level of agricultural mechanization in Indonesia is relatively low. The low mechanization level, about 30% on average nationally (Handaka, 2005) and 21% in Riau (Paman et al., 2012) offers a market opportunity for machinery hire services to be widely developed and thus create small businesses for smallholder farmers. The development of custom hiring services through enterprises could accelerate the pace of mechanization (Dixit et al., 2014), which has the ultimate goal of increasing the welfare of farm households and increasing employment opportunities (Hendriadi, 2009). Sims et al. (2011) reported that the machinery hire businesses in some developing countries have offered many opportunities for small farmers in rural areas to diversify and increase income sources. In addition, mechanization development has had a profound effect on the socio-economic conditions in rural areas (Annamalai, 2004) and has further improved the economic status of small-scale farmers (Mada and Mahai, 2013).

Actually, farm machinery hire services are multi-farm use systems and small commercial enterprises within small farming communities, in which farm machinery is used full-time on a hire basis (Gifford, 1992). Some forms of multi-farm use, which have been established in many developing countries (Chancellor, 1971; Kolawale, 1972; Panin, 1995; de Toro and Hansson, 2004; Koike, 2009; Kamboj et al., 2012; Singh et al., 2013; Rahman et al., 2013; Alabadan and Yusuf, 2013), such as public hire services, private hire services, cooperative ownership, and joint ownership, are required for economic utilization (Rijk, 1985). Therefore, machinery hire services can be profitable and viable businesses to generate off-farm income. It is essential to receive a reasonable financial return (profit) from the machinery investment (Jacobs and

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Harrell, 1983). Custom machinery hire businesses are also regarded as a set of machinery management packages that are capable of generating profits (Koike, 2009).

Farm machinery hire services have established and expanded across regions in Indonesia, primarily in rice production areas (Ariningsih and Tarigan, 2005; Hutahaean et al., 2005; Hamidah and Soedarto, 2006; Galib, 2010). Machinery hire services have become economic institutions within small farming communities in rural areas which are oriented towards profit-making. According to Tudor and Tudor (1997), the purpose of these businesses is to provide a machinery service to others (a group) and obtain a profit. In Riau Province, machinery hire services have also been important businesses supported by government through mechanization development programs for increasing rice production, which is still about 55% lower than required annually in the region (Food Crops Services, 2013). Currently, such government provision significantly contributes to the advancement of farm machinery use in the province.

In the Kampar Regency of Riau Province, machinery hire services are managed by either a group or an individual owner, with the former being the most dominant. A machinery hire services group is led by a manager and assisted by operators, depending on the number of machines owned. Members of the hire service groups are small rice farmers who are landholders. The technical aspect of the machinery hire services have been reported by Paman et al. (2014), who studied the economic potential of tractor hire businesses with a specific focus on hand tractors in Riau Province (Paman et al., 2010). The present study attempts to evaluate the economic aspects of the machinery hire service groups with a focus on cost, revenue, profitability, and economic efficiency for seven types of small farm machines managed by the groups in Kampar Regency, Indonesia. In particular, cost, revenue, and profit are important factors in determining the viability and success of a business.

Materials and Methods

The research was carried out in Kampar Regency in which the machinery hire service groups predominantly provide services for small rice farmers. A total sample of 20 hire service groups located in 7 of 21 districts of the region were purposely selected as samples. The hire service groups selected as samples had to be well-structured, manage at least one machine, and perform custom machinery services actively for their group members. The districts selected included Bangkinang Seberang, Kampar, Kampar Timur, Kampar Utara, Kuok, Salo, and Tambang. These districts are in the rice producing area in the region with a high adoption of farm machinery through custom hiring services for performing farm operations. The field survey was conducted during the rainy (growing) season in 2012/2013 by visiting the hire service groups' centers.

Data were collected through personal interviews with group managers and custom operators using pre-structured questionnaires. The hire service groups have to complete annual financial reports, and the data in this article were compiled from these. Nevertheless, most data were gathered from interviews with group managers and custom operators. The data collected included the type and number of machines, purchase year, seasonal working scale (ha or ton), custom rates, fuel and lubricant uses, repair and maintenance costs, and other related items. Data were analyzed using statistical techniques and a simple cost accounting method. The statistical techniques included means, percentages, standard deviation, and simple regression analysis. The simple accounting method was employed to estimate costs, revenue, profit, and the economic efficiency of hire business groups. For this study, the cost, revenue, and profit were calculated on a seasonal and per hectare basis for each type of machinery as well as each hire service group. The values were then expressed in United States dollars (USD).

Results and Discussion

Seasonal Work

The type of farm machines managed by hire service groups consisted of rotary tillers, moldboard plows, hydro tillers, cultivators, water pumps, power threshers, and rice milling units (RMUs) (fig. 1). The volume of seasonal work done by the various machine types is presented in table 1. The seasonal work varied across machine types and was dominated by tillage operations. According to Sims et al. (2012) the highest demand in farm operations is

Figure 1. Type of farm machines managed by hire service groups.

Table 1. Seasonal workloads for machine types and hire service groups.

