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Adoption of Integrated Rice Crop Management in Majalengka, West Java, Indonesia

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Abstract:- The application of Integrated Crop Management (ICM) technology in rice by farmers in Majalengka District is not yet as expected, therefore this study aimed to: (1) describe the level of ICM technology adoption, (2) analyze the factors that influence the adoption of ICM, (3) find strategies to increase the adoption of ICM technology. This survey research was conducted in Cigasong Sub-district. The research sample was determined by following the Isaac & Michael formula with total of 45 people from a population of 125 people. Data were collected through direct interviews using a questionnaire containing statements for each variable. Before being used to collect data, the questionnaire was tested for its validity and reliability. The data were then analyzed in two ways; based on descriptive statistics, to explain the performance of research variables, and multiple linear regression to analyze the factors that influence adoption. The results of the study were: (1) most of the respondents (44.45%) were elderly of 56-78 years, elementary school education level (71.11%), had farming experience over 27 years, and owned narrow land area with an average of 0.39 ha ; (2) in general the adoption of ICM in Cigasong Sub-district has reached 61.60 percent, influenced by the capacity of farmers and the characteristics of innovation; (3) formulation of strategies to accelerate the adoption of ICM, namely; (1) formulation of strategies to increase adoption which are; choosing the right agricultural innovation according to the needs of farmers, choosing effective extension methods, and optimizing the role of extension.

***Keywords**:- Integrated Crop Management, Farmer, Rice,, Linear Regression.*

I. INTRODUCTION

Integrated crop management (ICM) for lowland rice is an innovative approach in an effort to increase farming efficiency by combining various technological components that support plant growth and productivity. ICM consists of several technological components, including: use of superior varieties, use of quality and labeled seeds, suitable soil management, nursery with fertilization, use of young seedlings (14-21 dap), application of *legowo* row planting, balanced fertilization based on the leaf chartcolor (LCC), intermittent irrigation according to water needs, pest control using the IPM approach, and controlling weeds. As an innovation, ICM has certainly gone through several stages of assessment and has been known and proven to have advantages and benefits. Based on several research reports, ICM can increase production, especially in lowland rice, if previously lowland rice productivity had only reached 4 - 5 tons per hectare, by implementing ICM, productivity could reach 6-7 tons per hectare, meaning that it could significantly increase rice production.

Even though ICM has been socialized more than 15 years ago, however, the implementation in the field by farmers is still not entirely up to expectations. Effendy (2020) found some obstacles in implementing ICM based on the results of his 2018 study, namely (1) the technology package contained in ICM must be implemented simultaneously according to its recommendations, which means that it cannot be only part or certain technology components, (1) 2) there is a conflict between land owners and tenants, on the one hand the tenant wants to apply ICM but is not permitted by the land owner and vice versa, and (3) certain components of ICM require extra labor or costs compared to conventional ones, while farmers are reluctant to spend more .

The results of preliminary observations in the field show that ICM technology in Cigasong Sub-district has been introduced since 2005, and until the research was carried out the level of application of the ICM components was not satisfactory, including: (1) the *legowo* row planting system implemented only reached 40%, (2) the use of quality seeds was only 50%, (3) most farmers (55%) still rely on factory chemical fertilizers, and (4) around 50 percent of farmers still use conventional methods to control of plant pests (OPT), namely using chemical pesticides.

In 2013 - 2014 several locations in Majalengka District were selected to implement ICM through the Integrated Crop Management Field School (ICM-FS) program and the Integrated Crop Management Implementation Movement (ICM-IM) in 2015 which was carried out by lowland rice farmers. However, until now, the adoption rate of the basic components of ICM in lowland rice is only in the medium category (58,6%) (Aisyah and Sugiarti, 2017). Based on the above problems, this aims of this study: (1) describing the process of adopting ICM in lowland rice, (2) analyzing the factors that influence the adoption of ICM, and (3) formulating strategies to increase the adoption and diffusion of ICM components in lowland rice.

