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Impact of Mechanization Development on Women and Hired Labor Utilizations of Small-Scale Rice Farming Operations in Kampar Region, Indonesia

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Abstract

This research examines the impact of mechanization development on women and hired labor utilization of small-scale rice farming operations in Kampar Region. Surveys were conducted in Kuok and Bangkinang districts of the region during July–August 2018. Sixty women farmers were purposively selected for samples and interviewed personally to collect primary data. Data were analyzed using descriptive–quantitative and simple regression techniques. The mechanization development in small-scale rice farming gradually reduced women and hired labor utilization. The time requirement for performing rice farming operations was relatively high to account for 602.56 h ha⁻¹. Most of the hours were required for manual operations, primarily weeding, transplanting and harvesting. Whilst, the working hours with mechanized operations reduced significantly, including ploughing, harvesting, threshing, and milling.

[Keywords] mechanization development, women, women labor, hired labor, small-scale rice farming

I Introduction

Women have long been recognized as an important labor force primarily in rural economies around the world. They hold a crucial role in agricultural and rural development (FAO, 2018) and key players in the agricultural sector (Enete and Amusa, 2010; Kumar and Kumari, 2018). Women are involved in over half of the farm activities in most developing countries (Bayisenge et al., 2019) and encompass the largest percentage of the workforce in the agricultural sector (Assefa and de Roo, 2015). Women have made greatly contribution to about 43% of the agricultural labor force in the agricultural sector globally and it increased to about 70% in some developing countries (FAO, 2011a; 2011b; 2018). The figures ranged from 15–81% in Southeast Asia and 42% in Indonesia (Paris, 2009). However, the current agricultural transformation toward mechanized farming system has had a different impact on women labor contribution in agricultural sector and changed rapidly in many parts of the world (Sisei, 2016).

Women's role in agriculture production is high, particularly in rice production. The vital role of women in agricultural production of most developing countries particularly in rice farming operations has been reported by a number of studies (Ajadi, et al., 2015; Amare and Endalew, 2016; Baba et al., 2015; Cisco, 2016; Enete and Amusa, 2010; Sims and Kienzle, 2016; Sisei, 2016). They revealed that women have been involved in almost the whole farm operations from land preparation to post-harvest processing with different rates of contribution. However, the involvement of women in rice production

varies from region to region and even within regions (Effiong et al., 2015; Fonjong and Athanasia, 2007). Moreover, the involvement of women differs with difference in agro-production systems (Bala, 2010) and also varies from land preparation to post harvest operations (Sucharita and Bishnoi, 2018).

Traditionally, the roles of rural women were such as household maintenance, cooking, fetching drinking water, and fuel wood (Santhi et al., 2005), while in rice production included planting, weeding, harvesting, processing, and rice post-harvest activities (Sucharita and Bishnoi, 2018; Waris, 2015). These roles have been practiced in many countries in the world. For instance, in Western Uttar Pradesh, India, women farmers have engaged in most of the agricultural operations except ploughing and their participation depend on the labor requirement for various crops (Baliyan, 2018). In Nigeria, women mostly participated in post farming operations such as harvesting, storage, watering, and transporting (Olawepo and Fatulu, 2012). In the same country, Yusuf et al. (2014) stated that the contribution of the women farmers ranges from tasks as land clearing, land tilling, and planting, weeding, fertilizer (manure) application to harvesting, food processing, and threshing.

The rapid development of agricultural mechanization today through the introduction of new technologies especially farm machinery and equipment has brought about changes in farming system in most developing countries. The important process of the mechanization development is to replace human labors and draught animals by mechanical devices (farm machinery and equipment) in farming activities (Akinbamowo, 2013; Basu and Nandi 2014; Chandrasekaran et al., 2008; Paman et

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al., 2018; Reddy et al., 2014; Simalenga, 2000). The introduction of mechanization and other labor-saving technologies has led to increase agricultural production, but brought about the decrease in labor use (Kay et al., 2016).

