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Partial vs. Full Adoption of Healthy Planting Management Innovations: Impact on Rice Productivity in Indonesian Farmer Groups

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Abstract. This study investigates the impact of Healthy Planting Management (MTS) innovations on rice farming productivity in Indonesian farmer groups (POKTANs). Using a sample of 195 POKTANs from Lamongan Regency, we employed One Way ANOVA to compare productivity levels among groups fully implementing, partially implementing, and not implementing MTS innovations. Contrary to expectations, full MTS implementation was associated with lower productivity (7.2614 tons/ha) compared to partial implementation (7.4179 tons/ha) and non-implementation (7.4181 tons/ha). These findings suggest that partial adoption of institutional innovations may be more effective in the context of Indonesian rice farming. The study contributes to the understanding of institutional innovation adoption in agriculture and has implications for agricultural policy and extension services in developing countries.

Keywords: innovation, institutions, farmer groups, and rice productivity

1. Introduction

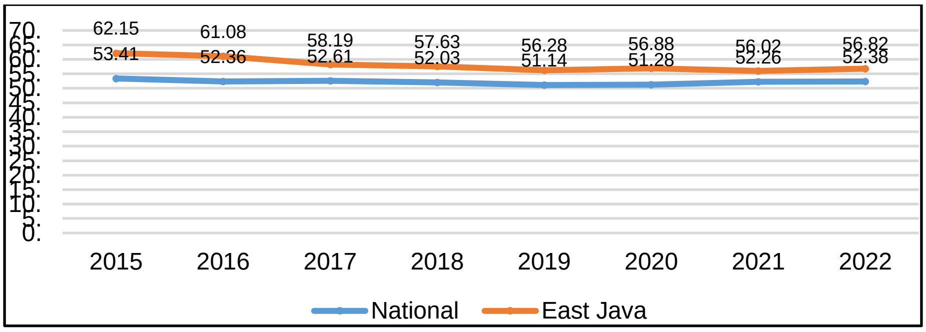
In the past, Indonesian agriculture has achievement for a good results and made an important contribution to Indonesia's economic growth, including creating jobs and drastically reducing poverty. It is achieved by focus on staple food crops like rice. However, by a sharp decline in productivity for all types of staple crops, plus the majority of farmers working in rice fields of less than 0.5 hectares. There are agricultural activities that losing in the potential benefits and innovation to create additional jobs and increase income (Rosegrant and Hazell., 2000). The empirical fact makes economists (representatives of the market) always undervalue with the agricultural sector, which is contribution or share of agricultural sector to a country's Gross Domestic Product (GDP) has decreased. In poor countries, World Bank data shown that the agricultural sector's share of GDP decreased from around 60 percent in 1965 to around 28 percent in 2000. Likewise, in the Middle Income Countries group, the above percentage decreased from 22 percent to 16 percent or in developed countries, the decline rate was recorded from 5 percent to 2 percent for the period 1965-2000.

In the developing country such Indonesia, absolutely have a lot of contribution in the agricultural sector or traditional sector to GDP, indeed. This process of decreasing contribution can be traced back to Engle's Law, which stated that if income increases, the proportion of expenditure on food ingredients produced by the agricultural sector will decrease. In economic condition terms, the elasticity of demand for food is less than one or inelastic, so that the increase in demand for food is not as big as the demand for goods produced in the industrial and service sectors. In essence, the real price of agricultural commodities decreased, especially compared to the prices of industrial and service sector commodities. Based on a research study has been conducted by Timmer (1996) shown that the real price of rice in the 1950s was recorded at above US$ 500 per ton and decreased to below US$ 160 per ton in the 1990s. There is a widening of the price spread for agricultural commodities or prices at the producer level and prices at the consumer level, which is closely related to the asymmetrical market structure in Indonesia.