Study Framework

The framework in this study is a reflection of the factors that are thought to influence the adoption rate of ICM in lowland rice, namely: (1) The farmers characteristics consist of age, level of formal education, farming experience and land area, (2) Farmers' capacity consists of knowledge, attitude, and skills, (3) the characteristics of innovation consist of: relative advantage, suitability, complexity, the possibility of being tested (trialable), and the possibility of being observed (observable). Meanwhile, the adoption of the basic components of ICM consists of: new superior varieties, quality and labeled seeds, provision of organic straw, plant population regulation, fertilization based on plant needs, and controlling pests based on the IPM approach. Schematically, the research hypothesis is presented in Figure 1.

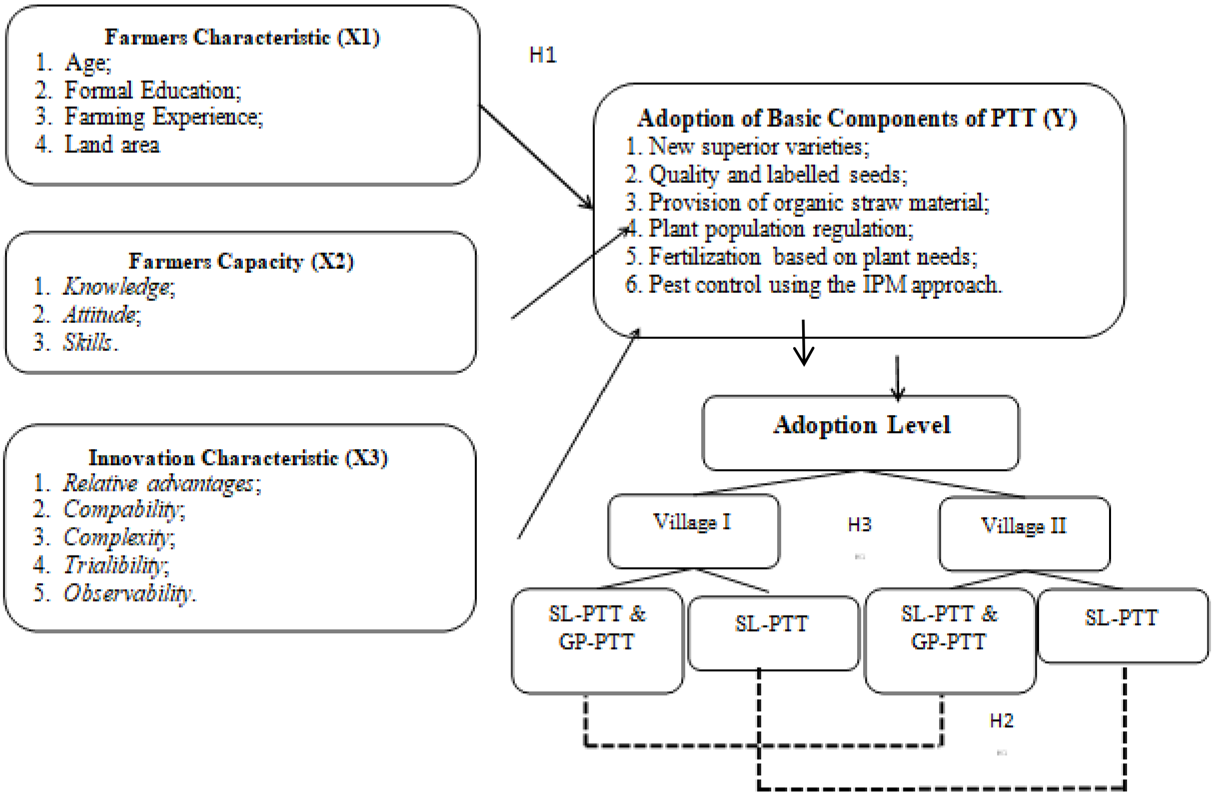

Figure 1. Hypothetical framework for the adoption of ICM in Majalengka District Lowland Rice

II. METHODS

2.1. Method of collecting data

This study is a form of ex post facto research, namely research observing past progress. And based on its objective is explanatory research, meaning to explain the causes and effects of the factors in study. This study was conducted in Cigasong Sub-district, which was selected as a village that had participated in ICM-FS and ICM-IM. Furthermore, it was carried out in the form of a survey conducted on the population and represented by the sample. The sampling technique used the Isaac and Michael formula (Sugiyono, 2017), with an error rate of 10 percent, through the formula it was found that the number of samples was 45 people from a population of 125 people.