	Number of Machines and Seasonal Working Scale													
	Rotary Tiller		Hydro Tiller		Moldboard Plow		Cultivator		Water Pump		Power Thresher		RMU[a]	
Name of Groups	MN[b]	Ha	MN	Ha	MN	Ha	MN	Ha	MN	Ha	MN	Ha	MN	Ha
Bonca Ukam (BU)	1	10.0	2	20.0	-	-	1	2.0	1	5.0	1	2.9	-	-
Suka Maju (SM)	2	10.0	4	28.0	2	10.0	1	2.0	2	12.0	1	2.3	1	5.5
Pulau Lestari (PL)	2	20.0	4	40.0	2	20.0	2	4.0	1	8.0	2	4.1	1	4.5
Karya Bersama (KB)	2	24.0	-	-	-	-	-	-	-	-	-	-	-	-
Tani Bersama (TB)	1	12.0	-	-	-	-	-	-	-	-	-	-	-	-
Birandang Jaya (BJ)	1	24.0	-	-	1	24.0	-	-	-	-	2	4.6	1	7.0
Karya Jaya (KJ)	2	10.0	1	5.0	1	5.0	-	-	-	-	-	-	1	6.3
Sinar Tani (ST)	1	7.5	1	7.5	1	7.5	-	-	-	-	-	-	1	6.0
Baliok Imbo (BI)	1	15.0	1	15.0	-	-	-	-	-	-	-	-	-	-
Sinar Harapan (SH)	-	-	1	16.0	-	-	-	-	-	-	-	-	-	-
Nikmat Usaha (NU)	1	4.0	2	10.0	2	10.0	1	2.5	3	12.0	2	5.6	-	-
Karya Indah (KI)	1	12.2	1	12.5	-	-	-	-	-	-	-	-	-	-
Rizki Bersama (RB)	-	-	3	15.0	-	-	-	-	1	5.0	1	1.9	1	5.0
Sri Rezeki (SR)	2	16.0	3	24.0		-	1	1.0	-	-	1	1.5	1	4.5
Titian Rizki (SR)	-	-	3	30.0	-	-	-	-	1	3.0	-	-	-	-
Tani Maju (TM)	1	8.0	-	-	1	5.0	-	-	-	-	1	2.3	-	-
Tunas Harapan (TH)	-	-	1	10.0	1	10.0	-	-	-	-	1	3.0	-	-
Zoki Busamo (ZB)	1	8.0	-	-	-	-	1	1.0	-	-	1	1.8	-	-
Kerja Bersama (KB)	2	20.0	-	-	-	-	-	-	-	-	-	-	-	-
Pelambaian Indah (PI)	1	20.0	-	-	-	-	-	-	1	10.0	-	-	-	-
Total	22	-	27	-	11	-	7	-	10	-	13	-	7	-
Average	-	13.8	-	17.9	-	11.4	-	2.1	-	7.9	-	2.9	-	5.5

[a] RMU = Rice Milling Unit.
[b] MN = Machine number; Ha = Hectare.

usually for land preparation services. The hydro tillers had the largest seasonal workloads among tillage machines, ranging from 5 ha for Karya Jaya to 40 ha for Pulau Lestari, with an average of 17.9 ha with a total of 27 machines from 13 hire service groups.

The low demand for cultivators caused the lowest seasonal workload of the machines (ranging from 1 ha for Palau Lestari and Sri Rezeki to 4 ha for Zoki Busamo), with a total of 7 machines from 6 hire services groups. The lower seasonal workload is due to the machines only being used specifically on dry land preparation for vegetable cultivation in the survey area. Furthermore, water pumps, which were owned by 7 hire service groups, had seasonal work of about 7.9 ha on average (ranging from 12 ha for Suka Maju and Nikmat Usaha to 3 ha for Titian Rizki). The machine was usually used to only supply water to paddy fields when the availability of water in the paddy field is not sufficient to perform tillage works.

For the same analysis purpose, seasonal workloads for power threshers and RMUs were converted into hectare by assuming 4 ton.ha^{-1}, according to the average of rice yield in the region. With a total of 13 machines from 10 hire service groups, the seasonal work of power threshers ranged from 1.5 ha for Sri Rezeki to 5.6 ha for Nikmat Usaha, with an average of 2.9 ha. The average seasonal work of RMUs was found to be 5.5 ha, ranging from 4.5 ha for Pulau Lestari and Sri Rezeki to 7 ha for Birandang Jaya, with a total of 7 machines from 7 hire service groups. The use pattern of RMUs differed compared to other machine types in the survey area. The machines were used all year and varied across months. Because most rice farming is subsistence based, most farmers habitually store the paddy's production and will just mill it when the rice is needed for consumption. Interviews with group managers revealed that the demand for milling services usually increased primarily after the rice harvest.

Furthermore, seasonal total work of each hire service group was obtained by summing all seasonal workloads from each machine type managed by the groups. The seasonal total work of hire service groups depended considerably on the number and type of machines owned. Figure 2 shows that the seasonal total work increases with the increasing number of machines with the largest area of 100.6 ha for Pulau Lestari. The number of the seasonal total work was dominated by tillage operations, ranging from 56% to 100%. In addition, the seasonal workloads of each farm machine are relatively low due to the limited seasonal working days (20-25 days per season) during the rice-growing season. This eventually affects the seasonal working scale of hire service groups. Kolawale (1972) found that the length of the growing season also determined the amount of work done, besides the frequency of equipment breakdowns, degree of farm mechanization, and availability of off-season jobs.

COSTS

Referring to some literature studies (Fairbanks et al., 1971; Kepner et al., 1980; Jacobs and Harrell, 1983; Finner and Straub, 1985; Hunt, 1983; Pflueger, 2005; Paneerselvam, 2007), costs associated with owning and operating machines include fixed and variable costs. Fixed costs are time-related expenses, while variable costs are use-related costs (Patterson and Painter, 2011). For this study, depreciation and interest expenses were considered fixed costs. Both depreciation and interest are major fixed costs (Cross and Perry, 1996). Depreciation was estimated using a straight-line depreciation over 5 years of useful life. The method is the most realistic and simplest way for estimating depreciation and is readily acceptable (Butterworth and Nix, 1983).