Kirui (2019) reported that tractor-powered mechanization had significant effects on the use of family and hired labors especially during land preparation. In Adamawa state, for example, the human power was gradually replaced by single axle multipurpose machines from land preparation to post-harvest (Mada and Mahai, 2013). According to Diao et al. (2014), the agricultural mechanization represents technology change through the adoption of mechanical power to undertake agricultural operations such as ploughing, harvesting, shelling, and planting. This development process may withdraw women labors early out of the farming activities because they commonly operate manual tools to perform farm works and eventually had a major impact on demand and supply to farm labor (Schmitz and Moss, 2015).

Agricultural works physically demand much power and the working conditions are often harsh (Srivastava et al., 2006). Under these conditions, the mechanization technologies become essential for agricultural production and processing (Mlengera et al., 2015) in order to take the drudgery out of such hard work (Kienzle et al., 2013; Mujawamariya and Kalema, 2017; Namdeo et al., 2018; Sucharita and Bishnoi, 2018), which makes a difficulty for women labors to manually perform of the operations. Currently, the mechanization is required not only for increasing crop production, but also for processing and along the entire value chain (Sims and Kienzle, 2017). Furthermore, and most importantly, mechanization can also help to perform for very difficult tasks in agriculture with short time and less cost (Basu and Nandi, 2014), so the introduction of mechanization implements and technologies enables to lighten burden of women labors (Amare and Endalew, 2016).

Hence, farm machinery has become increasingly available on farm and highly required primarily for mechanizing rice farming operations in rural area today. The displacement of women labors and together with hired labors in agricultural activities as a result of mechanization development has been a common phenomenon in most developing countries, including Indonesia. The widespread use of the farm machinery has had serious equity consequences in terms of the displacement of labor and tenant farmers (Pingali, 2007). The replacement of women labors has become increasingly important because women produce lower rice output and less efficient compared to men (Addison et al., 2016). In Indonesia particularly in Kampar Region, women have involved from generation to generation in the agriculture activities, particularly in rice production as well as post-harvest processing. Currently, the

role of women on rice farm activities has been reducing gradually in the region as a result of increasing farm machinery application for rice farming operations. The present research examines the impact of mechanization development on women and hired labors utilization in small-scale rice farming operations in Kampar Region.

II Materials and Methods

Kampar Region is divided into 21 districts that widely spread on area of 1,128,928 ha. According to *Food Crops and Horticulture Services of Kampar Regency* (2019), plantation area is dominant in the region to reach 415,702 ha (approximately 37% of total), consisting of palm oil, rubber, coconut, crops, and other plantation crops, and the second dominant area is forestry to reach 76,853 ha (6.81% of total). While, paddy field area has 6,546 ha (0.58% of the total) and spreads only over 15 districts and the paddy fields are mostly rain-fed. Although rice is not a main crop in the region, it is an important crop to provide stable food for feeding population especially in the region. Therefore, local government greatly supports rice farmers to enhance production and productivity through more intensively application of farm machinery to perform farming operations. Based on BPS (2019), approximately 53% of 352,478 the working population in Kampar Regency in 2018 work in agricultural sector (including food crop, plantation, forestry, livestock and fisheries).

Rice in Kampar Region is grown on both irrigated and rain-fed paddy field areas and cropping intensity can be once or twice a year depending on type of land and climatic conditions. Wet (rainy) season is main cropping season of rice in Kampar region i.e., during October to March. The second cropping season is on dry season, i.e., during April to August every year. The duration of both seasons included 1 month for land preparation before rice transplanting. Interview with farmers revealed that the whole rice areas are usually cultivated during wet season due to supply water from rainfall is sufficient mainly the beginning of growing season to facilitate land preparation operation.

From 21 districts in Kampar Region (Fig. 1), there are 15 districts to have paddy field areas that produce rice every year. These districts are important areas to supply local rice needs in the region. The field survey was conducted only in the 2 districts, namely Kuok and Bangkinang which were purposively selected from 15 districts of the region. Two villages then were selected from each selected districts with a total of 4 villages. The areas selected for the survey are based on their high level of farm machinery application with a high role of human and hired labors in the rice production activities.

