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The Effectiveness of The Dissemination Method on Soybean Technology Innovation

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Abstract. The study aims to analyze the increase in farmers' knowledge and attitudes to technological innovations in soybean production using the dissemination method. The study was carried out from October 2020 to January 2021 by combining the dissemination of meetings information and technology demonstrations in the Grobogan Regency. Data collection used a survey before (pre-test) and after (post-test) evaluation in the dissemination implementation. Respondents were determined using purposive sampling, 35 cooperative farmers in disseminating soybean technology innovation activities. The data were descriptively analyzed using the average value, percentage, and paired sample t-test. The enhancement of farmers' knowledge is analyzed based on the percentage of correct answers by farmers. Changes in farmers' attitude-response are implemented into a radar graph. The study results showed that after attending meetings information and technology demonstrations, the farmers' knowledge of soybean production technology increased by 21.1%. The pre-test results showed that farmers already had a positive attitude and response to soybean production technology, with an average score of 2.64. The post-test results showed that farmers' positive attitudes and responses increased, with an average score of 2.84.

1 Introduction

Soybean technology innovation can increase soybean productivity and quality. Some of these innovations include i) the use of superior varieties can increase productivity per unit area compared to other technologies [1], the easiest to implement, and relatively cheaper [2] ii) certified and quality seeds at the farmer level can increase farming efficiency by 20% [3], iii) land management can increase soybean productivity up to 50.3% and increase farmers'

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income by 40.7% in St. Paulo Brazil [4], iv) integrated pest control using sex-pheromone are still effective, inexpensive, and easy to attract and trap *S. litura* moths in soybean plantations [5], and v) the application of post-harvest technology aspects is currently getting better so that it contributes to reducing seed quality losses and increasing soybean cultivation production potential [6]. This technological innovation will be in vain if it only "sit on the shelf" or only at the station research level. Principally, innovation is the dissemination process to accelerate the technology application at the user level to be widely adopted.

Technology innovation is significant for soybean production, while farmers spear its implementation. These two factors must synergize so that they are equal. Mannan and Nordin [7] stated that a technological innovation will be adopted by farmers if the technology has the characteristics of relative advantages, compatibility, complexity, trialability, and observability. Technological innovation will be in vain if farmers are not able to take advantage of it. Therefore, the technology innovations must also be adapted to the characteristics of farmers. It must be realized that the characteristics of rural farmers have a low level of education with a subsistence farming system, generally characterized by poverty, poor health conditions, and lack of knowledge [8]. This lack of knowledge causes them to be limited in accessing technology information, so more than 50% of farmers do not have information related to extension [9]. In line by Krisdiana et al. [1], the characteristics of these farmers require that the soybean technological innovations produced are adaptive, easy to try, affordable, technically appropriate, economical, and socially acceptable. An understanding of the characteristics of innovation and farmers is needed as a basis for determining the right technology and dissemination method.

The dissemination method or extension method communicates between farmers and extension agents [10]. The appropriate dissemination method serves as effective communication to improve the users' knowledge, attitudes, and skills towards the technology. The dissemination method is divided into three groups: i) technology demonstration group: visitor display, visitor plot, technology degree, ii) interpersonal communication group: clinic of technology, field day, forum of information, technology application forum, and iii) information development group: brochures, leaflets, radio broadcasts, TV, and internet [11]. The dissemination method has advantages and disadvantages, so the selection is based on the dissemination purpose, targets, budget, and time [12]. Azumah et al. [13] stated the agricultural extension methods including farmer-to- farmer extension, demonstration farms, and household extension are the most significant to communicate information to farmers. The combination of several dissemination methods remains an option and tends to be more effective [11]. The study results of Lukkainen [10] stated that farm demonstrations, farmer trainers, and dissemination facilitators provided the best combination of dissemination methods. Based on this description, this paper aims to analyze the increase in farmers' knowledge and attitudes toward soybean production technology innovations by combining two dissemination methods: meetings information and technology demonstrations methods.

2 Methodology

2.1 Site and time of study

The study was conducted at the Mangestu Rahayu Farmer's Group, Gabus Village, Gabus District, Grobogan Regency. The location is determined using purposive sampling that Grobogan Regency is the soybeans center of Indonesia. Meetings information and technology demonstrations in soybean production innovation are held during the Rainy Season (MH) from October 2020 - to February 2021.