The depreciation cost was estimated as purchase price minus salvage value, divided by the number of years of

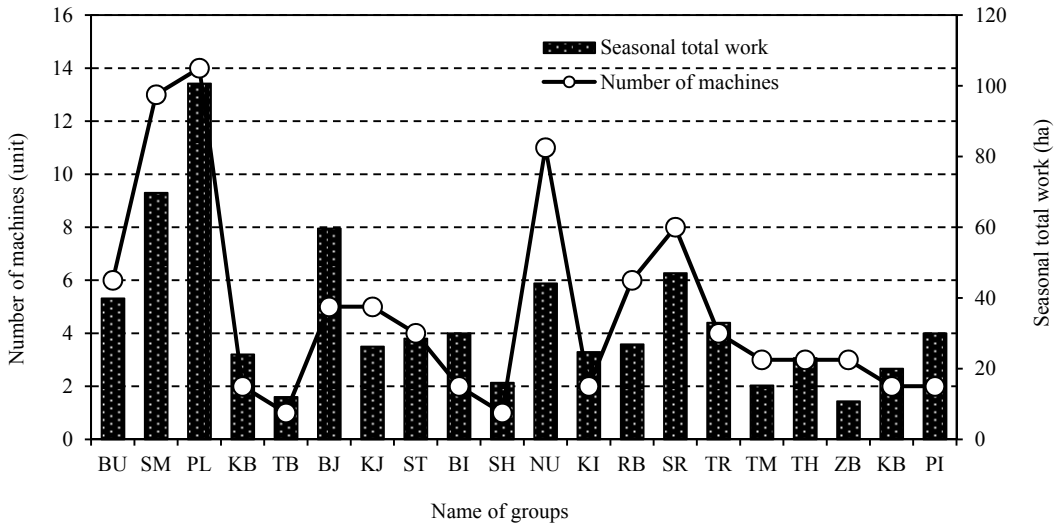

Figure 2. Relationship between number of machines and seasonal total work.

useful life (Hunt, 1983). Salvage value was assumed to be 10% of the purchase price (Rahmoo et al., 1979; Hunt, 1983; Jacobs and Harrell, 1983; Hafsah and Bernsten, 1983; Bukhari et al., 1988). The depreciation of housing was included in the fixed costs since the machines were housed to provide protection against the weather. According to the survey, some hire service groups did not provide special housing for their farm machines.

By using straight-line depreciation, for simplicity, interest was determined by taking one-half of the sum of the purchase prices and the salvage value, and then multiplying by the interest rate (Lessley and Holik, 1987; Kay and Edward, 1994). Relevant interest was estimated at 6%, the prevailing interest rate in the survey area. The interest rate should reflect prevailing rates (Kepner et al., 1980; Srivastava et al., 2006) and agricultural enterprises often use lower interest rates reflecting the cost of borrowed money (Peterson and Milligan, 1976). With the double-cropping season assumed in a year, annual depreciation and interest costs were then divided by 2 to obtain the seasonal fixed costs.

Variable costs considered in this study include labor, fuel, lubricants and repairs, and maintenance expenses. Labor costs were incurred for operator wages and were charged based on the prevailing local wage system. Fuel and lubricant expenses refer to the fuel and lubrication expenditures to operate machines. Repair and maintenance costs consisted of the expenses for replacement parts and labor to make repairs. The sum of fixed and variable costs is presented in table 2. Considerable variability in total machinery costs was found across machine types and hire service groups. Based on the coefficient of variation, the average cost of moldboard plows showed the largest variation (68%) across machine types and the variation was greater than the total cost variability of hire service groups (61%).

Typically, the largest average cost was found to be about USD 806.76 for rotary tillers, while the lowest was about USD 166.17 for power threshers. On the other hand, Pulau Lestari incurred the highest cost of USD 6,904.77, while the lowest was that of Tani Bersama with USD 845.18. According to Patterson and Painter (2011), the operating conditions, amount and type of machine use, original cost of the machines, replacement costs, interest rates, and quality of maintenance are factors affecting machinery costs. Specifically, the different purchase price, for instance, caused the variation of fixed costs, while the amount of work done affected the variation of variable costs across machines.

Moreover, figure 3 shows that labor and depreciation costs had a sizeable contribution to average total costs across machines. The contribution of labor cost to total costs ranged from 11% (accounting for USD 25) for cultivators to 53% (accounting for USD 312) for hydro tillers. The high demand and shortage of available machine operators during the growing season in the survey area caused operator wages to increase (i.e., higher labor costs). Nevertheless, the high wages of operators are, in fact, not enough to be attractive to young people in the survey area looking for a job. Some hire service groups found it difficult to find operators due to a lack of availability in the area. Seasonal job contracts were one of the main reasons for this. Furthermore, the contribution of depreciation cost to total costs ranged from 24% (accounting for USD 144) for hydro tillers to 51% (accounting for USD 119) for cultivators. A depreciation cost of USD 144 can be obtained for a hydro tiller with a purchase price of USD 1,600 and a salvage value of USD 160, kept for 5 years. The annual depreciation cost is calculated in the following way: USD (1,600-160) ÷ 5 = USD 288 ÷ 2 = USD 144. Interest is also an important part of fixed costs for farm machinery. This cost had a contribution ranging from 6% (accounting for USD 8) for water pumps to 22% (accounting for USD 52) for cultivators. As illustration, an interest cost of USD 8 can be obtained for a water pump with a purchase price of USD 470, a salvage value of USD 47, and an annual interest rate of 6%. The annual interest cost is computed by: (USD (470 + 47) ÷ 2) × 0.06 = USD 16 ÷ 2 = USD 8.

Table 2. Costs incurred by machine types and hire service groups.

	Rotary Tiller (USD)	Hydro Tiller (USD)	Moldboard Plow (USD)	Cultivator (USD)	Water Pump (USD)	Power Thresher (USD)	RMU (USD)	Total Costs (USD)
Bonca Ukam	701.10	1,210.85	-	219.90	175.91	183.17	-	2,490.92
Suka Maju	1,187.90	1,935.70	895.40	249.03	386.98	186.64	410.57	5,252.21
Pulau Lestari	1,451.55	2,594.25	1,400.15	523.29	234.05	312.66	388.83	6,904.77
Karya Bersama	2,293.00	-	-	-	-	-	-	2,293.00
Tani Bersama	845.18	-	-	-	-	-	-	845.18
Birandang Jaya	1,725.05	-	2,069.35	-	-	320.37	551.06	4,665.83
Karya Jaya	965.40	437.55	535.15	-	-	-	462.62	2,400.72
Sinar Tani	583.18	479.78	653.48	-	-	-	525.60	2,242.03
Baliok Imbo	1,000.80	891.30	-	-	-	-	-	1,892.10
Sinar Harapan	-	1,177.38	-	-	-	-	-	1,177.38
Nikmat Usaha	448.80	865.80	987.90	267.70	428.73	336.61	-	3,335.53
Karya Indah	994.05	1,129.60	-	-	-	-	-	2,123.65
Rizki Bersama	-	1,255.53	-	-	166.56	160.24	412.92	1,995.24
Sri Rezeki	1,189.00	1,461.63	-	166.80	-	138.74	286.08	3,242.24
Titian Rizki	-	1,962.25	-	-	110.49	-	-	2,072.74
Tani Maju	507.80	-	413.15	-	-	150.35	-	1,071.30
Tunas Harapan	-	583.19	651.80	-	-	212.46	-	1,447.45
Zoki Busamo	958.75	-	-	212.95	-	158.94	-	1,330.64
Kerja Bersama	1,465.50	-	-	-	-	-	-	1,465.50
Pelambaian Indah	1,431.65	-	-	-	294.59	-	-	1,726.24
Average	806.76	592.03	691.49	234.24	179.73	166.17	433.95	2,498.73
CV[a] (%)	41	34	68	19	30	12	21	61

