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To cite this article: Ujang Paman *et al* 2023 *IOP Conf. Ser.: Earth Environ. Sci.* **1228** 012014

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# Evaluation of Operator's Competence to Operate and Maintain Farm Machines in Riau Province, Indonesia

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**Abstract.** The operation of farm machinery requires an operator with better operational and technical skills to ensure efficient and effective use of the machinery. These competences are necessary to avoid breakdowns during field operations that can affect machine operating costs. This research aims to evaluate the operators' competence in the operation and maintenance of farm machinery. Field surveys were conducted in three regencies of the Riau Province, namely Kampar, Indragiri Hulu, and Siak regencies. 63 machine operators were purposively selected and interviewed using structured questionnaires. The collected data were analyzed using the descriptive-quantitative technique. The type of farm machines operated by the operators in the province included two-wheel tractors, four-wheel tractors, water pumps, rice transplanters, power threshers, combine harvesters, and rice milling units. Most operators can operate more than one type of farm machine. The competency of most operators to repair farm machinery is very poor because of a lack of training. Most operators get skills in machine operators from self-learning and other operators (friends). Therefore, the results suggest that machine operators must be well-trained in operational and technical skills, especially in the excellent operation and proper maintenance of farm machines, to avoid machine damage during field operation.

## 1. Introduction

The development of agricultural mechanization helped change the farming system towards modernization. Nowadays, agricultural mechanization is changing from a traditional tool such as a hoe, cycle, etc., to a simple machine such as a hand tractor and then to a complex machine such as a combine harvester. Using a machine instead of hand and animal-driven tools requires special management skills and abilities and appropriate maintenance services [1]. Farm machinery must be operated adequately because machinery breakdown can be costly [2, 3] and losses and inefficient labor utilization [4]. In addition, machine operators should be familiar with the use and maintenance for new brands and models of purchased machines [5].

Developing more complex machinery has increased opportunities to maximize agricultural productivity and minimize yield losses [6,7]. In addition, the development of increasingly complex machines has led to a rapid increase in agricultural production [8]. This is because a more complex machine has more reliability, more power, more efficiency, and less work. The sustainable growth of agriculture depends crucially on adopting this new technology [9].

Significant trends in the complexity of agricultural machinery must be anticipated and recognized. The development of complex machines often bring about various problems if they are not correctly used and properly maintained. Therefore, farm machinery requires a machine operator, technician, mechanic, and manager with better operational and technical skills. Machine efficiency often depends on the competency of the operator. Competency can be defined as behaviors shown by employees who have the potential to work perfectly, consistently, and effectively compared with the potential working average [10].

The continuous development of a more complex and improved agricultural machinery design requires a higher knowledge, management skills, and technical skills/knowledge for the operator to enable safe and efficient use of the machine. Effective use of agricultural machinery requires more than information transfer. New skills need to be created among operators, especially those introducing machines and new manufacturers and model machines for the first time. That is important to help operators by training them to use the machines better and reduce misuse [11].

There are many problems related to the use of agricultural machinery at the farm level during the machine's life. The main problem that most farmers face is failure due to broken parts. This is usually due to poor handling of the machines by the operators. Operators must have sufficient knowledge and skills in tractor operation and maintenance to minimize the frequency of tractor breakdowns [12]. Furthermore, many of the farm machinery owned by farmers cannot be operated without operational knowledge and skills [13]. Most operators lacked the technical knowledge to maintain and repair tractors due to insufficient education, special training, and work experience [1].

The current complexity of farm machinery from a simple model has increased the number of machinery failures in Riau Province [14, 15]. One of the leading causes of machinery breakdowns in many developing countries is that there are rarely farm machinery operators trained in the correct work skills. This may be due to sufficient knowledge and technical skills in using and maintaining the tractor. A study of operator ability was reported, especially for small tractors [16]. The complexity of farm machinery on the farm today requires more and more versatile know-how to operate and maintain different types and models of farm machines. This study aims to evaluate the operators' competencies in maintaining and using different farm machines. Operator competencies are critical for continuous, safe operation and reduced field breakdowns.

## 2. Methods

The survey was carried out in three regencies from twelve regencies in Riau Province, namely Kampar, Indragiri Hulu, and Siak (Figure 1). These regencies were selected to represent the rice production centers in the province. The application of various types of farm machines was higher and more complete compared to the other nine regencies regions of the province.

