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THE EFFECT OF INTEGRATED PEST MANAGEMENT TECHNOLOGY ADOPTION ON SHALLOTS ONION FARMING INCOME IN MIJEN SUBDISTRICT OF DEMAK DISTRICT, INDONESIA

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ABSTRACT
Shallots are an agricultural commodity that has high economic value, but in the last three years there has been a decline in production caused by pest and disease attacks, as well as uncertain climatic conditions. The government promotes programs related to pest control technology, namely integrated pest control (IPM). The purpose of this study was to analyze the income of shallot farming in farmers with IPM and non IPM, the influence of internal, external factors, IPM adoption on production and income of shallot farming in Mijen District, Demak Regency. Survey and interview research methods using structured questionnaires with 125 farmers as respondents. Data were analyzed descriptively and using path analysis. The results showed that the income of farmers who applied IPM was 26.66% greater than non IPM. The results of path analysis showed that internal factors, external factors and IPM technology adoption had a positive and significant effect on production. Production variables are able to mediate the significant influence of internal factors, external factors and IPM technology adoption on farmers' income.

KEY WORDS
Shallots, IPM technology, income.

Shallot (Allium ascalonicum L.) is one type of seasonal vegetable commodity that has a high economic value. Plants with the Liliaceae family are easily bred in a very wide range of agroecosystems. Onion cultivation in Indonesia is expanding every year in line with the increasing national demand for the commodity (Supartha et al, 2018).

According to statistics BPS (2023), Indonesia produced 2,004,590 tons of shallots, but in 2022 this number decreased by 1.11% to 1,982,360 tons. Nationally, in 2022 Brebes Regency is the area with the highest production amount, reaching 3,836,802 tons, while Demak Regency is in second place with a production amount reaching 510,809 tons (Dinas Pertanian Provinsi Jawa Tengah, 2022). One sub-district in Demak Regency with the highest production is Mijen Sub-district with a production of 146,116 tons in 2021 (Dinas Pertanian and Pangan Kabupaten Demak, 2022). Pests and diseases that attack shallot plants, as well as erratic weather patterns such as high rainfall are some of the causes of the decline in shallot yields (Sudarma & As-syakur, 2018; Servina, 2019).

Onion cultivation is currently mostly conventional. This conventional pattern is according to (Nalu et al, 2021) Problems often experienced by farmers in cultivating plants either conventionally or not are like controlling pest attacks on plants. Pest control is more inclined to chemical control, because chemical pesticides are more effective in overcoming pests and the results are more quickly known and the application is easier. The use of pesticides to control OPT (plant pest organisms) should be the last alternative and the negative impacts that arise must be minimized. The use of pesticides must meet six appropriate criteria, namely: the right type, the right quality, the right dose, the right time, the right target, the right method and application tools.

The excessive use of chemical pesticides has a negative impact such as pests becoming resistant to pesticides, and can be replaced by utilizing materials found in nature to protect plants from pests that damage plants. The use of vegetable pesticides can be a solution to keep plants healthy (Tasnia et al, 2022). The continuous use of non-selective

chemical pesticides to maintain crop productivity has resulted in some types of plant pest organisms becoming immune, followed by the destruction of natural enemies (parasitoids and predators) and other beneficial insects (Arifin, 2012), planting pest-resistant crops, and using pesticides wisely (Samiee et al, 2009).

Planting and utilizing plants that serve as habitat for natural enemies because they have a high effect on insect abundance (Heong et al, 2015). Refugia plants have the ability to attract natural enemies because refugia serve as a source of food (Kurniawati & Martono, 2015). The presence and density of refugia flowers around the plant creates a microclimate suitable for the development of natural enemies (Bahri, 2020).