The instrument used in this study was a questionnaire containing a list of questions related to the research variables. The structure of the instrument is divided into five parts, namely: the first part is the respondent's basic data, containing the number of the respondent, the name of the farmer group, the group class, the name of the respondent, gender, position in the group, address and non-formal education that has been attended before and the name of the enumerator and the date of the interview. The second part, contains questions related to the independent variables, consisting of: (X_1) Farmers characteristics, consisting of: age, formal education, farming experience, and land area. (X_2) farmer capacity, consisting of knowledge, attitudes and skills. (X_3) communication channels, consisting of: mass media channels and interpersonal channels. (X_4) the characteristics of innovation, consisting of: relative advantage, suitability, complexity, the possibility to be tested and easily observed. (Y) the adoption rate of the basic components of ICM in lowland rice, consisting of: new superior varieties, quality and labeled seeds, provision of organic matter, the planting population regulation, fertilization based on plant needs and nutrient status and controlling pests with IPM.

Before being used to collect questionnaire data, its validity and reliability were tested. Valid means that the instrument is a tool that is really suitable for measuring what should be measured. While reliable means that the questionnaire that is created when used several times to measure the same object will produce the same data. To strengthen the reliability of the instrument before the actual assessment, the following steps were taken: The results of the instrument test were known, that 70 questionnaire items were found, 67 questions were declared valid, while the results of the reliability test indicated that the Cronbach alpha value ranged from 0,931 to 0,988 (very reliable), thus questionnairecan be used and feasible to collect data. The data uses an interval scale with a score of 1 - 4, where the value 1 is the lowest value that reflects not knowing, not adopting and so on, while the value 4 is the highest value which means really understand, or the rate of adoption is very high.

2.2. Data analysis

The collected data were analyzed in two ways: (1) descriptive statistical analysis, to explain the variability of the variables studied in this study, (2) linear regression analysis to analyze the factors that affect adoption, while to formulate a strategy to increase adoption based on the formulation of the results of descriptive analysis. and linear regression. Linear regression analysis based on the equation:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon_I$$

Whereas:

Y = Basic component adoption rate
α = Constant,
β_1-β_7 = Coeeficient of regression,
X_1 = Respondent characteristic
X_2 = Respondent capacity
X_3 = Innovation characteristic

III. RESULT

3.1. General Condition of Research Location

Cigasong Sub-district located in the eastern of the district capital, with an orbit of ± 3 km from the district government center. Cigasong Sub-district has an area of approximately 2.433 hectares consisting of 1.241 hectares of rice fields and 1.192 hectares of land. Judging from the topography, it is divided into 2 areas, namely the northern area is lowland with altitudes at 50-100 m asl, and the southern region is a hill area with an altitude of about 300 m asl with a ratio of 50% flat and 40% bumpy. The northern area is relatively flat with a slope of 2% - 3%, while the southern part is bumpy with a slope of 5% - 15% (Extension program, 2018).

3.2. Characteristics of Respondent Farmer Characteristics

The descriptive analysis results of the farmer respondent characteristics show the general characteristics of age, level of education, farming experience, and land area are presented in Table 1.

Table 1. Description of the characteristics of farmer respondents

No	Details	Total (person)	Percentage (%)
	Age ($X_{1.1}$)		
1	< 45 years old (young)	10	22.22
2	45 - 55 years old (productive adult)	15	33.33
3	> 55 years old (elderly)	20	44.45
	Education ($X_{1.2}$)		
1	< 7 years (low)	32	71.11
2	7 - 12 years (medium)	12	26.67
3	> 12 years (high)	1	2.22
	Farming Experience ($X_{1.3}$)		
1	< 10 years (new)	1	2.22
2	10 - 20 years (moderate)	11	24.44
3	> 20 years (old)	33	73.34
	Farming Area ($X_{1.4}$)		
1	< 0.5 ha (narrow)	31	68.89
2	0.5 - 1 ha (moderate)	14	31.11
3	> 1 ha (large)	0	0.00

Table 1 shows that the age of the farmer respondents is dominated by the age group above 55 years, namely 44.45 percent, only 22.22 percent of the farmer respondents are less than 45 years old. Most of the respondents (71.11%) have low education level, namely elementary school, while most farmer respondents (73.34%) who have experience in business over 20 years is included in the old category. While the area of farm land ownership, most of them (68.89%) have less than 0.5 ha of land.