[a] Coefficient of variation (CV) was computed by dividing the standard deviation by the average.

Total costs for hire service groups were computed by summing all costs incurred for each machine owned during a season. The total costs depended on the number of machines owned by hire service groups, as presented in table 2. By owning 14 machines, for example, Pulau Lestari incurred the largest total costs, accounting for about USD 6,904.77 seasonally. In addition, the type of machine also affected the total costs incurred by hire service groups. For instance, by owning the same number (4 units each) and different type of machines, Birandang Jaya incurred the higher total costs of about USD 4,665.83, compared to Karya Jaya of about USD 2,400.72. Birandang Jaya owned one rotary tiller, one moldboard plow, one power thresher, and one RMU, while Karya Jaya had one rotary tiller, one hydro tiller, one moldboard plow, and one RMU.

REVENUE

The seasonal revenue per machine type is determined by multiplying the seasonal work (ha or ton) by the custom rates. Thus, total revenue for hire service groups was

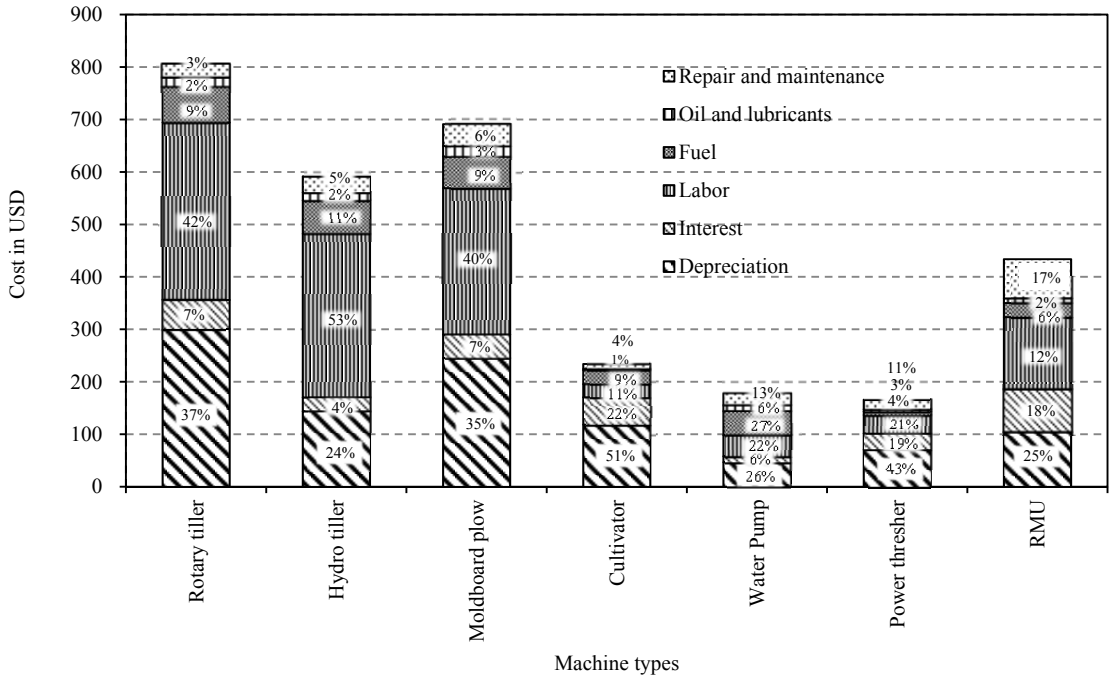

Figure 3. Contribution of relative importance of cost items on total costs per machine type.

Table 3. Custom rates and revenue for machine types and hire service groups.

	Rotary Tiller		Hydro Tiller		Moldboard Plow		Cultivator		Water Pump		Power Thresher		RMU[a]		Total
Name of MHBGs	CR[b]	R	CR	R	CR	R	CR	R	CR	R	CR	R	CR	R	Revenue
Bonca Ukam	95.0	950.0	95.0	1900.0			120.0	240.0	40.0	200.0	0.018	201.3			3491.3
Suka Maju	150.0	1500.0	100.0	2800.0	100.0	1000.0	150.0	300.0	40.0	480.0	0.025	225.0	0.025	550.0	6855.0
Pulau Lestari	100.0	2000.0	100.0	4000.0	100.0	2000.0	150.0	600.0	40.0	320.0	0.021	341.3	0.030	540.0	9801.3
Karya Bersama	150.0	3600.0													3600.0
Tani Bersama	100.0	1200.0													1200.0
Birandang Jaya	120.0	2880.0			150.0	3.600.0					0.025	462.5	0.025	700.0	7642.5
Karya Jaya	120.0	1050.0	120.0	600.0	120.0	600.0							0.023	575.0	2825.0
Sinar Tani	90.0	675.0	90.0	675.0	120.0	900.0							0.030	720.0	2970.0
Baliok Imbo	100.0	1500.0	100.0	1500.0											3000.0
Sinar Harapan			125.0	2000.0											2000.0
Nikmat Usaha	120.0	480.0	120.0	1200.0	120.0	1200.0	120.0	300.0	40.0	540.0	0.018	393.8			4113.8
Karya Indah	120.0	1500.0	150.0	1875.0											3375.0
Rizki Bersama			120.0	1800.0					40.0	200.0	0.025	187.5	0.028	560.0	2747.5
Sri Rezeki	90.0	1440.0	90.0	2160.0			150.0	150.0			0.025	150.0	0.020	360.0	4260.0
Titian Rizki			100.0	3000.0					40.0	120.0					3120.0
Tani Maju	95.0	570.0			95.0	475.0					0.020	180.0			1225.0
Tunas Harapan			90.0	900.0	90.0	900.0					0.025	300.0			2100.0
Zoki Busamo	120.0	1440.0					150.0	225.0			0.025	175.0			1840.0
Kerja Bersama	100.0	2000.0													2000.0
Pelambaian Indah	120.0	2400.0							40.0	400.0					2800.0
Average	112.3	1144.7	105.0	904.1	110.5	970.5	141.4	259.3	40.0	220.0	0.022	201.3	0.026	572.1	3548.3
CV (%)	19	55	14	40	16	92	10	28	0	39	16	20	14	21	62