However, in the next fact is problems to recur every year, even twice or more a year, cannot be reduced by an existing policy instruments. According to the retail price of rice soars, generally during the planting season such as December-January, the dry and lean season in June-August, and national holidays such as Eid al-Fitr, Christmas and New Year. Nevertheless, the price of grain at the farmer level fell, sometimes below the cost of producing rice, even at the subsistence level. As a result, in recent years farmers have continued to be cornered and marginalized. There is no need to mention how during the dry season farmers have to suffer the worst because important infrastructure such as dams and irrigation canals, that are not working optimal. Since, the quality of roads is seriously damaged and disrupts the strategic commodity distribution system, thus increasing transportation costs significantly. The next impact is a main food production of rice that has experienced by a negative trend over the last eight years, National rice production was 75,398 tons in 2015, decreasing by 54,749 tons in 2022 and East Java rice production reached 12,566 tons, decreasing by 9,687 tons in 2022.

According to Hayami and Ruttan (1985) discussed by economic development that a fairly good measure of agricultural productivity with more emphasis on the outcome level of farmer and community welfare. Land productivity is calculated by comparing production levels with land area (Arable Land). Meanwhile, the ratio of land to labor is getting smaller and smaller, because labor continues to increase, while land is almost constant. Growth in labor productivity is also effective enough to alleviate Indonesian society from poverty, because it helps with high growth in land productivity and increased farming efficiency. In this case, there is so many efforts to increase agricultural productivity or rather land productivity that not able to compensate for the decline in the ratio of land to labor. In the Agriculture sector, based on technological change should bring about a surge in production output. It is able to offset with the rate of increase in agricultural labor due to high population growth. Further exploration for this simple measurement of productivity ultimately resulted by the theory of induced innovation related to the size of an increase in the relative price of one production factor. This relative to other production factors are encourage technological change, which will reduce the use of that production relative to other production factors.

In contrast, the phenomenon of decreasing a rice productivity might be because of production capacity has decreased. Rice productivity is starting increase to stagnate (leveling off) and even decrease at the current production capacity condition. Currently, rice farming is requires changes in superior technology to increase production, as well as land productivity and labor productivity. Innovations are changes in seed technology, fertilizer, smart farming, use of drones, water saving techniques, weather modification and others can increase productivity. Technological changes also require increasing the capacity of farmers' human resources (HR), so the entire agricultural production capacity also increases.



Source: Ministry of Agriculture, 2023

Fig.1: National and East Java Rice Productivity

Figure 1, it will be explained the performance of National and East Java rice productivity in 2022. It is generally much lower than performance in 2015, because of the conversion of rice fields to other uses also impact to the performance of harvested area. However, the result for a long drought in the last few years and super intensive efforts to increase the planting index to IP 300, which is not necessarily sustainable in the long term. Innovation in agriculture by environment planting patterns, crop rotation systems, intercropping systems, accompanied by assistance and institutional empowerment of farmers can be a strategy to mitigate the impact of extreme dry seasons and even extreme rainy seasons such as the La Nina phenomenon at the end of 2020 and early 2021. Furthermore, poor productivity performance is most likely due to the sources of growth being too saturated (exhausted). It should investigate the production growth has reached by a decreasing rate of increase (diminishing return). The application of superior seeds, fertilizers and pesticides, or what is better known as biological-chemistry technology, which has been the main mainstay so far. It might be have reached with a saturation point. Likewise, large-scale investment in irrigation facilities and infrastructure has also begun to decline, which is course closely related to the decline in economic income that can be obtained by farmers or aggregate state revenue.

Ultimately, the performance characteristics of rice production have barely changed, in fact the figures tend to decline. Because of rice production is mostly due to increases in harvested areas or levels of intensification, not due to improvements in production efficiency and technological surges, but the discovery of new varieties and so on. Besides that the harvest area factor is so dominant, negligence in rice production management, and poor management of rice food stocks. There are serious obstacles to rice production performance in the rice production management that requires regular irrigation network systems, primary, secondary, and tertiary at the farmer level and other important factors.