2.2 Method of the study implementation

Data was collected using a survey method on 35 participatory farmers by questionnaires. Farmers' learning of soybean production technology innovations uses two dissemination methods: meetings information and technology demonstrations. The meetings information or technical meetings method provides information in the technological innovation material by interviewees (extensions/researchers) to farmers in classrooms face-to-face. The technology demonstration method is a dissemination method by demonstrating or providing direct examples of technological innovations to farmers. The two dissemination methods aim to provide farmers with knowledge and skills so they can be applied in their farming systems. Primary data includes i) data on the level of knowledge of farmers on technological innovations in soybean production with the ICM (Integrated Crop Management) approach and ii) farmer attitudes and responses to technological innovations introduced. Primary data is obtained through an evaluation before (pre-test) and after (post-test) implementation of meetings information and technology demonstrations.

Farmers' knowledge levels were analyzed based on the average percentage of farmers' answers before and after implementing meetings information and technology demonstrations. The ICM approach asked the 20 questions related to technology innovation in soybean seed production (Appendix 1). The farmer must answer the question by choosing TRUE or FALSE. The percentage of assessment results, then implemented in a line graph and tested for significance using the Paired Sample T-test.

Changes in farmers' attitudes and responses were qualitative data that were converted into quantitative data using scoring techniques. Score technique using 3 scales of 20 statements related to farmers' attitudes and responses to technological innovations in soybean seed production using the ICM approach (Appendix 2). The three scales including scale 1 (score 1), which means farmers do not agree; scale 2 (score 2) means farmers are unsure; and scale 3 (score 3) means farmers agree. The average score for each statement before and after the implementation of meetings information, and technology demonstrations is implemented on a radar chart. Radar chart is a graphical method for displaying multivariate data consisting of three or more quantitative variables and presented in a two-dimensional chart starting at the same axis point [14]. Chanifah et al. [15], farmers' attitudes before and after the dissemination process were categorized into three interval scales and were tested for significance using the Paired Sample T-test. The determination of the interval scale category is as follows:
Average score = Total score/number of respondents
Interval scale = (highest score – lowest score)/number of interval scales
The three categories of farmer attitudes on an interval scale are as follows:

a) Scale 1.00 – 1.67 = Negative category, meaning that the farmers reject disseminated technology innovations and refuse to adopt
b) Scale 1.68 – 2.33 = Normal category, meaning that the farmers are ordinary or indifferent to the disseminated technology innovations
c) Scale 2.34 – 3.00 = Positive category, meaning that the farmers accept disseminated innovations and are ready to adopt

3 Result and discussions

3.1 Socio-economic characteristics of the respondents

Farmers' socio-economic characteristics include age, education level, number of families, farming experience, land ownership area, and others that significantly influence farmers' attitudes and behavior in determining farming system decisions and acceptance of

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technological innovation [15, 16]. Table 1 shows the socio-economic characteristics of the respondent.

The age of farmers ranged from 27-82 years old, with an average of 48.54 years. The standard deviation of the farmer age variable is quite high, reaching 15.74, which indicates a high variation in the farmer age. As much 88.57% of farmers are productive age (15-64 years), while 11.13% of farmers are of unproductive age. Productive age positively implicates productivity levels. The farmers' highest productivity is in the age group of 25-45 years; farmers under 25 years and above 55 years generally have lower productivity levels due to lack of experience, lack of capital, and are reluctant to adopt new technological innovations to avoid risk [17].

Table 1. Identity of soybean respondent farmers in Gabus District, Grobogan Regency, 2020-2021.

No.	Description	Percentage (%)	Minimum-Maximum	Average	Standard Deviation
1.	Age (years)		27 - 28	48.54	15.74
	a. Productive (15-64)	88.87			
	b. Unproductive (> 64)	11.13			
2.	Education (years)		6 - 17	8.43	3.29
	a. Primary school	57.14			
	b. Junior high school	14.29			
	c. Senior high school	22.86			
	d. Undergraduate	5.71			
3.	Family members (people)		2 - 6	3.51	1.15
	a. 2 - 4	82.86			
	b. 5 - 6	17.14			
4.	Farming Experience (years)		1 - 30	9.06	9.51
	a. 1 - 10	68.57			
	b. > 10	31.43			
5.	Landholding (ha)		0.03 - 0.75	0.16	0.94
6.	Primary occupation (%)				0.44
	a. Farmers	74			
	b. Others	26			

The proportion of farmers' formal education is primary school 57.14%, junior high school 14.29%, senior high school 22.86%, and undergraduate 5.71%. The formal education of farmers is relatively low. with an average of 8.43 years (equivalent to junior high school). Farmers with formal education are more productive than uneducated farmers because farmers with higher education tend to apply new technologies and more productive inputs [18]. However, farmers' productivity can be increased through non-formal education extension activities such as information gathering, training, practice, area demonstration, and others. Islahi and Nasrin [19] stated non-formal education provides better farming methods, farmers are able to follow changes in innovation and are able to share experiences with other farmers.