[a] RMU = Rice Milling Unit.
[b] CR = Custom Rate and R = Revenue (in USD).

obtained by the sum of revenues derived from each machine owned. Table 3 shows that the total seasonal revenue varied across hire service groups as indicated by the coefficient of variation of 62%. The largest revenue was found to account for about USD 9,801.3 seasonally for Pulau Lestari, while the lowest total revenue accounted for USD 2,000 seasonally for Tani Bersama. The number of seasonal workloads and custom rates of each farm machine were determinant factors of the total revenue of hire services groups. Paman et al. (2014) reported that there was a variation in custom rates, especially for tillage operations, due to the difference in machine type, group manager policy, and field conditions (for instance field size and shape, weed conditions, and distance from the machine center to the located operation farm).

Furthermore, the contribution of the revenue of each machine type to the total revenue obtained by hire service groups is depicted in figure 4. Although differing across hire service groups, tillage machines contributed quite considerably to total revenue derived by the groups. For example, hydro tillers had the largest contribution (54%) to total revenue in Bonca Ukam. On the other hand, moldboard plows had the largest contribution (47%) to total revenue obtained in Birandang Jaya. Both power threshers and RMUs had the largest contribution to total revenue of about 15% and 24% for Tani Maju and Sinar Tani, respectively.

EFFECT OF SEASONAL WORK ON COST AND REVENUE

The effect of seasonal work on cost and revenue per hectare is graphically illustrated in figure 5. The

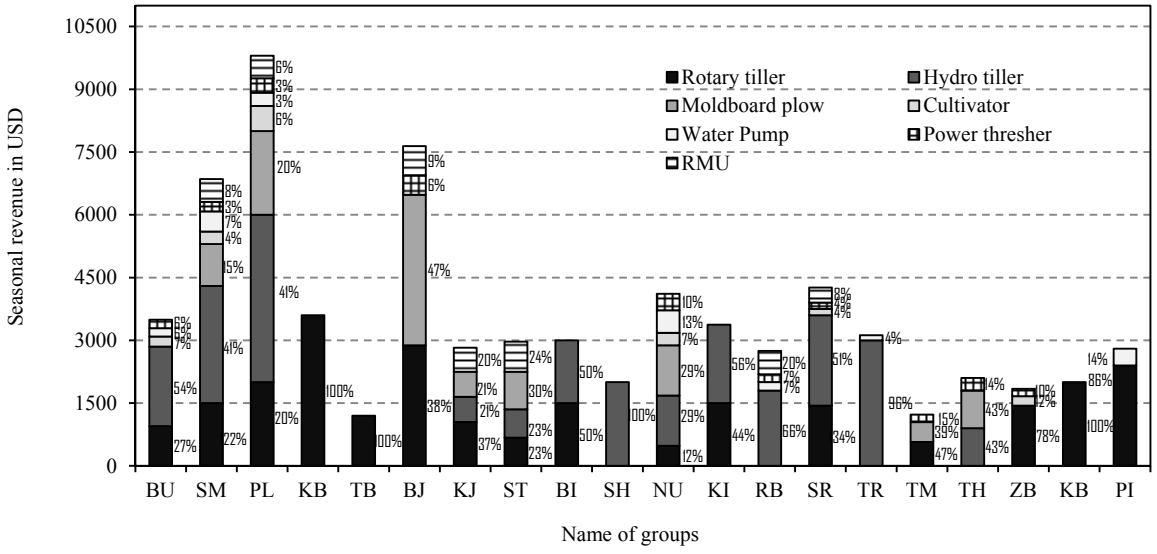

Figure 4. Contribution of revenue derived by machine types to total revenue of hire service groups.