The use of modern technology also provides to get a lot of benefits and offers opportunities for farmers to increase crop yields and productivity. A digitalization of agricultural systems allows farmers to predict weather and crop yields, choose appropriate crops for a region and better manage irrigation systems (Nazirul Islam Sarker et al., 2019). Furthermore, adoption of new technology is usually influenced by the farmer's education level, land area, age, farming experience, number of dependents, income, land ownership status and land ownership status (Sukarman, 2020). Meanwhile, some conditions must be met for modern farming to survive and develop are science and technology that is suitable to local conditions (Anantanyu et al., 2009). From the results of interviews (In-depth Interviews) with PUPT Lamongan Regency, it was revealed by Poktans that implement the Healthy Planting Management (MTS) innovations. It has a much higher level of efficiency, production, and productivity in rice farming than Poktans and not implemented by MTS innovation.

In essence, many several research findings also reveal the negative impact of adopting chemical input technology (pesticides and herbicides) on increasing production (Gebeyehu, 2016). The use of Rice Transplanter technology has a negative impact on farming production or farmers' welfare levels (Dahiri, 2019). In case, the use of Heavy agricultural machinery can increase soil density thereby reducing crop production or productivity (Parkhomenko et al., 2019).

There is a research gap that examine Poktans with the institutional innovations using MTS and do not use MTS, based on phenomena in the field, the majority of Poktans do not use MTS. By looking at the Poktan phenomenon in Lamongan Regency, there are those that implement MTS innovation fully and some of the MTS innovation criteria. There are Poktans that do not implement MTS innovation in rice farming. Based on this phenomenon, this research aims to determine differences in the level of productivity of rice farming in Farmer Groups. Poktan is fully, partially, and did not implement MTS innovation in Lamongan Regency.

2. Theoretical Implication

According to AT Mosher (1968) defines farming as follows: Farming is a place or part of the earth's surface, where farming is carried out by farmers either as owners or farmers who act as managers. The level of farming productivity is referred to as the level of ability or potential of land in farming to produce at a certain level of production and unit area, such as the level of production that can be achieved per hectare in one planting season. Meanwhile Mubyarto, (1989) said that farming is a collection of natural resources founded in that place, which are needed for agricultural production (land and water bodies) and needed to improve agricultural production (sunlight, buildings erected on the land etc).

Kholifa (2016) defines productivity as a measure stated that how much input is needed to produce a certain amount of output. Productivity is the result per unit area of land, labor, capital or other inputs (Chimwamurombe & Mataranyika, 2021). The productivity of rice crops can be achieved by improving technology. An existence of technological improvements makes it possible to achieve increase the production from fixed production factors. However, technological innovation in rice crops tends to be slow, where the flow of technological innovation created by research institutions to rice farmers is relatively slow. It can be seen from the slowing role of technology in increasing rice production. Because of horizontal growth is carried out through diversification of food crops. Meanwhile, vertical growth is through increasing the productivity of rice farming which is linked to agro-industry and international trade.

The level of farming productivity is like a level of ability or potential of land in farming to produce production per hectare in one planting season with the use of certain inputs. Agricultural productivity is decreasing not only because of a lack of mastery or application of good farming methods, but also expensive price of inputs (especially seeds, fertilizer and labor) causes farmers not to use enough inputs. The productivity of agricultural commodities is influenced by a combination of many factors such as varieties, level of land suitability, type of technology used, availability of capital, quality of fertilizer, quality of supporting infrastructure (irrigation) and farmer's education level. Productivity has two dimensions such as effectiveness that leads to achieving targets related to quality; and efficiency relates to efforts to compare input with actual use or how the work is carried out.

Generally, dry land farmers (corn farming) depend more on climate and rainfall for their production, while for wet land (rice farming) water availability is not an obstacle. Many factors have impact to the productivity, namely: 1) plant cultivation (on farm); 2) provision of land; 3) planted varieties; 4) procurement of plant materials; 5) tillage; 6) planting time; 7) fertilization; 8) maintenance, for example landfill; 9) harvest; and 10) processing. Apart from the factors mentioned above, there are other factors for low productivity. These factors are include outdated equipment, unpredictable workload, inefficient work flow, inappropriate work design, and infrequent training and development activities. Apart from that, there are intrinsic factors of the farmer himself, such as the level of knowledge, attitudes, skills, and abilities as well as motivation.