A total of 63 samples were selected purposively, consisting of 22 operators from Kampar and 21 operators and 20 operators from Siak Regencies and Indragiri Hulu, respectively. They are the operators of farm machinery managed by farmer groups. Farmer group is a farm-level small business offering custom hiring services to group members. There are 26 groups from the above three regencies, namely 11 groups in Kampar, 8 in Siak, and 7 in Indragiri Hulu. Farmer groups contract operators to operate their farm machines during each rice growing season. There are two seasons, namely the rainy and dry seasons, and the rainy season is more dominant than the dry season in rice cultivation.

Most machine operators are also farmers with the skills and physical ability to operate farm machinery. The type of farm machinery managed by farmer groups includes two-wheel tractors (moldboard plows, rotary tillers, hydro tillers, and cultivators), four-wheel tractors, water pumps, transplanters, combine harvesters, power threshers and rice milling units (RMUs). Operators can operate one or more farm machinery according to their abilities.
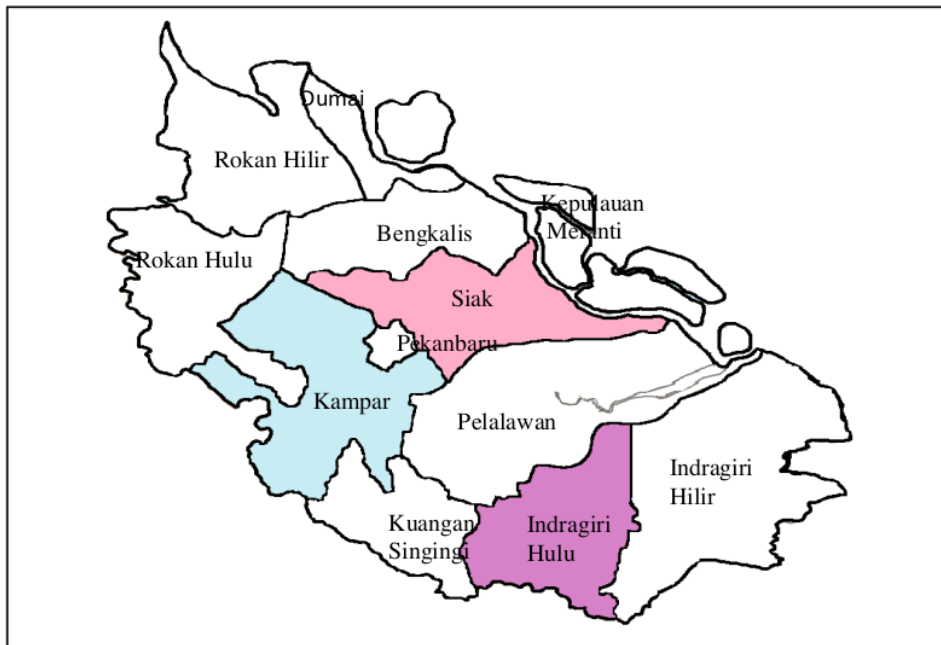
**Figure 1**. Map of Riau Province showing survey locations

The data collected consisted of primary and secondary data. Primary data was obtained by interviewing machine operators through questionnaires. The data included the operator's age, education level, experience, training, type of machine used, and repair and maintenance capability. Secondary data such as the number and type of farm machinery, is obtained from the publication of the Riau Provincial Bureau of Statistics and Food Production Service of Kampar, Indragiri Hulu, and Siak Regencies.

## 3. Results and Discussion

### 3.1. Farm machinery Availability and Condition
Farm machinery spread widely with different numbers of machines across the Riau Province. According to Table 1, the most significant machine type found in Riau province is the water pump, accounting for 3,105 units. The second largest machine is two-wheel tractors with approximately 2,431 units. Both types of machines were used for tilling soil. The water pump was necessary to supply the field with water, especially during the dry growing season. About 1,693 units of power threshers and 937 units and 160 units of rice milling units and four-wheel tractors, respectively, were also found in survey area.