The use of yellow traps can suppress pest populations very well (Karo-Karo et al, 2014). Pest control using lights as an alternative in environmentally friendly control, insect attraction to color is an insect adaptation aimed at protecting themselves from predators. Insect attraction to color as a reference in pest control using light traps (Mudatsir, 2023). The use of biological agents such as Feromon Exi, Trichoderma Harzianum and Beauveria Bassiana, Trichoderma sp, serves to suppress the attack of fusarium fungi that cause base rot/moler disease in shallot plants and purple spot caused by Alternaria porri (Mahdizadehnaraghi et al, 2015). Carrying capacity and location-specific technologies are important to consider (Burhanuddin et al, 2018). Control measures taken are environmentally friendly, economical, and do not cause pest and disease resistance. Control using IPM is one of the alternatives that can be done (Patra, 2021).

Maximum farmer income, must be able to minimize production costs and increase income. According to Rosi & Andrial (2021), High income is always expected by farmers in producing agricultural production, to get maximum income farmers must increase production and reduce production costs, therefore farmers are able to provide farm inputs efficiently, so that the results obtained provide considerable benefits for farmers. The objectives to be achieved in this study are: Analyzing the differences in income of IPM and non IPM farmers and analyzing the influence of internal, external factors, IPM adoption on production and income of shallot farming.

METHODS OF RESEARCH

The research was conducted in Pasir Village, Bantengmati, Bermi and Gempolsongo Mijen Subdistrict, Demak Regency, from March to April 2024. The location was determined deliberately, namely shallot farmers who are registered in the Agricultural Extension Management Information System (SIMLUHTAN), which was selected proportionally, they are members of farmer groups, and have received IPM technology assistance programs from the government including using yellow likat, planting refugia, using light traps, and using biological agents. The population of Non IPM shallot farmers is 1,613 farmers and IPM is 487 farmers and the number of research samples is 65 farmers and 60 farmers, so the total sample is 125 farmers. The calculation determines the sample size of the population using the Isaac and Michael formula. (Sugiyono, 2015).

Data collection methods through interviews, questionnaires and observation. The data analysis technique in this study was carried out descriptively; this analysis is to see a description of the behavior of farmers in the use of IPM and Non-IPM technology. Each indicator was measured using a 4-point Likert scale, namely Point 1. Very Poor; Point 2. Not Good; Point 3. Good; Point 4. Very Good (Dewi et al, 2020). Data analysis was carried out using a path analysis model where the analysis tested how much influence internal factors, external factors, IPM technology adoption, production and income of shallot farmers. Data processing was carried out using the Smart PLS program.

The amount of shallot farming income using the formula: $\pi = TR-TC$ with π = Farm Income (Rp), TR = Revenue (Rp), TC = Total Cost. Total cost is the overall cost of the total production costs that have been incurred by summing up fixed costs and non-fixed costs. $TC = FC + VC$ with TC = Total Cost (Rp), FC = Fixed Cost (Rp), VC = Non-Fixed Cost (Rp). Revenue can be calculated using the formula: $TR = P \times Q$ with TR = Revenue (Rp), P = Price (Rp/Kg), Q = Quantity (Kg) (Dahlianawati et al., 2020).

To determine the influence of several variables on production and income from the use of IPM and Non IPM technology, it can be analyzed using path analysis (Keneq, 2020). The path analysis scheme can be seen in Figure 1.