There are five absolute conditions that must be met for agricultural development to occur, namely: 1) an existence of a market for agribusiness products; 2) technology is constantly changing; 3) availability of facilities; 4) there is a production stimulus for producers; and 5) an existence of transportation facilities (Teguh, 2017). By technological change, agricultural development will be hampered even though the other four absolute requirements have been met (Sudana & Subagyono, 2012). According to (Musyafak & Tatang, 2005) and (Cuchird et al., 2017) assumed that technology can be defined as a new method used to produce primary agricultural products, process primary agricultural products, prepare and transport the resulting agribusiness products. Meanwhile, according to Bach (1989), innovation is an action idea or object that is considered with the new business by someone or by another adopted unit. More firmly, Abdallah et al., (2014) said that only new technology can be said to be innovation. In everyday use the term innovation is included with the term technology.

Bach (1989), defines the adoption process as a person's mental process, from hearing about an innovation to adopting it. To assess an innovation can be adopted by its users, it is necessary to pay attention to the characteristics of the innovation including, (Barrett et al., 2012): 1) Pelative Adventage; 2) Compatibility; 3) Complexify; 4) Triability; and 5) Observabilify. Meanwhile, technology is to increase productivity, improve quality and diversify processed by products in the downstream sector, both for small, medium and large scales (Musyafak & Tatang, 2005). Research based on Sudana & Subagyono (2012) said that the process of providing and disseminating agro ecosystem-specific and agricultural technology, which is appropriate to local socio-economic and cultural conditions. It is still relatively slow and one of the obstacles in accelerating agricultural development. Panggabean et al., (2016) explained that the dissemination of agricultural technology is influenced by the capacity and level of effectiveness of the institutions supporting dissemination themselves, especially research and development institutions, extension institutions, farmer institutions and other related institutions.

According to Sukarman (2020) adoption of a new technology is usually influenced by: the farmer's education level; land area; age; farming experience; the number of dependents; income; land ownership status; and land ownership status. Apart from that, (Benimana et al., 2021); (Apriani et al., 2018) and (Dedrick et al., 2015) there are several determining factors for farmers to apply or not apply technology components, namely: location-specific new superior varieties, quality and labeled seeds, provision of organic materials, population regulation optimum plants, fertilization based on plant needs and soil nutrient status, and pest control use IPM approach. According to research by Rogers (1971) defines an innovation as new ideas, new practices, or objects that can be perceived as something new by individuals or communities targeted for extension (Hollingsworth, 2023). Meanwhile, (Canwat & Onakuse, 2022) and (Dedrick et al., 2015) define innovation not just as something new, and encourage renewal in society or in certain localities. According to Workie & Tasew (2023) discussed that the application of farming technology must meet 4 criteria, namely relative advantage, easy to implement, in accordance with local values and complexity. It can be said that there will be continuous changes in the way farmers work if good and appropriate technological communication is provided to them (Bach, 1989).

Conceptually, institutions can be called by institutions and organizations. In the sense of institutions have the meaning of rules of the game, regulation of rights and obligations (Property Rights), jurisdictional boundaries or ties and an existence of sanctions (Nuryanti & Swastika, 2016). Activeness in groups can be seen from the level of attendance, involvement in activities and discussions in Poktan. The level of farmer activity in Poktan is positively and significantly related to the level of farmers' ability to manage marginal land (Djoumessi, 2021). Apart from that, there is encouragement for members to each other in carrying out activities. This group was formed with the aim of getting the final result or situation desired by all group members. However, lowland rice farming can be carried out well and to increase lowland rice productivity, several production factors are needed, such as the availability of seeds, fertilizers, pesticides, agricultural tools, agricultural machines, irrigation channels, labor and so on. The Department of Agriculture (2010) stated that seeds are plants used to reproduce and breed lowland rice plants (Bahri, 2019). Therefore, the task of agricultural instructors is to help farmers explain these production factors with lowland rice farming increases. Even though, it is very difficult to measure and quantify, it is trying to show that each farming manager has art (Teguh, 2017).