The population of the research consisted of small rice farmers from 4 selected villages in the Kampar Region. Thirty



Fig. 1 Map of Kampar Region showing survey location

small rice farmers were randomly selected from each village for samples making a total of 60 samples. Most of the samples are women who directly involve in rice farming cultivation. This research used primary data which were collected by personal interview method of the farmers using a structured questionnaire after the main cropping season of 2018. Data collected consisted of sample characteristics, working hours of men, women, hired labors, and machines from each type of rice farming operations, rice farming areas, and rice yields. The data collected thus were tabulated and analyzed by using descriptive-quantitative appropriate such as percentage, median and simple regression technique.

III Results and Discussion

1. Characteristics of samples and rice farms

As outlined in advance, sample farmers in this research were women who directly manage involved in rice farming cultivation. They were 46 years old and had 8 years of formal education on average. Rice cultivation has been hereditary cultivated carried out from generation to generation as the main source of livelihood and provided rice food mainly for household consumption. Therefore, farmers have a long time of experience in rice cultivation to average 17 years. The number of family members was 5 persons on average, consisting of parent and 3 children. Most of the farmers did not employ their children in rice farming activities because they go to school in their villages or in the city out of the village.

In survey area, farmers commonly manage not only rice crop but also cash crops such as palm oil and rubber under family management system. Husband and wife are shared tasks and responsibility in managing of the farms. As the primary staple food crop, rice crop is cultivated to produce rice for being consumed primarily by their family. The farmers will sell rice to the market when occurs excess production. This rice farming is carried out and organized into small family farm units. Labor mostly comes from family

member mainly wife and husband and employ hired labor at the peak season. The paddy fields are mostly rain-fed, so harvesting is greatly determined by growing season.

It has been hereditary practiced in survey area in which rice is cultivated and fully managed by women. It is because women have major responsibility for ensuring the rice food security of their families. Women predominantly manage rice farming and men are focus to manage plantation crops. All management decisions associated with rice farming made by them such as decision about buying inputs and hiring of labor. Besides making these decisions, women (wife) directly involved in all rice farm activities such as land preparation, planting, weeding, harvesting, threshing, and storage of rice. The involvement of women only supervises for land preparation, harvesting, and threshing operations because these operations have been replaced by machines. Men (husband) only assisted in performing few operations, like pest and disease control, transporting rice to home and bring rice to rice mill. On the other hand, men perform other agricultural activities namely palm oil or rubber plantation as a source of family income for financing rice farming as well as other household needs, such as buying non rice foods, clothes, housing, education, and other social costs. The income obtained from managing palm oil ranged from IDR 1,500,000 (USD 107) to IDR 3,000,000 (USD 214) per month under exchange rate of IDR 14,000 per USD for farming area was at arrange of 1–2ha.

The rice farm owned farmers in survey areas are characterized by small-scale area, ranging from 0.11 to 1.00 ha with an average of 0.33 ha. The size of the rice farming has persistently become smaller and smaller because of land fragmentation that has been occurred as a result of the inheritance system. Few farmers could not fully use the machine to perform the operations due to too small size of the farm holdings. The rice production ranged from 0.44 to 3.20t with an average of 1.27 t (equivalent to 3.96 t ha^{-1}). The production was mostly used to fulfill the rice need for family consumption. About 44 % of rice farmers could fulfill the rice need less than 12 months and even 22 % of them was only enough for less or equal to 6 months. It means that approximately 56 % of rice farmers could fulfill rice need more than 1 year and they can sell the excess production for additional income.

2. Labor and machine utilization

Type of farm machines which have popularly been used by small rice farms in Kampar Region is hand tractors, combine harvesters, power threshers, and rice milling units (RMUs) (Fig. 2). They have been gradually replacing traditional tools like hoes, sickles, pedal threshers, etc. with farm machines. According to Paman et al. (2014), these farm machines are



Fig. 2 Type of farm machines used by small rice farmers di Kampar Region

mostly managed by hire service providers for small rice farmers. There is not many farmers to own farm machines themselves due to low purchasing power. Therefore, majority of small farmers harnessed farm machinery service providers to work their farming operations. In practice, the application

level of the machines in rice farming operations varied not only among districts or rice growing areas but also between individual farmers. The level of the machinery application of farmers depended on farmer's economic ability to pay machinery services, availability of family labors, size of farm holdings, and farmers' age. For instance, small farmers who have enough money replaced most family women and hired labor with farm machines. The main reasons are to shorten operation time and improve work quality of rice farming. The using of farm machines enables farmers in the same area to plant rice at the same time to hinder pest attack like bird, rat etc. Consequently, the utilization of both women and hired labor gradually reduced in the survey areas.