The number of farmer family members ranges from 2 to 6 people with an average of 3.51. Family members become the source of cheap family labor [20]. The allocation of labor in the family is crucial and relieves farmers because they are not paid in cash, although the outpouring of time is not entirely for agriculture the level of participation of family members is relatively high [21]. The number of farmer family members is 2-4 people by 82.86% and 5-6 people by 17.14%. The experience of farmers in carrying out soybean farming reached an average of 9.06 years. As much 68.57% of farmers have experience of 1-10 years, while 31.43% of farmers have experience of more than ten years. Farming experience shows a positive relationship with farmer's output; the higher the farming experience the higher the output [20].

Farmers' land tenure ranges from 0.03 to 0.75 ha with an average of 0.16 ha. Land tenure relatively narrow, it can affect the farmers' behavior who are reluctant to adopt new technological innovations. The narrow land is a hope for farmers to earn income, if it is used to experiment with new technologies so farmers are afraid that they will fail. Most of the respondents 74% have their main job as farmers, but they also have side jobs to increase family income, namely as farmers, traders and laborers.

3.2 The Enhancement of farmers' knowledge of soybean technology innovation

Figure 1 shows that during the pre-test dissemination process. respondents only answer the questions correctly at an average of 71.4% (shown in red line). After the post-test dissemination process. the farmers' knowledge level increased because they could answer questions correctly with an average of 92.6% (shown in blue). The farmers' level of knowledge before the implementation of meetings information and technology demonstrations (pre-test) and after (post-test) increased by 21.1%. The study results indicate that extension using the methods of meetings information and technology demonstrations effectively increases farmers' knowledge. Meetings information is considered effective if one of the evaluations shows a behavior change, Arlinghause et al. [22] stated behavioral changes are likely to occur if knowledge increases due to the individual's awareness of the related information. The study results follow research by Malia [23] which states that the average increase in farmer knowledge after the dissemination process with the lecture method increases by 50%.

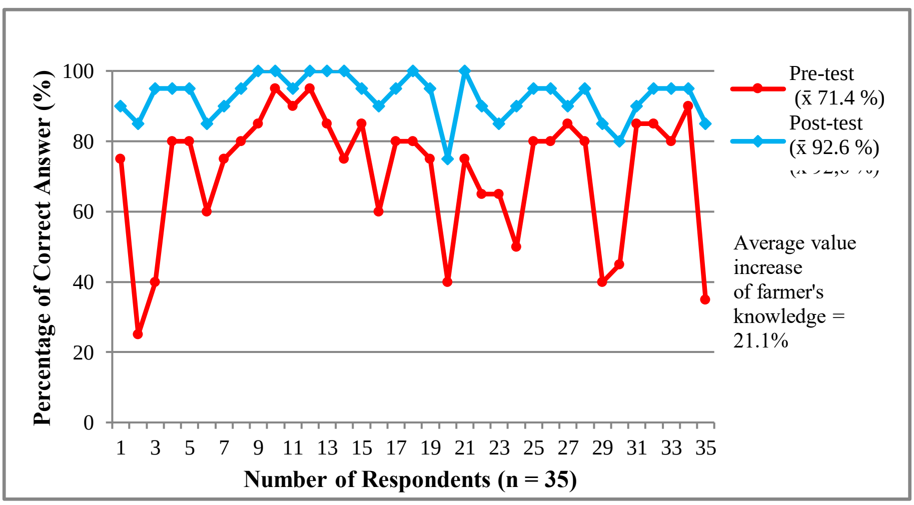

Fig 1. The enhancement of farmers' knowledge of soybean production technology innovations in Grobogan Regency. 2020-2021.

The paired sample t-test results show a significant difference in the farmers' knowledge level before and after the dissemination process with meetings information and technology demonstrations methods. The t-test results show that the value of sig. (2-tailed) of 0.000 <0.05. meaning that there is a significant difference in knowledge at the farmer level from pre-test and post-test of the dissemination process (Table 2). These results are following research by Thamrin et al. [24] which states that the results of the t-test show a p-value <0.05. meaning that there is a significant difference in knowledge at the level of the training participants "Soybean Cultivation Technology as an Intercrop among Immature Rubber Plants" from pre-test and after post-test following the extension.

Table 2. Paired Sample T-Test results of farmers' knowledge level in pre-test and post-test dissemination process in Grobogan Regency. 2020-2021.

No	Treatment	Average Value
1.	Pre-test	71.4[a]
2.	Post-test	92.6[b]

Note: Numbers followed by different letters show a significant difference at the 0.05 level (sig. (2-tailed) value of 0.000<0.05

3.3. Farmers' attitudes towards soybean technology innovation

Figure 2 shows the evaluation results of farmers' attitudes and responses to soybean production technology innovations, before implementing dissemination with the meetings information and technology demonstrations methods farmers already had attitudes and responses in the positive category with an average score of 2.64 (red line). It means that the farmers accepted disseminated innovations and were ready to adopt them. After the dissemination process. the farmers' attitudes and responses remained in a positive category, even the assessment score increased to 2.84 (blue line) which means that farmers accepted the disseminated innovations and were ready to adopt them.