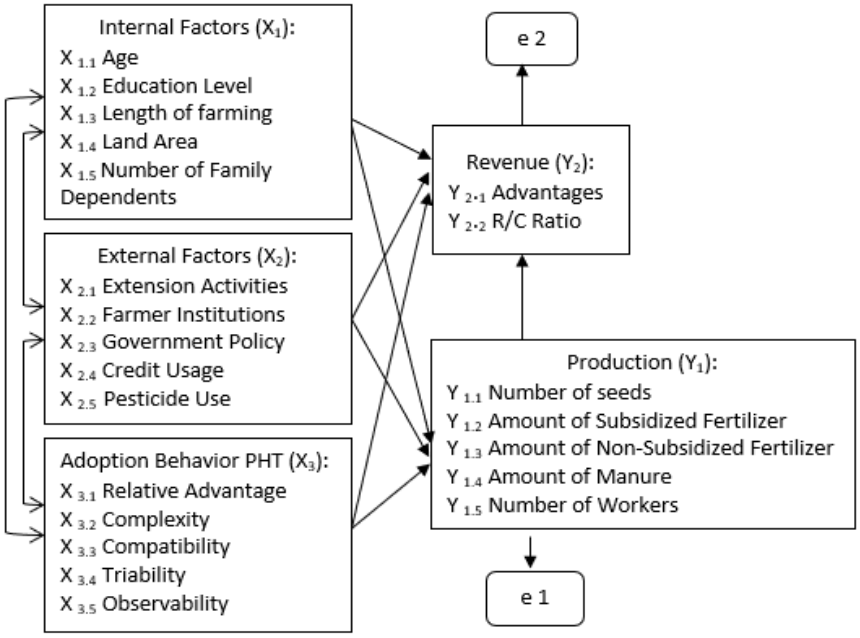

Figure 1 – Schematic diagram of the research flow

Based on this scheme, the path analysis equation formula is as follows:

$$Y1= \rho 1x1+ \rho 2x2+ \rho 3x3+\varepsilon 1$$
$$Y2= \rho 4x1 + \rho 5x2 +\rho 6x6+\varepsilon 2$$

Where: X1 = Internal factors; X2 = External factors; X3 = Technology Adoption; Y1 = Production; Y2 = Income; $\rho 1x1$ = Path Coefficient; ε 1 and ε 2 = Error rate or research error rate (5%).

RESULTS AND DISCUSSION

Based on Figure 2, the majority of farmers 44% are at the age of more than 50 years. Age can be a measure of the success of farming activities, farmers who have a younger age will usually work better and more optimally than farmers who are older. (Gusti et al, 2022). The majority of farmers are in higher education to produce a better crop. Education can have a big influence on a person's mindset. Farmers who have higher education will have a tendency to think more advanced compared to farmers with low backgrounds (Rasoki & Asnamawati, 2023). Based on the number of family dependents, the majority of farmers have 3-4 dependents as many as 39.2%. The greater the number of family dependents, the greater the amount of costs incurred so that family needs can be met. In addition, the number of family members can be seen as labor in working on the land cultivated (Nurjanah et al, 2018).

Based on Figure 3, the majority of farmers with a length of farming 39.2% more than 10 years, the page farming will affect decision making. Experienced farmers will be more selective and precise in choosing the type of innovation to be applied, experienced farmers will also be more careful in the decision-making process (Agatha & Wulandari, 2018).

Farm income based on land area data, as many as 48% have a land area of 0.5-1 ha. According to Sayogyo (1977) grouped farmers in Java into three categories, namely small-scale farmers with farmland area <0.5 ha, medium scale with farmland area of 0.5-0.1 ha,

and large scale with farmland area >1.0 ha. The average land area of production of IPM farmers is lower than Non-IPM. According to Ibrahim et al (2021), Farm income is divided into two, namely: farm income and net farm income.