Rice production is a labor-intensive operation with fluctuating workload depending on operation type of farming. In practice, labor is usually required much more and very hard for plowing, planting, harvesting, threshing, and milling operations. Therefore, these operations were replaced more early than other ones, like seedling, weeding, pest and disease control, transporting, and drying. In survey areas, these operations were worked by either human or hired labor or farm machines. It was found that approximately 90% of farmers fully used farm machines (hand tractor) to perform land preparation, whereas this operation was previously worked manually by either women or hired labor. About 20 and 72% of farmers used farm machines to perform both harvesting and threshing operations, respectively. The milling operation has fully mechanized and farmers did not employ women and hired labor for that operation anymore in the survey areas.

3. Impact on women and hired labors ⁴

Table 1 shows that totally, time requirement for rice farming operations was about 602 h ha^{-1} . This finding is smaller than 851 h ha^{-1} as reported by Paman et al. (2012) for Riau Province in 2012 (Kampar is one of 12 regions of the Riau Province). It means that there was a decrease of the required time for rice farming operations per ha to approximately 29% during the last 7 years. Furthermore, the most time required for weeding was 136.31 h ha^{-1} , followed by transplanting (132.59 h ha^{-1}) and then harvesting (99.77 h ha^{-1}). These operations required more time due to dominantly worked by human labor. Hitherto, the farm machines for performing above operations have been not available yet, except for harvesting such as combine harvester. Direct seeding as alternatives for labor saving was not practiced by farmers anymore in survey area.

Four intensive operations which have mostly been taken over by farm machines included plowing, harvesting, threshing, and milling. The operations were worked with requiring shorter time to account to 61.88, 99.76, 30.27, and 45.92 h ha^{-1} for

Table 1 Labor requirement for rice farming operations (h ha⁻¹)

Type of operation	Family Labor		Hired Labor		Machine	Total
	Man	Woman	Man	Woman		
Ploughing	13.74	14.80	0.00	0.00	33.34	61.88
Seedling	2.94	10.47	0.00	0.00	0.00	13.41
Transplanting	23.20	90.77	0.00	18.62	0.00	132.59
Fertilizing	3.30	34.41	0.00	0.00	0.00	37.71
Weeding	15.93	110.12	0.18	12.28	0.00	136.31
Pest and disease control	4.04	16.32	0.00	0.00	0.00	20.35
Harvesting	11.38	64.04	4.42	16.96	2.97	99.76
Threshing	0.00	9.87	0.00	0.00	20.40	30.27
Transporting	7.49	3.58	0.00	0.00	0.00	11.07
Drying	1.39	11.89	0.00	0.00	0.00	13.28
Milling	0.00	0.00	0.00	0.00	45.92	45.92
Total	83.41	356.40	4.60	47.86	82.23	602.56

plowing, harvesting, threshing, and milling, respectively. Ploughing, harvesting, and threshing operations have not fully mechanized yet. The contribution of farm machines was about 61, 3, and 67% for ploughing, harvesting, and threshing, respectively. Meanwhile, the milling was worked completely by small rice milling units (RMUs) (hullers). Now, both harvesting and threshing operations could be done together with combine harvester, so time requirement would be relatively shorter.

Referring to Paman et al. (2015), there was 3 types of hand tractors have been popularly used for land preparation i.e., moldboard ploughs, rotary tillers, and hydro tillers. The use of these farm machines depended on field conditions primarily water supply on the paddy field. Both rotary and hydro tillers were used under condition of the water supply into paddy field is sufficient where the water on the surface of field is flooding. Therefore, they were commonly used during wet growing season.

Furthermore, combine harvester has begun to be used for harvesting and threshing operations, although this machine is just in its infancy in survey areas today. Previously, the above operations were worked dominantly by women or hired labors with sickles for harvesting and pedal threshers for threshing. Consequently, the displacement of women and hired labors with machine caused to reduce significantly human labors utilization in rice farming operations. Interview with farmers revealed that land preparation required time at least 25–30 working days by human labor, this time reduced significantly to be only 2–3 d by hand tractors. Other operations that were also replaced by machines also required shorter and shorter time.