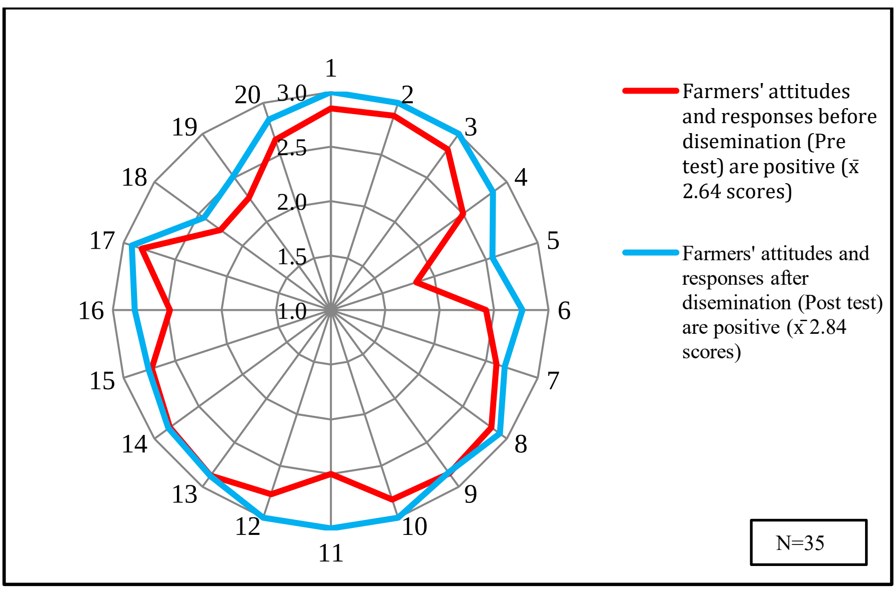

Fig 2. Graph of farmers' attitudes and responses to soybean production technology innovations before (Pre-test) and after (Post-test) the dissemination process in Grobogan Regency. 2020-2021.

The positive attitudes and responses of farmers enhance by 7.57%. The results showed that the dissemination method using the combination of meetings information and technology demonstrations effectively increased farmers' attitudes and responses to soybean production technology innovations by 7.57%. A study by Lukkainen [10] stated that the three methods of dissemination that were considered the most effective in increasing farmers' knowledge and attitudes towards agricultural technology were farm demonstration, farm visits, and farmer trainers. On farm demonstration is the most effective method but requires a high cost and requires a long time, while farming visits and farmer trainers are cheaper and the time is relatively short. Research by Gonzales et al. [12] showed that the technology degree dissemination method has the highest effectiveness in increasing the knowledge, attitudes, and motivation of farmers. Therefore. the selection of the dissemination method must be adjusted to the goals and targets considering the budget, time, technological complexity, and socio-economic conditions of the farmers.

The paired sample t-test results showed significant differences in the attitudes and responses of farmers from before and after participating in learning with meetings information and technology demonstrations methods. The t-test results show the value of sig. (2-tailed) of 0.013 <0.05. showing significant differences in attitudes and responses at the farmer level from before (pre-test) and after (post-test) the dissemination process (Table 3).

Table 3. The Paired Sample T-Test Results of Farmers' Attitudes and Responses before (pre-test) and after (post-test) the dissemination process in Grobogan Regency. 2020-2021.

No	Treatment	Average Value
1.	Pre-test	2.64[a]
2.	Post-test	2.84[b]

Note: Numbers with different letters show a significant difference at the 0.05 level (sig. (2-tailed) value of 0.013<0.05

4 Conclusion

Soybean production technology innovation is one of the crucial points to increase national soybean productivity, so it must be disseminated at the farmer level to be useful. The downstream process of soybean production technology innovation is carried out through a extension process, including the dissemination methods is information meetings and technology demonstrations. The farmers' knowledge level before the implementation of meetings information. and technology demonstrations (pre-test) and after that (post-test) increased by 20.1% (from the average value of 70.9% increased to 90%). At first, the attitude and response of farmers were positive towards soybean production technology innovation (pre-test) with a score of 2.64. After implementing meetings information and technology demonstrations (post-test), farmers' positive attitude and response increased with a score of 2.84 or 7.57%. The dissemination method by combining meetings information and technology demonstrations effectively proves to increase the knowledge and attitudes of farmers to technological innovations in soybean production.

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