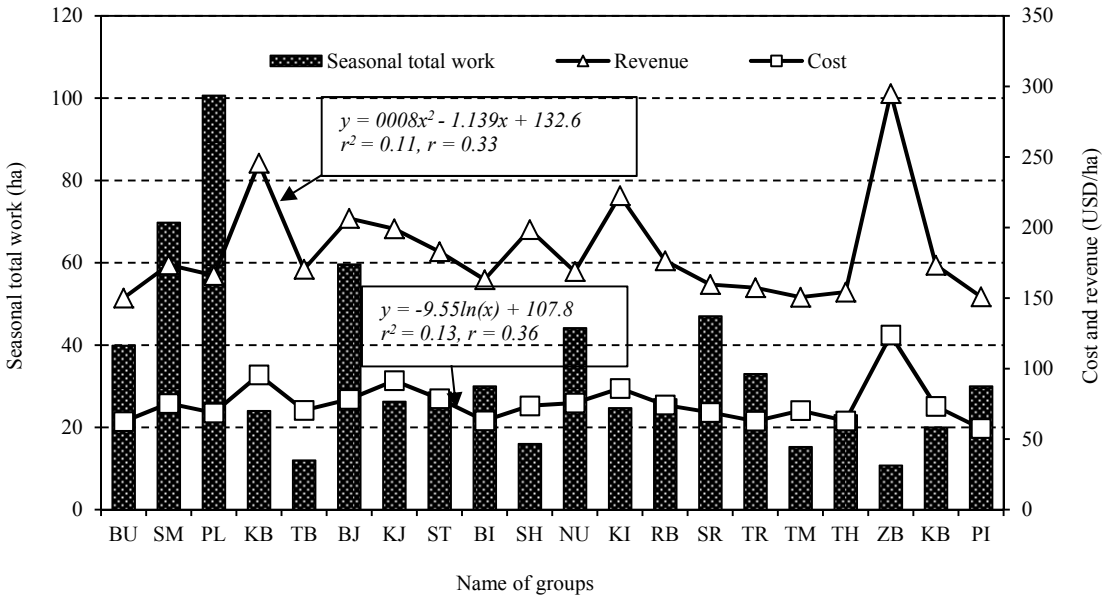

Figure 5. Relationship between total seasonal work and cost and revenue by hire service groups.

relationship between seasonal total work (x) and cost per hectare (y) indicates a negative and relatively low correlation, as shown by logarithmic regression ($y = -9.55\ln(x) + 107.8$; $r = 0.36$). The regression gave a well-fitted result compared with linear, polynomial, exponential, and power types, determined as 13% ($r^2 = 0.13$) of the observed variation in cost per hectare. The result indicates that cost per hectare tended to decrease with increasing seasonal total work. Although there appears to be little correlation between seasonal work and cost per hectare, lower cost per hectare with increasing seasonal work was observed for most hire service groups surveyed, such as Pulau Lestari, Birandang Jaya, and Sri Rezeki. This is due to the cost being spread over a large number of hectares.

Similarly, a relationship between seasonal total work (x) and revenue (y) was found. The best-fitting regression, polynomial ($y = 0008x^2 - 1.139x + 132.6$; $r = 0.33$), shows a positive and very low correlation. This result means that there is an increase in revenue per hectare with increasing seasonal work; however, this increase in revenue could only explain 11% ($r^2 = 0.11$) of the observed variation in revenue per hectare. According to Fig. 3, the increase of revenue per hectare as a result of increasing seasonal work can be found for some hire service groups like Birandang Jaya, Nimat Usaha, and Sri Rezeki. The low correlation can be caused by other factors, primarily custom rates and costs (fixed and variable costs). The results suggest that seasonal total work in hectares alone cannot provide an adequate basis for predicting the costs and revenue of machinery hire service operations.

PROFITABILITY AND ECONOMIC EFFICIENCY

Profit is the difference between revenue and total costs, when revenue exceeds costs (Riggs et al., 1998) or there is a surplus of receipts over expenses (Cramer et al., 2001). The total profit is obtained from the sum of the profits obtained for each machine under current levels of custom rates. The calculation was expressed as an average for each machine type and a total per hire services group. Table 4 indicates that rotary tillers had the highest profit seasonally and cultivators were the lowest, accounting for about USD 338 and USD 25.1 on average, respectively. Furthermore, the average profit received by power threshers was around USD 35.1 and RMU was about USD 138.2. The results showed that tillage machines generate more profit than other machine types. The research conducted by Rahman et al. (2013) in Bangladesh revealed that the utilization of a tractor for tillage operations was economical for a tractor entrepreneur.

Table 4 indicates that the hire service groups each made a different profit. The large variation in profit was found for moldboard plows and cultivators with a coefficient of variation of 153% and 115%, respectively. The variation was larger than that of total profit derived by hire service groups, which had a coefficient of variation of 70%. The three hire service groups with the highest seasonal total profit were Birandang Jaya with approximately USD 2,976.6, followed by Palau Lestari with about USD 2,896.6, and Suka Maju with about USD 1597.7. In contrast, the lowest profit was for Tani Maju, amounting to around USD 153.8 seasonally. The number of farm machines owned, the volume of seasonal work done, and custom rates were major determinants of the total profit derived by the hire service groups.

Most farm machines that are managed by hire service groups are purchased with government assistance. The limited budget allocation from governments for farm machinery means that the requirements of farmer groups cannot always be fulfilled, while the economic capacity of farmer groups to purchase farm machines themselves is very low. Furthermore, the number of seasonal workloads can also depend on field conditions (such as field distance from machine center, land scale, weeds growing in paddy fields, water supply into paddy fields, etc.) and operator

Table 4. Profit derived from each machine type and hire services group.

	Rotary Tiller (USD)	Hydro Tiller (USD)	Moldboard Plow (USD)	Cultivator (USD)	Water Pump (USD)	Power Thresher (USD)	RMU[a] (USD)	Total Profit (USD)	Economic Efficiency
Bonca Ukam	248.9	689.2	-	20.1	24.1	18.1	-	1000.4	1.40
Suka Maju	307.1	864.3	104.6	50.9	93.0	38.4	139.4	1597.7	1.31
Pulau Lestari	548.5	1405.8	599.9	76.7	85.9	28.6	151.2	2896.6	1.42
Karya Bersama	1307.0	-	-	-	-	-	-	1307.0	1.57
Tani Bersama	354.8	-	-	-	-	-	-	354.8	1.42
Birandang Jaya	1154.9	-	1530.7	-	-	142.1	148.9	2976.6	1.64
Karya Jaya	84.6	162.5	64.9	-	-	-	112.4	424.4	1.18
Sinar Tani	91.8	195.2	246.5	-	-	-	194.4	727.9	1.32
Baliok Imbo	499.2	608.7	-	-	-	-	-	1107.9	1.59
Sinar Harapan	-	822.6	-	-	-	-	-	822.6	1.70
Nikmat Usaha	31.2	334.2	212.1	32.3	45.3	57.1	-	712.2	1.23
Karya Indah	505.9	745.4	-	-		-	-	1251.3	1.59
Rizki Bersama	-	544.5	-	-	33.4	27.3	147.1	752.3	1.38
Sri Rezeki	251.0	698.4	-	-16.8		11.3	73.9	1017.8	1.31
Titian Rizki	-	1037.8	-	-	9.5	-	-	1047.3	1.51
Tani Maju	62.2	-	61.9	-	-	29.7	-	153.8	1.14
Tunas Harapan	-	316.8	248.2	-	-	87.5	-	652.5	1.45
Zoki busamo	481.3	-	-	12.1	-	16.1	-	509.5	1.38
Kerja Bersama	534.5	-	-	-	-	-	-	534.5	1.36
Pelambaian Indah	968.4	-	-	-	105.4	-	-	1073.8	1.62
Average	338.0	312.0	278.9	25.1	40.3	35.1	138.2	1046.0	
CV (%)	90	54	153	115	82	83	29	70	