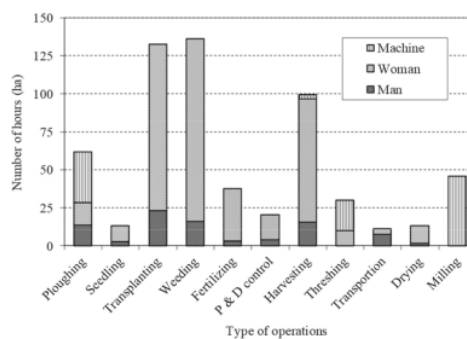


Fig. 3 Contribution of human labor and machinery in rice farming operations

The contribution of women labors as well as men labors in rice farming operations varied from types of operations as presented in Fig. 3. The milling operation did not involve family women as well as hired labor anymore and the operation was completely worked by rice milling units (RMUs). This operation replaced by machine quicker than other ones and reached full mechanized today. It is because many milling service providers offering cheap price are available in survey areas. Plowing, harvesting, and threshing operations still involved women although their contributions have gradually been reduced. For instance, the contribution of women labors remained only 32 and 28% for plowing and threshing, respectively. Current introduction of mini tractors and combine harvesters will replace women labor soon in the future in survey areas. Other operations were still dominated by women, exception transportation.

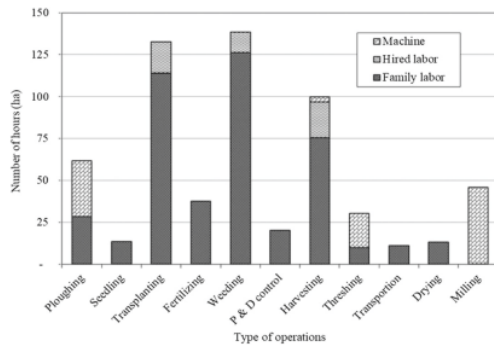


Fig. 4 Contribution of hired labor and machinery in rice farming operations

According to Fig. 4, the involvement of hired labors in rice farming operations in survey areas was only in transplanting, weeding, and harvesting operations. Previously, the hired labors were mostly required in ploughing before being replaced by machine. While, for light and easy operations, the operations were commonly worked by family labors such as seedling, fertilizing, etc. The contribution of hired labor in transplanting, weeding, and harvesting operations was relatively lesser, accounting for about 16%, 10%, and 28%, respectively. In this case, the hired labors were mostly women, while men were not so interested to be hired labor on rice farming due to a low wage rate. The hired labors commonly worked 8 h/d and were paid based on a working day basis. The prevailing rates of wage, which were established by the farmer community in survey areas, are IDR 100,000 (USD 7.14) per working day for men and IDR 80,000 (USD 5.71) per working day for women. Most farmers revealed that the rate of wage did not increase during the last 4 years due to an unchangeable price of rice product.

Comparing to wage for palm oil plantation, the rates of hired labor wage for rice are slightly cheaper compared to hired labor wage for oil palm plantation. Interview with farmers, the hired labor wage differs between operation (working) types and fluctuates according to the price of fresh fruit bunch (product). The hired labor wage for harvesting, for example, ranges from IDR 100,000 (USD 7.14) to 120,000 (USD 8.57) per working day for men and IDR 80,000 (USD 5.72) to 100,000 (USD 7.14) per working day for women. The hired labor for palm oil plantation is dominantly men, while the hired labor for rice farming is mostly women. It is because the working conditions on oil palm plantation are harder than the working conditions on rice farming, so it is more suitable for men labor and vice versa.