In Siak Regency, two-wheel tractors and four-wheel tractors were dominantly found with 474 units and 28 units, respectively, while powerl threshers was dominant in Indragiri Hilir, reaching 485 units. The amount of 931 units of water pumps were found in Siak and the largest number among regencies in Riau province. The largest rice milling unit was found in Indrigiri Hilir with 274 units

**Table 1.** Spread of farm machines across regencies in Riau Province

| Regency | Two-wheel tractor | Four-wheel tractor | Power thresher | Water Pump | Rice milling unit |
|---|---|---|---|---|---|
| Kampar | 236 | 28 | 85 | 439 | 74 |
| Indragiri Hulu | 206 | 9 | 90 | 160 | 44 |
| Indragiri Hilir | 200 | 3 | 485 | 209 | 274 |
| Bengkalis | 204 | 7 | 123 | 104 | 50 |
| Rokan Hulu | 401 | 10 | 155 | 269 | 162 |
| Rokan Hilir | 376 | 24 | 388 | 424 | 127 |
| Kuantan Singingi | 183 | 1 | 124 | 46 | 47 |
| Siak | 474 | 39 | 76 | 931 | 41 |
| Dumai | 74 | 5 | 34 | 147 | 12 |
| Pekanbaru | 99 | 6 | 0 | 184 | 0 |
| Pelalawan | 194 | 28 | 101 | 140 | 88 |
| Kepulauan Meranti | 112 | 0 | 32 | 52 | 20 |
| Total | 2,431 | 160 | 1,693 | 3,105 | 937 |
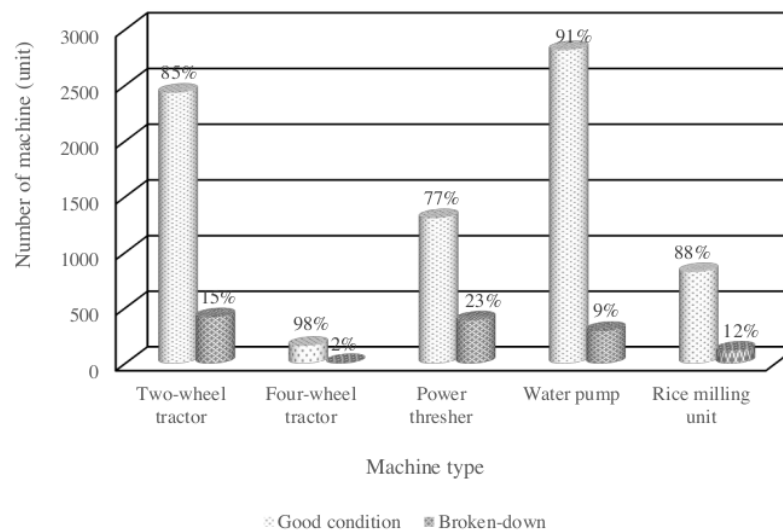


**Figure 2**. Number of farm machines in good condition and broken

The number of farm machines in good condition and broken-down is shown in Figure 2. Good condition means that the machine can work on the rice farm in any season. A broken-down is a grounded machine due to a component/part failure. The most significant number of broken machinery was power threshers (about 23%), followed by two-wheel tractors and rice milling units with 15% and 12%, respectively. The lowest rate of broken machines was on the four-wheel tractor, accounting for about 2%.

*3.2. Operator Characteristics*
Age, education and experience in using farm machinery are important characteristics for the physical ability of the operator. The operator's age varied between 19 and 58 years, averaging 45.9 years. The

operators are still relatively young, so they have good physical strength to operate farm machines. Machine operators must have physical strength and stamina to perform their jobs. The operators had an average of 11.2 years of formal education ranging from 6 to 16 years. They mostly graduated from high and vocational high school with an average formal educational of 11.2 years, varying from 6 to 16 years. The operators also had enough experience to account for 7.9 years, varying from 2 to 20 years.

**Table 2**. Characteristics of machine operators

| Characteristics | Age range (year) | Average age (year) |
|---|---|---|
| Age | 19 – 58 | 45.9 |
| Education level | 06 – 16 | 11.2 |
| Experience | 02 – 20 | 7.9 |

### 3.3. Operator Ability to Operate Farm Machine

Based on Table 3, the operators can use several farm machines. Most operators can operate two types of farm machines, namely, the two-wheel tractor and power thresher. These machines have been popular among rice farmers for at least a few decades. 3 operators can operate four farm machines with two-wheel tractors and power thresher dominant. They are skilled or experienced operators and have received previous training. However, two operators could only use the rice milling unit. About 87% of operators (55) know how to use two-wheel tractors. This is because rice farmers have long used the two-wheel tractor in the survey areas and the tractor is easy to operate.