3.3. The capacity of the farmer respondents at PTT

The results of the descriptive analysis of the capacity of farmer respondents on PTT technology show that the capacity of the farmers towards PTT technology is still classified as moderate as presented in Table 1.

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Table 2. The capacity of the respondent farmer's PTT technology

No	Capacity	Category		
		Low (%)	Medium (%)	High (%)
1	Knowledge	8.87	68.91	22.22
2	Attitude	34.12	64.44	1.44
3	Skills	30.32	57.78	11.90

Table 2 shows that most of the farmer respondents (68.91%) still rated their knowledge of ICM technology in the moderate category, similar to their attitude towards ICM, most of them (64.44%) considered it moderate. Likewise, some of them (57.78%) rated their skills as still in the moderate category. From these results the capacity of farmer respondents on ICM technology is still not satisfactory, which means that it still needs to be improved.

3.4. Performance of the Characteristics of ICM Technology Innovation

Descriptive analysis of the characteristics of ICM technology is obtained, that all aspects that characterize ICM as innovation are considered moderate by the farmer respondents, as presented in Table 3.

Table 3. Performance characteristics of ICM innovations

No	Characteristic	Category		
	Of ICM	Low (%)	Moderate (%)	High (%)
1	Relative Advantage	29.89	65.91	4.21
2	Suitability	24.13	71,94	3.93
3	Complexity	30.11	65.78	4.11
4	Trialable	14.68	50,11	35.21
5	Observable	12.94	49,83	37.23

Table 3 describes that the value of the characteristics of the ICM innovation is entirely in the moderate category according to the farmer respondents. Most of the farmer respondents considered the suitability characteristic to be moderate (71.94%), same as the relative advantage, 65.91 percent of farmers rated it as being the same as the complexity level feature, as many as 65.78 percent of farmers considered it moderate. Furthermore, 50.11 percent of farmers considered the possibility of being tested on a small scale (trialable), while 49.83 percent of respondents considered the characteristics of the possibility of being observed by the process and the results (observable). These results indicate that the PTT technology in the field is still not satisfying for farmers, therefore it still needs to be improved.

3.5. Adoption of ICM Technology

As described in the previous chapter, the ICM components observed and studied in this study are the basic components of ICM technology, namely: new superior varieties (VUB), quality and labeled seeds (BBB), provision of organic matter (PBO), planting population regulation (PPT), fertilization as needed (PSK), and pest control with IPM. In detail, the results of the descriptive analysis of the ICM technology components are presented in Table 4.

Table 4. Performance of ICM technology adoption

No	Characteristic	Category		
	of ICM	Low (%)	Moderate (%)	High (%)
1	New Superior Varieties (VUB)	6.07	79,72	14.21
2	Quality and Labelled Seed (BBB)	16.07	70.00	13.93
3	Organic Ingredients (PBO)	14.23	81,66	4.11
4	Planting Population Regulation (PPT)	1.79	75.00	23.21
5	Fertilization according to plant needs	21.66	61,11	17.23
6	Pest control using theIPM approach	19.97	65.00	15.03

Table 4 describes the results of the descriptive analysis of the level of adoption of ICM components in lowland rice by farmers, which in general the adoption of ICM components is in the moderate category. Most of the farmer respondents (81.66%) considered that the component of providing organic matter (PBO) was classified as moderate, followed by the component of using new varieties (VUB) of 79.72% farmer respondents, then the component of planting population regulation (PPT) which in this case was the application of the *legowo* row planting (*jarwo*) was 75 percent of farmers, while for the pest control component with IPM and fertilization as needed (PSK), respectively, 65 percent and 61.11 percent of the number of farmers. This result once again proves that the lowland rice ICM technology in Cigasong, Majalengka District is still not satisfactory and should receive more attention.

