Comparative of the application of combine harvester with the traditional harvest at Tanah Miring District, Merauke Regency

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Abstract. Harvesting rice conventionally is generally done using traditional tools. Many obstacles on harvesting using traditional tools such as fecal contamination, reduced the harvest. This research aimed to analyze the use difference between the Combined Harvester-CH and sickles, either from the cost side or labors and efficiency. The research was a case study of the paddy farmers who used CH with ten informants consisting of the chairman of farmer union, agricultural extension agent, operator of Combined Harvester, and farmers. The research results indicated that the use of Combine Harvester provided additional rice production of 275 kg rice/ha and an additional income of Rp.3,570,000. The efficiency level of rice harvest using human power was 5.27 kg rice/ha, while the efficiency of CH rice was 11.29. The CH machines were suitable to operate on tidal land and in brackish water. Harvester traditionally needed high waged workers, while some workers were no interested in working in the fields. Cultivating farmers preferred to use CH machines on their paddy farming. Meanwhile, the formers worked as the waged laborers in order to supplement their family income. The cost of the harvest using CH machine was Rp. 1,800,000/ha while the cost of the conventional harvesting was 4,000,000/ha. However, the presence combine harvester machine could not take the position of the workers as paid workers or the labor power in the agriculture sector.

1. Introduction

Rice is the staple food consumed by most Indonesians with a high per capita consumption compared to neighboring countries [1]. Rice harvest in Indonesia generally conventionally uses traditional tools. Many obstacles to harvesting using traditional tools such as dirt contamination and others. Especially in months with high rainfall, rice that is ready to be harvested cannot be harvested immediately, resulting in decreased rice quality.

Gadu (summer) harvested area data in Kampung Isano Mbias is 1126 ha. By looking at the condition of the ability of traditional tools it is estimated that 100 people can harvest an area of 60 ha, so it is needed a Combine Harvester harvesting machine that can harvest 2-3 ha per day, depending on weather and land conditions. This source is from the results of researchers' interviews with (Taslim, head of Gapoktan and Darmanto PPL, Isanombias Village).

Various obstacles are still faced in the process of rice cultivation in the process of harvesting so that the quality and productivity of rice is low. When harvesting needs to be considered, in order to get
good results as desired. Water content in this situation reaches 25-27% [2]. The purpose of the study was to identify the driving factors and inhibiting factors in the application of the Combine Harvesters harvesting method and the utilization strategy.

Rice is a commodity that is easily damaged, cannot be stored for long so its use must be fast before it is damaged. This means that rice must be moved quickly from the planting field to the processing location so that it can be quickly handled in the next processing [3].

In principle, combine clean harvester grain is accommodated in a sack. So the process carried out on a combine harvester machine is cutting, threshing, cleaning and storage in sacks. Cutting width can be adjusted to the width of the tool with a working capacity of about 3-4 hours per hectare depending on weather conditions and land conditions.

Because of its large size, this machine is only widely used in groups such as Gapoktan. In using this machine, to obtain optimum work efficiency, the harvest area is 3-8 hectares. The purpose of harvesting using a Combine Harvester machine include, Reducing work fatigue and increasing the efficiency of human labor and reducing damage to agricultural production, guaranteeing an increase in the quality and quantity of production. Reducing production costs. Improving the standard of living of farmers.

Agricultural products are perishable materials, so they need fast and precise handling. Improper handling results in a high level of yield loss (both quality and quantity) which is certainly detrimental to farmers. The main cause is not only social and economic problems, but also technical problems [4]. Therefore, the development of agricultural technology adoption is needed to increase agricultural productivity [5]. Observing the contribution of harvest handling in increasing rice production, it is necessary to formulate an appropriate adoption strategy to be accepted by farmers so that they have a strong willingness to improve harvest handling methods [6].

Whereas the rice harvested by the general public had adopted a mechanical harvesting method. Need a variety of scientific information to improve the process of rice harvesting, considering the harvesting process is a stage that requires time and energy is very large and expensive.