**Table 3**. Number of type farm machine operated by an operator

| Number of operators (Person) | Two-wheel tractor | Four-wheel tractor | Transplanter | Combine harvester | Power thresher | Rice milling unit |
|---|---|---|---|---|---|---|
| 1 | √ | √ | √ | √ | √ | |
| 3 | √ | | √ | √ | √ | |
| 2 | √ | √ | √ | √ | | |
| 1 | √ | √ | √ | | √ | |
| 4 | √ | | √ | √ | | |
| 2 | √ | | | √ | | √ |
| 2 | √ | √ | | | √ | |
| 1 | √ | | √ | | √ | |
| 1 | √ | √ | | √ | | |
| 1 | √ | | | | √ | √ |
| 22 | √ | | | | √ | |
| 4 | | | √ | √ | | |
| 2 | √ | | √ | | | |
| 1 | | | | | √ | √ |
| 13 | √ | | | | | |
| 2 | | | | | | √ |
| 1 | | | √ | | | |
| 63 | 55 (87%) | 7 | 19 | 17 | 32 | 6 |

A machine operator is a person who operates and maintains machines and is primarily responsible for their operation and maintenance. The operator must have different skills to perform their tasks, because the machine's performance depends mainly on the ability of the operator to use the machine

correctly. For example, operating a fam machine in wet or dry conditions has many difficulties, so its operation requires the operators' skills. Fig 3 shows the machine operators operating several types of farm machines.

The operator must also think about how to maximize the power and performance of the farm machine and save fuel. In addition, machine operators need troubleshooting skills. If the machine is not working correctly, the machine operator must be able to find the source of the problem and fix it. This ensures correct and efficient operation of the machine in the future. In addition, the machine operator can inspect and identify possible defects or inconsistencies in the machine. Therefore, quality control is also necessary so that the operator can identify opportunities to improve operational processes and increase efficiency.



**Figure 3**. Operators operating farm machines in Riau Province

### 3.4. Operator Training
Operator training is essential to ensure farm machinery's safe and efficient operation. Machine damage is often associated with a lack of proper and adequate operator training. Operators who regularly operate farm machinery should be trained. According to Table 4, it was found that approximately 23% of farm machine operators received training for operating tractors and other types of farm machines with a duration for 7-8 hours (one day). Only 2% of operators received 45 hours of preliminary training in maintenance and repair work. Most operators (76%) acquired operator skills through self-learning or from their friends (other operators).

**Table 4.** Training experience of farm machinery operators

| Type of received training | Number of operators (person) | Training time (hour) |
|---|---|---|
| Operating tractors and other types of farm machines | 14 (23%) | 7 - 8 |
| Preventive maintenance and repair | 4 (7%) | 45 |
| Self-learning to operate farm machines | 44 (70%) | - |

*3.5. Operator Capability to Maintain and Repair Farm Machines*

Machine maintenance and repair skills are essential for operators to understand how the machine works and which parts need maintenance. In this way, the operator can also keep his farm machine in good condition, which can reduce the risk of breakdown while using the machine. It also ensures the smooth and efficient operation of the farm machine.

According to Table 5, about 83% of operators were able to regularly change the oil, clean the air filter and lubricate the moving parts. In addition, about 60% of operators could also do minor repairs, such as changing the belt, fuel, and oil filters and adjusting the clutch and brake. Few operators could only do the major repair. 7% of the operators have received preventive maintenance and repair training for farm machinery.

**Table 5.** Operator capability for maintenance and repair of farm machines

| Type of maintenance and repair | Number of operators (person) | Type of job conducted |
|---|---|---|
| Maintenance | 51 (83%) | Changing oil<br>Cleaning air filters<br>Lubricating moving parts |
| Minor Repair | 37 (60%) | Replacing belting<br>Replacing fuel & oil filters<br>Setting clutch and brake |
| Major Repair | 4 (7%) | Replacing wheel bearing, wheel seal, clutch facing, and other repairs |

**4. Conclusions**

The largest farm machinery available in Riau province is the water pump, which amounts to 3,105 units, followed by two-wheel tractors and power threshers, accounting for 2, 31, and 1,693 units, respectively. The machine operators were 9 years old and had 11.2 years of education and 7.9 years of work experience. Most operators can operate several types of farm machines, with dominating (87%) two-wheel tractors. Farm machinery operating skills are mainly acquired through self-learning and other operators (friends). Most operators are not adequately qualified to perform preventive maintenance and repairs due to a lack of training. Only 23% and 7% of operators received preventive maintenance and repair training. Consequently, the competency of operators to repair a broken farm machine is very low. About 60% can do minor repairs, and only 7% can perform major repairs. Therefore, farm machinery operators must be well-trained for safe and efficient operations, good preventive maintenance, and the proper repair of farm machinery. This is necessary to reduce the risk of machine breakdown during field operation.

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