According to (Oppong et al., 2020) stated that institutional innovation can be carried out through institutional management involving two aspects, namely the organizational management aspect and the institutional management process itself. Meanwhile, many factors are impact to the organizational/group innovation adoption process. There are type of innovation, nature of innovation, method of communication, social dynamics of the community, and method of introduction carried out by an extension officers. Apart from that, the economic benefits of innovation also determine the speed of adoption by farmers. In this case, the role of the communicator is very influential on the speed of innovation adoption. Additionally, farmer institutional innovation includes elements, namely how to lead, leader function, local culture, distribution of structural roles, loyalty of administrators, availability of financing sources, availability of physical facilities, quality of human resources and technology adoption (Wallman, 2009). However, in reality, farmer institutions still experience significant obstacles such as financing, facilities, quality of management, technology and the high dependence of management on leaders which is the cause of the lack of development of farmers' abilities (Hollingsworth, 2023).

3. Method

Population is a collection of individuals with predetermined with qualities and characteristics (Kholis & Setiaji, 2020). This research is use a sample by the Purposive Sampling method with consideration of Poktans such as fully, partially or not implemented the 9 (nine) MTS criteria. However, the total population of Poktans that fully, partially and do not implement MTS in sixteen (16) sub-districts is 886 Poktans. The determining of the number for many samples uses the Slovin formula, as follows:

$$n = \frac{N}{1 + N(e)^2}$$

The total sample of Poktans implementing the MTS innovation is 136 Poktans with a determining of the number of Poktans that implemented by fully and partially. It was determined through interviews, namely Poktans that implemented fully were 42 and Poktans that implemented partially were 94 Poktans. The number of comparison samples was 57 Poktans without MTS innovation, so the total sample for this research was 195 Poktans.

The data analysis technique was used in this research is the one-way ANOVA test, which is a one-way analysis of variance used to determine the average or effect of treatment with one factor. An application of the One Way ANOVA analysis tool in this research was to determine the differences in the average value of productivity levels among Farmer Groups that implemented with full MTS innovation, partially, and did not implement MTS innovation. Before carrying out data analysis with the t test, the following must be done:

Normality Test
The normality test aims to see whether the sample data is normally distributed or not. The statistics used in this normality test are the chi-square test as follows:

$$x^2 = \frac{\sum(f_0 - f_n)^2}{f_n}$$

…………………………………………………………….(1)
Information:

X2: Calculated normality values
f_0 : Frequency obtained from calculated data
f_h : Expected frequency
Determine the X2 table with dk = k – 1 and a significance level of 5%. Decision Rules:
If, X2 count > X2 table, it means the data distribution is not normal.
If, X2 count > X2 table, it means the data is normally distributed.

Homogeneity Test

This variance homogeneity test aims to see whether the two data have homogeneous variances or not. The homogeneity tests that will be used in this research are the F test and the Bartlett test.

The F test formula is:

$$F_{hitung} = \frac{variansiterbesar}{variansiterkecil}$$

……………………………………………..(2)
Determine F-table with dk numerator = n1 – 1 and dk denominator = n2 – 1 with a significance level of 5%.

The Bartlett test formula is:

$X2 = (\ln 10) x (B - \sum (db) Log Si)$ …………………………………………….(3)
information:

ln 10: A fixed number with a value of 2.3026
B : The price must be calculated beforehand

The formula above can only be substituted after we calculate the following two calculations:

1. S (pooled variance) is calculated by the formula

$$S = \frac{(n_1 S_1) + (n_2 S_2)}{n_1 + n_2} \text{ ……………………………………………………………(4)}$$

Price of Barlet with the formula:

B = (Log S) x (∑(ni – 1)

$$F_{hitung} = \frac{variansiterbesar}{variansiterkecil} \text{ ……………………………………………..(5)}$$

Determine Ftable with dk numerator = n1 - 1 and dk denominator = n2 - 1 with a significance level of 0.05. Decision rules:

If, Fcount ≥ Ftable, it means it is not homogeneous.
If, Fcount ≤ Ftable, it mean is homogeneous.