According to Swastika [7], one of the harvesting patterns applied in harvesting rice in farmers fields is by a combine harvester. In harvesting the Combine Harvester system the rice is harvested, cut, the rice is separated from the straw, and the grain is immediately stored in a sack. In this harvesting method, rice is blown into vertical drying pipes of a certain length, then separated between grain straw and air using a flexible hose mounted at the end of the harvest pipeline. Productivity analysis has simple steps, but the benefits are enormous which allows researchers to design equipment or machines on a small scale, are inexpensive, and are not difficult to carry out in the laboratory. This study aims to analyze the comparison of production achieved through traditional harvest and how to harvest Combine Harvester machines.

2. Methods

2.1. Research design
The research conducted was descriptive quantitative research (field survey). The data obtained will be presented in a comparative discrete perspective [8], which is the comparison of rice harvest using human labor with rice harvest with Harvester Combine.

2.2. Research location
The research location of Kampung Isano Mbias SP6 Tanah Miring District, Merauke Regency and previously a survey was conducted in the field. The research period of 1 month in July 2018 (during the gadu harvest season) can be seen in figure 1.
2.3. Data collection method

The method of collecting data collected is documentation. This research collects data from authorized agencies, publishes data that will be used in research.

2.4. Data analysis

Data analysis method used in this research is:

\[
\text{harvest productivity} = \frac{\text{The production of rice harvest is one harvest season (Kg)}}{\text{The area of arable land is one hectare (Ha)}}
\]

Rice farming income using formula: Firmana & Nurmalina [9].

\[
P_d = TR - TC
= Y \times By - Bm
\]

\[
Pd = \text{Net income (Rp / ha / MT)}
TR = \text{Receipt (Rp / Ha / MT)}
TC = \text{harvest fee}
Y = \text{Production Results (Kw)}
Py = \text{Price of grain products per Kw (Rp / Kw)}
Bm = \text{Cost (IDR / Ha / MT)}
\]
The measured variables include Combine harvester and labor use during the rice harvest process, namely: Harvest production, Rendement, Farm income, Benefit and Socio-economic Impact. The assumptions in this study were the length of the rice harvest was calculated only when the Combine Harvester machine was working in the paddy field. The capacity was calculated by the amount of grain in the sack until the process became rice.

3. Results

Yields using traditional tools vary from 88 to 91 sacks of un-hulled rice, the average yield of 90 sacks of un-hulled rice per hectare can be seen in Table 1, although planting simultaneously there is a delay in harvesting and occurs during the harvest cycle simultaneously these conditions due to owners of the power thresher is difficult to set the time In responding to the demands of the respondent farmers, the harvested rice must wait for their turn to be threshed so that some of the crop losses and soil fertility are uneven.

| The name of the respondent | Land area | RESULTS (grain bag) |
|---------------------------|-----------|---------------------|
| Toriki                    | 1 Hectare | 90                  |
| Daryadi                   | 1 Hectare | 88                  |
| Jemono                    | 1 Hectare | 90                  |
| Mulyono                   | 1 Hectare | 89                  |
| Nur                       | 1 Hectare | 90                  |
| M Syah                    | 1 Hectare | 90                  |
| Rohadi                    | 1 Hectare | 87                  |
| Jajat S                   | 1 Hectare | 92                  |
| Nanang R                  | 1 Hectare | 90                  |
| Taslim (Gapotan)          | 1 Hectare | 91                  |

While variations occur at the planting and harvesting stages, the scarcity of local workers occurs at the planting stage because planting and harvesting laborers are mostly women who are harvested using a Combined Harvester machine taken from 10 respondents with an average planting area of 1 hectare and yields vary due to plant fertility. same harvest schedule. Rice harvesting in Isano Mbias village is regulated by farmer groups greatly affecting grain production although scientifically old rice that is ready to be harvested must wait a shift, the area in the middle or farthest from the main road tends to be harvested later so that the Combine Harvester harvesting machine does not damage plants that have not been harvested. are old. The availability of labor or harvest workers in the village of Isano Mbias is very lacking.