[a] RMU = Rice Milling Unit.

skills. This brings about low field capacity (performance) of machines and causes a low seasonal workload. In addition, the machines are operated only for one month each season (wet and dry season), while they remain idle for the rest of the year. The low purchasing power of most farmers as a result of low financial return makes it difficult for them to hire service groups to raise custom rates (rental charges) and generate more profits.

However, the hire service groups could be successful businesses because they are supported by governments to provide farm machinery services to small farmers who have low economic capacity for purchasing and owning their own farm machinery. Custom hire services are needed due to technological transformations from traditional to mechanized systems. This has increased more demand for machinery hire services to perform farming operations. The most important reason for available custom hiring is that it justifies the ownership of farm machinery for small rice farming when it is not economic otherwise.

Figure 6 shows the contribution of profit derived from each machine to total profit obtained by hire service groups. The largest contribution is from rotary tillers (ranging from 4% for Nikmat Usaha to 100% for Karya Bersama, Tani Bersama, and Kerja Bersama), followed by hydro tillers (ranging from 27% for Sinar Tani to 100% for Sinar Harapan), and moldboard plows (ranging from 7%

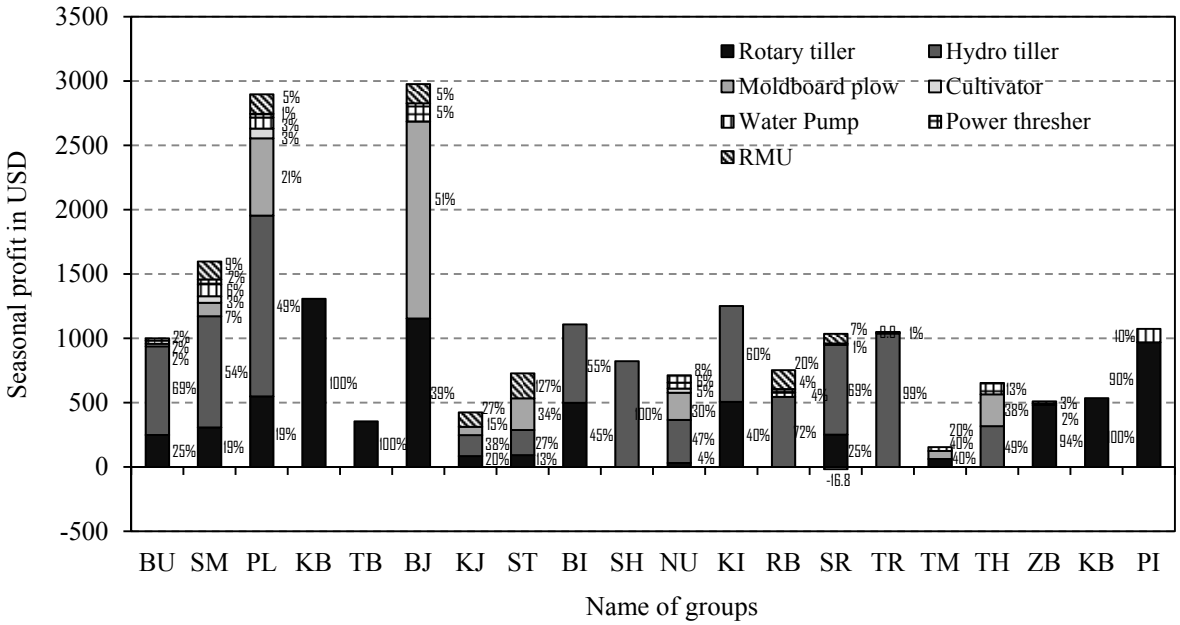

Figure 6. Contribution of profit derived from each machine type to total profit of hire services groups.

for Suka Maju to 51% for Birandang Jaya). The contribution variation was affected by the profit value for hire service groups from operating their farm machines.

According to Panneerselvam (2007), economic efficiency is the ratio of output to input for a business system. For this study, output is the total revenue earned over the season and input is the total cost incurred by hire service groups for owning and operating farm machinery. Higher value is desirable for profitable and viable businesses. Thus, the value of economic efficiency should be more than 1 (100%). Based on this ratio, all of the hire service groups were found to be economically efficient to different extents. The highest economic efficiency was found for Sinar Harapan (1.70), followed by Birandang Jaya (1.64), and Pelambaian Indah (1.62). On the other hand, the lowest economic efficiency was found for Tani Maju (1.14). To increase economic efficiency, the cost of operating farm machines by hire service groups must be reduced as much as possible.

Effect of Machine Number and Seasonal Work on Profit

The effect of machine number and seasonal total work on total profit is illustrated in figures 7 and 8. The effect of the number of machines (x) on total profit (y) of hire service groups can be seen from the linear regression ($y = 92.47x + 597.55$; $r = 0.49$). The relationship between machine number and total profit shows positive and moderate correlations. The results indicate that total profit increases with increasing number of machines. The effect can predominantly be found for the Pulau Lestari and Suka Maju groups. The coefficient of determination ($r^2 = 0.24$) indicates that 24% for the variation in total profit is explained by number of machines. This result suggests that other factors, not considered here, are important determinants of the total profit of hire service groups.