Hypothesis testing
In accordance to the research problem formula, the technique used to analyze data to test hypotheses 1 and 2. It is uses the t test if the data is normally distributed and homogeneous, if not homogeneous then the t-test for the 3rd hypothesis using One Way Anova.

a. T-test
Based on hypotheses number 1 and 2, the test technique used is the t test. If the data is normally distributed and homogeneous then use the t-test, namely:

$$t_{hitung} = \frac{M_x - M_y}{\sqrt{\left(\frac{SD_x}{\sqrt{N-1}}\right)^2 + \left(\frac{SD_y}{\sqrt{N-1}}\right)}} \text{ ……………………………………………...(6)}$$

Information:
Mx: Mean of variable X
My : Mean of variable Y
SDx: Standard deviation of variable X
SDy: Standard deviation of variable Y
N : Number of samples

The purpose of this test is to find out whether there are differences in the level of productivity of rice farming in Poktans that implement MTS innovation fully, partially and do not implement MTS innovation in Lamongan Regency. The test carried out is a right-hand test, being significance value that obtained with smaller than α = 0.05, then the hypothesis H1 is accepted, if the significance value obtained is greater than α = 0.05, then H0 is accepted.

b. One Way ANOVA Test

The calculation formula for finding the one-way ANOVA Fraction is as follows:

$$F_A = \frac{RK_A}{RK_d} \quad (7)$$

$$F_B = \frac{RK_B}{RK_d} \quad (8)$$

$$F_{AB} = \frac{RK_{AB}}{RK_d} \quad (9)$$

RKA = (mean square) factor A obtained by the formula:

$$RK_A = \frac{JK_A}{dkJK_A} \quad (10)$$

RKB = (mean square) factor B is obtained by the formula:

$$RK_B = \frac{JK_B}{dkJK_B} \quad (11)$$

RKAB = (mean square) factor AxB is obtained by the formula:

$$RK_{AB} = \frac{JK_{AB}}{dkJK_{AB}} \quad (12)$$

dk (degrees of freedom obtained by subtracting N (number of cases, number of respondents) from 1 (N – 1). JKA (sum of squares) factor A is obtained using the formula:

$$JK_A = \sum \frac{A^2}{qn} - \frac{G^2}{N} \quad (13)$$

JKB (sum of squares) factor B is obtained by the formula:

$JK_B = \sum \frac{B^2}{qn} - \frac{G^2}{N}$……………………………………………………...(14)

JKAB (sum of squares) of factors A and B together for the entire treatment is obtained by the formula:…………………………………………(15)

The RKd is obtained using the formula:

$\mathrm{RK_d} = \frac{\mathrm{JK_d}}{\mathrm{dkJK_d}}$…………………………………………………………(16)

Meanwhile, JKd is obtained by subtracting JKt from JKa. Meanwhile JKt is obtained using the formula:

$JK_t = \sum X^2 - \frac{G^2}{N}$……………………………………………………...(17)

And JKa (intermediate sum of squares) is obtained by the formula:

$JK_a = \frac{AB^2}{n} - \frac{G^2}{N}$…………………………………………………………(18)

Information:
G: total score (total value of dependent variable measurements for the entire sample).
N: the total number of samples (is the sum of the number of samples in each cell).
A: the total score of each row (the total score of each row on factor A).
B: total score for each column (sum of scores for each column on factor B).
P: number of groups in factor A.
q: number of groups in factor B.
n: the number of each sample.

The degrees of freedom of each JK are:

$dkJK_A = p - 1$
$dkJK_A = q - 1$
$dkJK_{AB} = dkJK_B - dkJK_A - dkJK_B$
$dkJK_A x dkJK_B$
$(p - 1)(q - 1)$

The aim of this test is to find out whether the average productivity value of Farmer Groups that fully implement MTS innovation. It is better than an average productivity of farmer groups that partially implement and do not implement MTS innovation. A test absolutely carried out with a right-hand test, the test criteria being that if the significance value obtained is smaller than α = 0.05, then the hypothesis H1 is accepted, if the significance value obtained is greater than α = 0.05, then H0 is accepted.