Harvest uses a Combine Harvester (CH) machine in 1 Ha with an average of 85 sacks. For 1 sack of grain is equal to 35 kg of rice. So that for 85 kg x 35 kg of rice = 2,975 kg of rice (2 tons and 975 kg of rice). This research shows that the level of productivity. Combine harvesting machine produces 35 kg of rice per sack which contains 50 kg of grain. By looking at the productivity of the harvest, the yield of rice production using Combine Harvester is greater. Harvest productivity=(The production of rice harvest is one harvest season (Kg/MT))/(The area of arable land is one hectare (Ha).

The difference in crop productivity is 2,975-2,700 = 275 kg. It can be seen that the grain yields in sacks use more human power but seen from the larger rice yield using Combine Harvester. One of the causes of the harvest using traditional tools is that there is still a lot of dirt involved in the form of hollow grain and straw slices while using Combine Harvester harvested rice grain that comes out of the machine is clean when entering the sack.

While using a Combine Harvester for 85 sacks. This is due in part to the rice straw. Economically using Combine Harvester can harvest rice with the area of paddy in accordance with the area of paddy planted can be seen in table 2. By looking at the productivity of the crop, the yield of rice production
using Combine Harvester can be seen in table 3. The difference in harvest productivity is 2,975 - 2,700 = 275 kg. The yield of rice from yields is higher, the yield of harvest using human labor by 60% while using CH by 70% or a difference of about 10% can then be seen in table 4.

| The name of the respondent | Land Area | RESULTS (grain bag) |
|---------------------------|-----------|---------------------|
| Toriki                    | 1 Hectare | 85                  |
| Daryadi                   | 1 Hectare | 83                  |
| Jemono                    | 1 Hectare | 86                  |
| Mulyono                   | 1 Hectare | 85                  |
| Nur                       | 1 Hectare | 87                  |
| M Syah                    | 1 Hectare | 85                  |
| Rohadi                    | 1 Hectare | 87                  |
| Jajat S                   | 1 Hectare | 87                  |
| Nanang R                  | 1 Hectare | 85                  |
| Taslim (Gapotan)          | 1 Hectare | 85                  |

Table 2. Harvest using Combine Harvester.

| Method                  | Amount of Sack (Ha) | Grain (Kg)/Sack | Rice (Kg)/sack | Harvest Productivity (axb) per MT |
|-------------------------|---------------------|-----------------|----------------|----------------------------------|
| Traditional tool        | 90                  | 50              | 35             | 60                               |
| Combine harvester       | 85                  | 50              | 35             | 70                               |

Table 3. Comparison of harvest yield using traditional tools and combine harvester.

| Method                  | Harvest Cost (IDR) (c) | Farmers Income (Bruto) (IDR) (R) | Rice Harvest Efficiency R/C |
|-------------------------|------------------------|----------------------------------|-----------------------------|
| Traditional tool        | 90                     | 50                               | 35                          |
| Combine harvester       | 85                     | 50                               | 35                          |

Table 4. Comparison of rice harvest efficiency using traditional tools and combine harvester.

Rice production can be increased among others by agricultural extensification and agricultural intensification. Agricultural extensification is an effort to increase rice production by expanding rice planting area, while agricultural intensification is an effort to increase rice production in an intensive way on land such as the use of superior seeds, providing appropriate fertilizer, adequate irrigation water, shortening the age of rice, quality of arable land. Accordingly so that productivity increases Map of the Sloping District District which is the research location. The general situation of Isano Mbias Village Tanah Miring District Isano Mbias village originated from the area of the former Transmigration settlement or commonly known as the UPT (Transmigration Settlement Unit of the Department of Transmigration and Forest Squatters).