3.6. Factors Affecting Adoption of ICM Technology

The results of multiple linear regression analysis on all independent variables that are thought to affect the dependent variable adoption rate are presented in Table 5.

Table 5. Factors affecting the adoption of ICM technology

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	***Std.error***	***Beta***	***F***	***Sig.***
R^2	0.795				
Constant	7.059				
Farmer Characteristic (X_1)	0.298	0.068	0.701	2.095	0.001*
Farmer Capacity (X_2)	0.370	0.079	0.616	4.686	0.000*
Characteristics of Innovation (X_3)	0.689	0.226	0.401	3.050	0.004*

The results of regression analysis (Table 5) show that the independent variables studied in this study have a significant effect on the adoption of ICM technology (<p = 0.005) with an R-square of 0.795 and a constant value of 7.059. The innovation characteristics (X_3) have an effect with a coefficient of 0.689, followed by the farmer capacity variable (X_2) with a coefficient of 0.370, and farmer characteristics (X_1) of 0.298.

These results can be explained: (1) the R-square value of 0.795 means that the independent variables selected in this study contributed 79.5 percent to the results of the research or the adoption rate of ICM technology, while the remaining 20.5 percent came from other factors outside the study; (2) a constant value of 7.059, which means that if the values of X_1, X_2, and X_3 are zero, the adoption rate of ICM technology is 7.059; (3) farmer characteristics (X_1) give a positive coefficient of 0.298, meaning that if the capacity of farmers (X_2) and characteristics of innovation (X_3) are zero, each increase in one unit of farmer characteristics will increase the adoption of ICM by 0.298; (4) farmer capacity gives a positive coefficient of 0.370, which means that if the value of farmer characteristics (X_1) and characteristics of innovation (X_3), then each increase of one unit of farmer capacity will increase the level of ICM adoption by 0.370; (5) the characteristics of innovation have a positive effect of 0.689, meaning that if the characteristics of farmers (X_1) and capacity of farmers (X_2) are zero, then each increase in the value of one unit of innovation characteristics (X_3) will increase the adoption of ICM by 0.689. This result produces a regression equation $\hat{Y} = 7.059 + 0.298X_1 + 0370X_2 + 0.689X_3 + é$. With these results, it can be concluded that the characteristics of farmers, farmer capacity, and characteristics of innovation affect the adoption of ICM technology, in other words H-0 is rejected and H-1 is accepted.

IV. DISCUSSION

The results of the regression analysis showed that the characteristics of the farmer respondents had a significant effect on the adoption of lowland rice ICM technology, with an influence coefficient of 0.298. While the results of the descriptive analysis show that most of the farmers, including the elderly above 55 years, have a low level of education, only elementary school, the narrow farm land ownership area is less than 0.5 ha, but they have run the business for a long time, which means that they are very experienced. These results can be interpreted that the characteristics of farmers can determine someone to decide whether or not to adopt an innovation. This proves the truth of Rogers' theory (1983) which states that a person's decision-making process is preceded by knowledge, means when a farmer or farmer group is directed to understand the benefits or advantages of an innovation. These results are also supported by Musyafak and Ibrahim (2014) which concluded that the acceleration of adoption and diffusion of innovation in agriculture is influenced by demographic characteristics of farmers. It is supported by Romdhon et. al. (2014) who concluded that the level of integrated crop management (ICM) adoption in Kendal is influenced by individual farmer factors. Likewise, Effendy and Gumelar (2020) concluded that the adoption of the use of organic fertilizers in Cikoneng, Ciamis Sub-district was influenced by the characteristics of farmers, including age, level of education, and the farming area. Thus, this study concludes that the characteristics of farmers determine the level of adoption of ICM technology in lowland rice.