4. Results

Based on the results of the One Way Anova Test in the Descriptives table, it can be seen that the difference in the average level of productivity in Farmer Groups that use MTS innovation in full is 7.2614 Tons/Ha, partially 7.4179 Tons/Ha and Farmer Groups that do not use MTS innovations are

7.4179 Tons/Ha. 7.4181 Tons/Ha. The average level of productivity among farmer groups that apply some of the MTS innovation criteria and do not apply MTS innovation, which is not much different, around 7.4 Tons/Ha. Meanwhile, the average productivity level of farmer groups that fully implement to the MTS innovation is 7.2 smaller than an average productivity level of farmer groups.

Table 1. Post Hoc Test

Dependent Variable: PRODUCTIVITIES						
Games-Howell						
(I) Technology	(J) Technology	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Not used it	Partial	.00020	.04553	1.000	-.1076	.1080
	Fully	.15664*	.03932	.000	.0628	.2505
Partly use	Not used it	-.00020	.04553	1.000	-.1080	.1076
	Fully	.15644*	.05007	.006	.0377	.2752
Fully	Not used it	-.15664*	.03932	.000	-.2505	-.0628
	Partly	-.15644*	.05007	.006	-.2752	-.0377

Post Hoc Test Results with Games-Howell is a multiple comparison test to determine the three average levels of productivity. In essence, comparison of the average productivity level of Farmer Groups not implementing MTS innovation with Farmer Groups, because some of the MTS innovation criteria, the average productivity is 0.00020 Tons/Ha. This figure of research is 0.00020 Ton/Ha that obtained from the average value for the productivity level of Farmer Groups. It did not apply MTS innovation (7.4181 Ton/Ha) minus an average productivity level of Farmer Groups that apply some of the MTS innovation criteria (7, 4179 Tons/Ha). The difference in average productivity levels is -0.1076 tons/ha to 0.1080 tons/ha at the 95% confidence level. Based on the output results, an sig value of 1,000 > 0.05 was obtained. It can be concluded that the productivity level of Farmer Groups do not apply MTS innovation and Farmer Groups. It is apply for some of the MTS innovation criteria with the same and the difference average of productivity between the two uses of innovation is not significant.

Based on the results of data analysis for the difference test, it was found that the significance value among farmer groups with fully innovative, partially implemented with MTS innovation was 0.006 < 0.05. It can be concluded that the productivity level of Farmer Groups partially implemented MTS innovations and Farmer Groups fully implemented MTS innovations. It has a different average productivity between the two uses of innovation is 7.4179 tons/ha for the farmer group that uses some MTS innovations and 7.2614 tons/ha for the farmer group that uses full MTS innovations. There is a difference average of rice productivity among Farmer Groups that implement full MTS innovations and Farmer Groups by partial MTS innovations. The average rice of productivity results in Farmer Groups can implemented with a full innovation were 7.2614 Tons/Ha, lower than the average rice productivity results in Farmer Groups that implemented by partial MTS innovations of 7.4179 Tons/Ha.

Low productivity is a symptom of an activity with less effective and efficient in its implementation. The effectiveness of organizational performance will be fulfilled if the efficient use of resources can produce more activities to increase the productivity of Farmer Groups. According to Canete & Temanel (2017), low efficiency in rice farming is influenced by several factors, namely: level of education, gender, farming experience, land location, water sources, use of seeds, land planning, harvest methods, fertilization, use of pesticides and soil type. Meanwhile, determinant factors such as production factors such as land area, use of labor, capital, fertilizer and pesticides. It can impact to the level of rice productivity (Akbar & Mukson, 2017) and (Simamora & Program, 2022).