The formulation of the name of the Village is carried out by KUPT together with the leaders of Masangka and adat in the area of SP 6. The placement of Isano Mbias residents began with the placement of fostered residents in September 1994 until January 1995 which consisted of residents assisted by general transmigration from outside Papua and Local Transmigration who are native Papuans. The number of Isano Mbias residents is 450 families (Head of the Family) with a total number of 1457 people, consisting of 350 transmigrants and 100 heads of local transmigrants. General transmigration originates from 3 provinces outside Papua, namely: Origin of West Java Region, Origin of Central Java Region and Origin of East Java Region. The number of residents of General
Transmigration is 350 families with 1,222 people originating from three provinces. While the Local Transmigration residents who are native sons of Merauke (Papua) numbered 100 families with a total of 235 inhabitants.

The coaching period by Transmigration lasts for 5 years. In the sixth year, Isano Mbias village was able and feasible to become a Definitive village. So in 1999 Isano Mbias Village was handed over to the Regional Government to become the definitive Village so that it would not depend on the Ministry of Transmigration and PPH anymore. To become a definitive village, there must be a leader to regulate government, development and pemayarakatan and its villages, then the village of Isano Mbias also in a democratic manner successively chose one of its best citizens to become the village head.

4. Discussion

This research found that production is the process of transforming inputs into outputs. Production technology can be described through the functions of production, costs, profits and revenues. The production function illustrates the technical relationship between inputs and outputs of a production process of Tinaprilta et al [10] harvested area is the area of plants that are harvested after the plants are old enough [11] rice production can be increased among others by agricultural extensification and agricultural intensification. Agricultural extensification is an effort to increase rice production by expanding rice planting area, while agricultural intensification is an effort to increase rice production in an intensive way on land such as the use of superior seeds, providing proper fertilizer, adequate irrigation water, shortening the age of rice, quality of arable land. accordingly so that the productivity of farm business income. Calculations to find out farm income using the following equation [12].

\[ P_d = TR - TC \]

Notes:
- \( P_d \) = Net income (Rp / ha / MT)
- \( TR \) = Receipt (Rp / Ha / MT)
- \( TC \) = Harvest Cost (Rp / Ha / MT)

Rp. 3,500,000. This is a traditional method of harvesting in Isanombias Village, Tanah Miring District. Data obtained in the field are rice yields during the gadu season (kg / MT) using traditional tools in 1 Ha as much as Rp. 18,360,000. Costs for processing land, seeds, planting and selection Rp. 4,000,000 and harvesting costs Rp. 3,500,000. Gross income (gross) in the amount of Rp. 18,360,000. So the farm income is Rp. 10,860,000. By looking at farm income, the income of rice farmers using Combine Harvester is greater than using human labor. The difference in harvest income is Rp. 14,430,000 - Rp.10,860,000 = Rp. 3,570,000. This is due to the CH lease of Rp. 1,800,000, already with two operator fees. So farmers do not incur operator costs.

From the above table that gross (gross) farm income using human labor is Rp. 18,360,000, obtained from 2,700 kg of rice multiplied by rice price of Rp. 6,800 per kg while the harvest using Combine Harvester is Rp. 20,230,000 , obtained from 2,975 kg of rice multiplied by the price of rice at Rp.6,800 per kg.

While the cost of harvesting with human labor is equal to Merauke Regency, the workers use sickles to harvest rice. If less sharp scythes are used to harvest rice, it will cause a violent vibration, as a result many rice grains will fall out. Therefore harvest time is sometimes reduced by sharpening (sharpening) less sharp scythe. In addition, the weight of the sickle is heavy enough to be a burden on workers. So as to address this, a large amount of human labor is employed so that within 1 day the harvest is complete. But with the increase in human labor resulted in increased crop costs.