Furthermore, the most important factor affecting total profit of hire service groups is seasonal total work. The linear regression ($y = 27.84x + 97.56$; $r = 0.83$) shows that the relationship between seasonal total work (x) and total profit (y) indicates a positive and high correlation. There is a significant increase in total profit with increasing seasonal work. The coefficient of determination ($r^2 = 0.68$) indicates that 68% of the variation in total profit is explained by seasonal work. The effect of seasonal work on total profit for hire service groups is shown in figure 8. The results suggest that seasonal total work is a major factor determining total profit derived by hire service groups.

Conclusions

The seasonal total work varied across hire business groups and depended considerably on the number and type of machines owned. The largest seasonal total work was 100.6 ha for Pulau Lestari and dominated by tillage operations. The costs also varied across hire business groups and both labor and depreciation costs were dominant. Pulau Lestari incurred the largest cost of about USD 6,904.77 seasonally. Although having a relatively low profit, the hire service groups were profitable and efficient businesses under the current level of custom rates. The largest total revenue was found for Pulau Lestari, at about USD 9,801.3 seasonally, while Birandang Jaya obtained the largest profit, at around USD 2,976.6. Furthermore, the hire service groups were also economically efficient and Sinar Harapan was the most efficient, with an efficiency value of 1.70. The limited number and type of machines and short seasonal working time were the main factors hampering an increase in seasonal working scale which would increase profits. The low purchasing power of farmers also caused a custom rate to remain low, which is an important source of profits. However, hire service groups are viable businesses within small farming communities in the region because they operate under government support and economic scale, and high demand for machinery hire services in the region. The seasonal total work should be increased primarily by increasing the number and type of farm

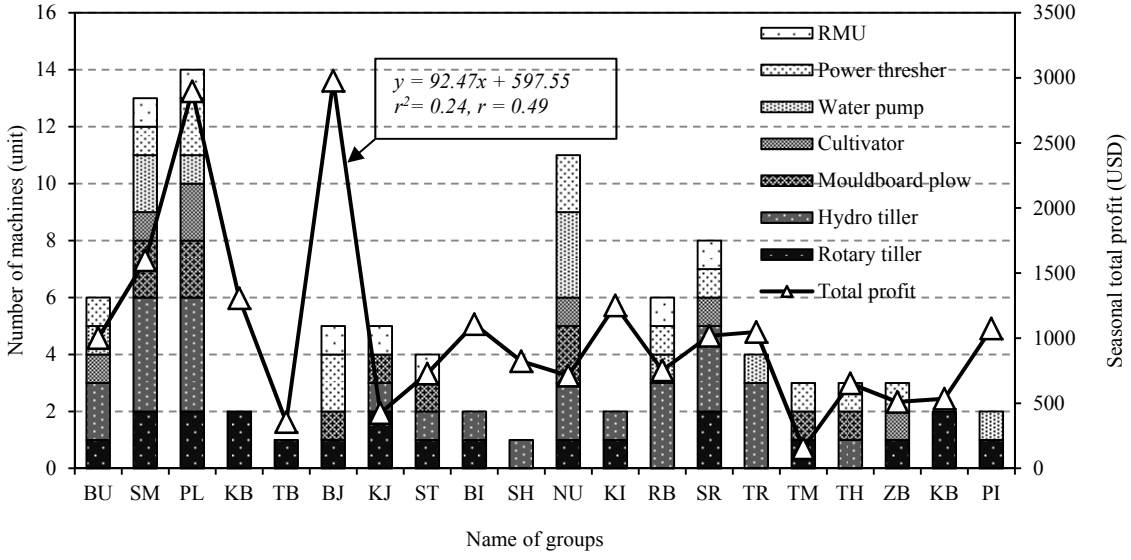

Figure 7. Relationship between number of machines and seasonal profit of hire service groups.

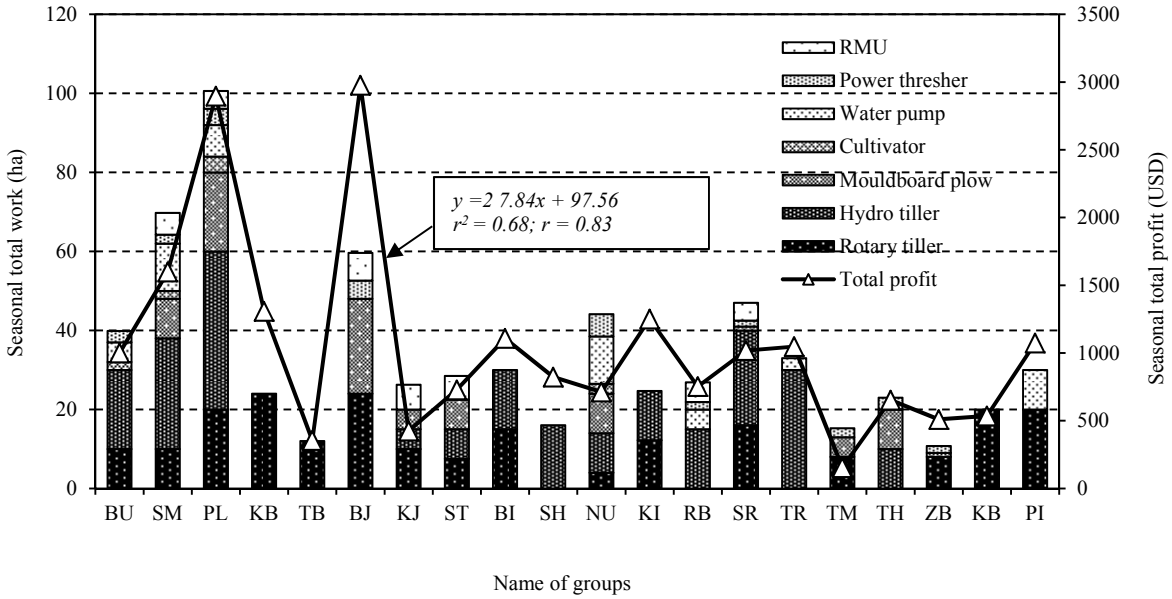

Figure 8. Relationship between seasonal total work and total profit of hire service groups.

machines to generate more profit. The number and type of machines can be increased by increasing government supports and an economic capability of hire service groups to purchase farm machines.

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