The low level of rice productivity in Farmer Groups can implement a full MTS innovation, which is due to land area, use of pesticides, soil type, and the lack of knowledge of farmer groups regarding the use of MTS innovation. Apart from that, factors in the application of MTS innovation that are still not optimal include the application of natural pest predators, planting refugia plants, healthy soil management (fulfillment of natural soil elements) which can be done by leaving straw residues after rice harvest and the manufacture of biological agents. Basically, farmers have a good perception and desire for MTS innovation in rice farming. However, in field implementation, farmers often encounter obstacles are difficult for them to overcome on their own, so in the process of adopting MTS, farmers still need assistance from extension officers or facilitators.

Based on the results, any significance values between Farmer Groups that are fully innovative and Farmer Groups that do not use MTS innovations of 0.000 < 0.05. It can be concluded by the productivity level of Farmer Groups that do not implement MTS innovations and Farmer Groups are fully implement MTS innovations with the different average. There are two uses of innovation with 7.4181 tons/ha for farmer groups that do not use MTS innovation and 7.2614 tons/ha for farmer groups that fully use MTS innovation.

There are several factors are cause an average value of rice productivity produced by farmer groups that do not use MTS innovation to Farmer Groups. It was an implement full MTS innovation, including the size of the land, rice planting planning. There is adaption to soil conditions, according to planting methods, use fertilizers, and pesticides. However, rapidly increasing rice productivity through the use of chemical fertilizers and pesticides, which has a significant impact on land degradation and environmental pollution in the long term. Furthermore, Farmer Groups located near River Basins (DAS) and dams can more easily manage their rice planting for irrigation that quite abundant. In the rice cultivation system, irrigation plays a very important role, because rice is a type of plant that requires enough water to produce optimal production.

Based on the results of the analysis, the significance value for farmer groups that partially innovate with Farmer Groups that do not use MTS innovation is 1,000 > 0.05. Even though, the productivity level of Farmer Groups that partially implement to MTS innovations and Farmer Groups. It did not implement to the MTS innovations, which is not different from the difference average productivity between the two uses of innovation is 7.4181 Ton/Ha for Farmer Groups. So, do not use MTS innovation and 7.4179 Ton/Ha for Farmer Groups that partly used by MTS innovation.

There is no difference average of rice productivity between Farmer Groups that implementing for some of them and Farmer Groups not implementing the MTS innovation. It can be seen from the average productivity value of around 7.41 tons/ha. An absence of difference term is due to the rice cultivation system used by the Farmer Groups. Some of business concept did not implement to the MTS Innovation, which is still more traditional, controlling a larger area of land, providing fertilizers, and pesticides. There are better in quantity and quality with the aim of maintaining quality. Planting rice is free from pests or diseases and the location of the land is in the dam's river basin, so irrigation needs during rice cultivation are met.

5. Conclusions

This research study reveals complex relationships between the adoption of Healthy Planting Management (MTS) innovations and rice farming productivity in Indonesian farmer groups. Contrary to expectations, full implementation of MTS innovations was associated with lower productivity compared to partial or no implementation. This unexpectation finding challenges conventional wisdom about the benefits of comprehensive adoption of agricultural innovations. Several factors might contribute to this result, including the small land area of full adopters, suboptimal implementation of MTS practices, and potential trade-offs between organic methods, and short-term productivity. These findings highlight the need for a nuanced approach to agricultural innovation adoption, considering local contexts, and potential short-term productivity impacts. The research study contributes to the literature on institutional innovations in agriculture by demonstrating that partial implementation of new practices may sometimes be more effective than full implementation, at least in the short term. This has important implications for agricultural policy and extension services, suggesting that a gradual, context-sensitive approach to innovation adoption might be more beneficial than rapid, and full-scale implementation.

6. Limitation & Future Research

Limitations of this research study is include with the focus on a single region in Indonesia and the cross-sectional nature of the data. Future research should investigate the longterm impacts of MTS adoption, explore the reasons behind the lower productivity in full adopters, and examine whether these findings hold true in other agricultural contexts.

7. Conclusions

In conclude, while institutional innovations like MTS hold promise for improving agricultural productivity, their implementation should be carefully tailored to local conditions. Policymakers and extension services should consider promoting flexible, stepwise adoption strategies that allow farmers to adapt innovations to their specific circumstances.

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