To assess the efficiency of rice harvest using traditional tools and harvest Combine Harvester machines

\[ \frac{R}{C} \text{ ratio } = \frac{R_2 - R_1}{C_2 - C_1} \]

\[ \frac{R}{C} \text{ Ratio } = \frac{\text{Benefit}}{\text{Cost}} = \frac{R_2 - R_1}{C_2 - C_1} \]

\[ \frac{R}{C} \text{ Ratio } = \frac{\text{Benefit}}{\text{Cost}} = \frac{R_2 - R_1}{C_2 - C_1} \]
R \text{Ratio} = \frac{R2 - R1 (\text{difference in acceptance})}{C2 - C1 (\text{Cost Difference})}

R = \text{The amount of acceptance (Rp/Ha/MT)}
C = \text{The amount of the cost of the harvest (Rp/Ha/MT)}

\[
\frac{18.360.000 - 20.230.000}{7.500.000 - 5.800.000} = \frac{-1.870.000}{1.700.000} = -1.1
\]

There are additional benefits of using a harvesting machine in the form of receiving harvest costs. Each unit of revenue obtained from the use of the machine causes a decrease in costs of -1.1.

The use of Combine Harvester has been very positively responded by the Isano Mbias village community. Farmers with productive old age (50-60 years old) have the spirit to work on rice fields for more than 1 ha. Farmers who initially worked on 1 hectare rice field with traditional labor harvests switched to working on 1-4 hectare rice fields using Combine Harvester. Because the harvest is faster, tool rental is cheaper and grain quality is better. Harvesting using Combine Harvester is faster because this is the process of harvesting from threshing rice into grain directly put into sacks in one process with the same tool. Then to rent a Combine Harvester tool is cheaper, especially using a Combine Harvester tool from Gapoktan. If you use a personal Combine Hasvester tool that is owned by farmers, it is rented for IDR 1,800,000 per hectare while using a Combine Harvester tool from Gapoktan Rp. 1,500,000 per hectare. Meanwhile, if using traditional tools requires as many as 30 workers at a cost of Rp. 3,000,000 plus consumption or a total cost of Rp. 3,500,000.

Uncertain climate. In the gadu season the weather is erratic, the rain still often occurs. When it rains, the Combine Harvester is not able to separate straw and grain. Even a small portion of grain is still attached to the straw due to the wet grain condition. Difficult land conditions On tiled land, it is difficult for operators to operate the equipment. Resulting in the time required is longer, resulting in delays in harvesting. Operator experience This is seen from the ability to operate a Combine Harvester tool. Experienced operators can properly harvest continuously. Whereas the inexperienced operator is there when the device turns for advanced harvest, the operator must arrange the Combine Harvester tool again because it is limited by galengan paddy fields.

Another strategy for using Combine Harvester is to manage the harvesting strategy using Combine Harvester operators from the village itself. Operators are equipped with effective harvest strategies, for example operators prioritize harvest orders that are close together so that in one day they can harvest at least 3 ha depending on weather and land conditions. Besides that, operators need to conduct Combine Harvester training / apprenticeship periodically and prioritize certified operators to improve their skills in operating Combine Harvester equipment while the Combine Harvester tool readiness strategy for harvesting, so there is a need for trained technicians in Alsintan workshop in Isono Mbias village. So that if there is a tool that needs to be repaired, it is quickly handled and the Combine Harvester tool is immediately operated again. This will give residents confidence in the Combine Harvester device that is ready to use optimally.

5. Conclusion and Recommendation
The use of CH provides an additional 275 kg of rice / ha of rice production and an additional income of IDR 3,570,000.00. The level of efficiency of rice harvest using human labor was 5.27, while the efficiency of rice harvest CH was 11.29. CH machines are suitable for operation on tidal and brackish water. Harvesting traditionally requires workers with high wages, while some workers are not interested in working in the fields. Cultivating farmers prefer to use CH machines in their rice farming business, then the farmer's workforce is utilized as laborers or paid workers to supplement family income. Harvest costs incurred Rp1,800,000.00 / ha with CH and Rp4,000,000.00 / ha by conventional harvest. The presence of CH machines does not shift labor as wage labor or as laborers in the
agricultural sector. There is a need for operator training so that if there is a damaged device that is immediately repaired, this will give people confidence in the Combine Harvester machine. The presence of agricultural technology such as combining harvester does not shift the existing workforce to work as wage labor or as laborers. Using this tool is only to avoid if during the harvest season lacks manpower, it is necessary to use a harvester comben and the time by using a combine harvester harvesting machine is faster and costs are also more economical.

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