Furthermore, it was also found that the capacity of the farmer respondents had a significant effect on the level of adoption of lowland rice ICM technology, with an influence coefficient of 0.370. Meanwhile, the results of the descriptive analysis showed that most farmers rated their capacity for ICM technology in the moderate category. These results may indicate that the farmer's capacity consisting of knowledge, attitudes, and skills towards ICM technology determines a person to decide whether or not to adopt an innovation. These results prove the correctness of the theory proposed by Rogers (1983) which states that a person's decision-making process is preceded by knowledge, means when a farmer or farmer group is directed to understand the benefits or benefits of an innovation. Effendy and Badri (2020) confirmed that the capacity of farmers in applying balanced fertilizers is influenced by the characteristics of farmers, especially age, farming experience, formal education and non-formal education, then capacity is also determined by supporting factors in the form of; farmer groups, the capacity to raise capital, and information technology, are then also influenced by extension activities consisting of; suitability of materials, extension methods used, intensity of extension, and ability of extension workers. This result is also in line with Effendy *et al.* (2020) that to accelerate the regeneration of farmers, they must pay attention to components that will affect the capacity of youth as capital to participate. Thus it can be concluded that to application of ICM technology, the capacity of farmers includes; knowledge, attitudes, and skills on ICM technology must be fulfilled first.

Furthermore, it is also known that the characteristics of innovation have a significant effect on the adoption rate of lowland rice ICM technology, with an influence coefficient of 0.689. Meanwhile, the results of the descriptive analysis showed that most farmers rated the characteristics of the ICM technology innovation in the moderate category. These results indicate that the characteristics of the innovation consist of new superior varieties, quality and labeled seeds, return of organic matter to the land, regulating plant populations by applying *jarwo* row planting, fertilization according to plant nutrient needs, and controlling pests using the IPM approach. This result is in accordance with Rogers (1983) that a person's decision-making process towards an innovation goes through several stages, namely: (1) Knowledge, namely the stage when a farmer or farmer group is directed to understand the existence and benefits/advantages and how an innovation functions; (2) Persuasion stage (Persuasion) when a farmer/farmer group (or other decision-making unit) forms a good or bad attitude; (3) Decisions Stage (Decisions) arise when a farmer or other decision-making unit is involved in; (4) the application stage (implementation); and (5) Confirmation stage, which is when an individual has made a decision, but after receiving information that is not in line with his decision to accept or reject an innovation that has been previously accepted.

Based on the description above, it can be concluded that farmer characteristics, farmer capacity, and characteristics inherent in an innovation play a role in determining the acceptance or introduction of lowland rice ICM technology in Ciamis District, thus the independent variables or those suspected to affect the adoption of ICM technology are proven that the characteristics of farmers, farmer capacity, and characteristics of innovation affect the level of adoption of basic technology of ICM in lowland rice in Ciamis District.

V. CONCLUSION

The results of this study can be concluded as: (1) The characteristics of rice farmers in Cikoneng Ciamis Sub-district; most of them are elderly group over 55 years, have a low level of education, only elementary school, a narrow farm land ownership area is less than 0.5 ha, but has run the farm in a long time which means they are very experienced; (2) farmer characteristics, which consist of age, level of education, land area, and farming experience; Furthermore, farmer capacity consisting of knowledge, attitudes and skills towards ICM, as well as innovation characteristics consisting of: relative advantage, suitability to local conditions, complexity, the possibility to be tested on a small scale (trialable), and the possibility of observing the process (observable) and the results have a significant effect ($p < 0.005$) on the adoption of ICM technology; (3) the strategy to increase adoption is to increase the capacity of farmers about PTT technology, then select and sort the technology according to the conditions and needs of the farmers.

VI. RECOMMENDATION

Based on the discussion of the research results, strategies can be formulated to increase the adoption and diffusion of ICM technology. Several alternative strategies are taken, namely: (1) related to the characteristics of innovation, to increase adoption, innovations that will be socialized should be selected and sorted according to the conditions and expectations of farmers, (2) in relation to the implementation of extension activities, the right method is chosen in the sense that it is in accordance with the conditions and expectations as well as the readiness of farmers including their needs, (3) optimizing the role of extension workers and other officers by increasing the intensity of extension and participation of farmers in the learning process during extension activities.

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