The impact of mechanization development on both working hours of women and hired labors per ha can be graphically

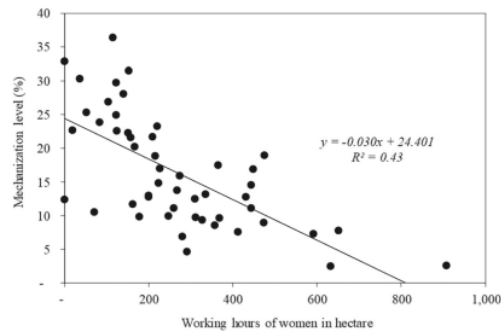


Fig. 5 Relationship between mechanization level and working hours of women

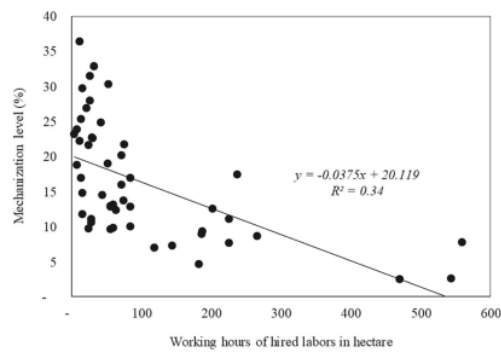


Fig. 6 Relationship between mechanization level and working hours of hired labors

illustrated in Fig. 5 and 6. The mechanization level in this analysis is the rate of machinery application for farming operations. A simple linear regression was used to relate working hours of women and mechanization level. The linear regression could explain 45% ($r = 0.45$) of the observed variation in working hours of women and showed a negative relationship between working hours of women per ha (w) and mechanization level (y) as described by the equation:

$$y = -0.030w + 24.4 \quad (1)$$

The result indicates that working hours of women per ha tended to decrease with increasing mechanization level.

Similarly, the relationship between mechanization level (y) and working hours of hired labors (h) per ha also showed a negative relationship and had a lower correlation. It means that the higher level of mechanization in farming operation caused the reduction of using hired labors. However, the decrease in working hours of hired labors could only explain 34% ($r = 0.34$) as shown by linear regression:

$$y = -0.038h + 20.1 \quad (2)$$

The other factors that may cause the reduction of working hours of hired labors such as the rate of labor wage, availability of hired labors in the village, and etc. that did not include in the regression model.

The replacement of farm works from manual tools to machines affected not only to reduce time and work hard (drudgery) during rice growing but also to decrease farming costs and additional farmer's income for hired labor. The reducing cost of rice farming was significance and improved efficiency of farm management. Based on interviews with farmers revealed that cost of land preparation reached IDR 2,500,000 (USD 143) per ha by human labor. If this operation is worked by hand tractor, it was required only IDR 1,500,000 (USD 107) per ha or decreased about 25%. This cost referred to the rate of service charge for hiring machine from local farm machinery providers.

4. Impact on non-agricultural works

The survey indicated that there was a tendency for women to move to non-agricultural works after introducing machinery in rice farming. It is because reducing working hours in the rice farm creates much opportunity for women to take job on non-agricultural works. The problem is that the productive or economic activities for women are very limited in the survey area. Few activities are available, such as trading (fruits), home industry (making cakes or other snacks), and tailoring (clothes). Some women could not harness the job opportunities because they have not enough money to invest for the businesses, so women choose to take a rest. Furthermore, most of the older women who aged more than 60 years old harness the time to take a rest at home. They felt tired to work a long time in rice farming because this activity has been done since young (approximately 15 years old). Nevertheless, women have much time to participate in social organization and Islamic religion activities in their neighborhood.

IV Conclusions

The present research concludes that the rice farming operations have gradually used machines to replace women and hired labors primarily for labor-intensive operations, including land preparation, harvesting, threshing, and milling. The application rate of the farm machines was different between individual farmers as well as type of operations. Totally, the time requirement for performing rice farming operations was relatively high to be 602.56 h ha⁻¹. Most of the hours were required to perform manually operations such as weeding (136.31 h ha⁻¹), transplanting (132.59 h ha⁻¹), and harvesting (99.77 h ha⁻¹). These operations required

more time due to dominantly worked by women and hired labor with manual tools. On the other hand, the operation hours that used farm machines reduced significantly, accounting for 61.88, 99.76, 30.27, and 45.92 h ha⁻¹ for ploughing, harvesting, threshing, and milling, respectively. The working hours of women and hired labor per ha tended to decrease with increasing farm machines application. Reduced working hours of rice farming has created few off-farm activities although some of them still work on non-rice farming and partly take a rest at home especially for older farmers.

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