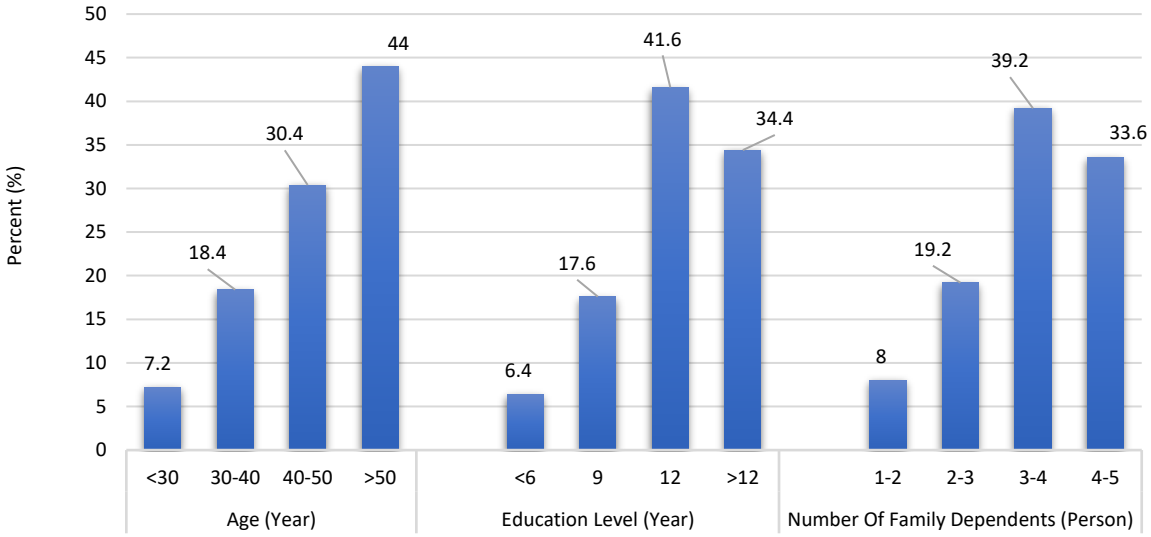

Figure 2 – The characteristics of shallot farmers in Mijen Sub-district, Demak Regency (Source: Primary data processed, 2024)

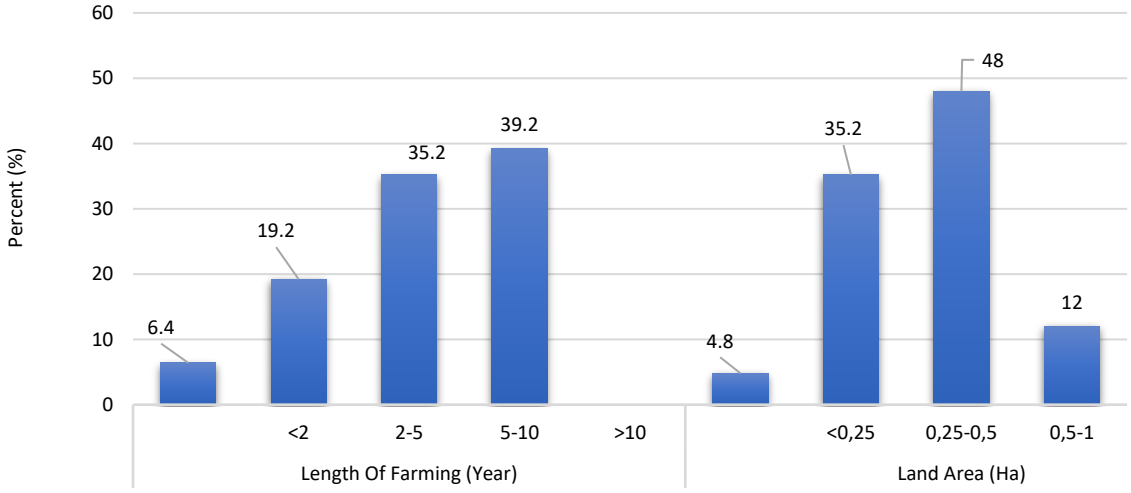

Figure 3 – The characteristics of respondents based on their business (Source: Primary data processed, 2024)

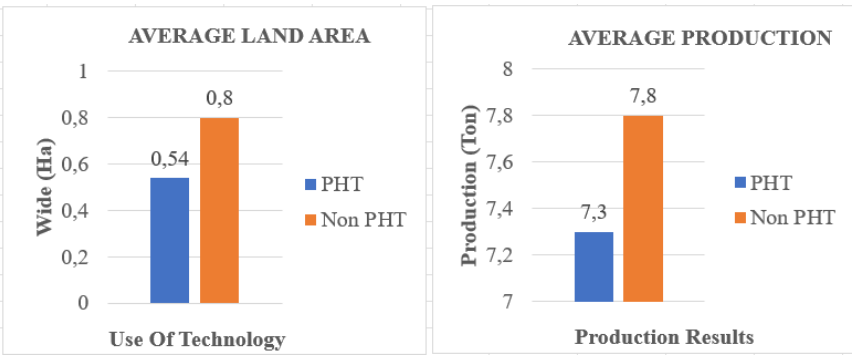

Figure 4 – The average land area and average shallot production (Source: Primary data processed, 2024)

The revenue and costs incurred by non-IPM farmers are 6.85% and 14.07% higher than IPM farmers, respectively, but the income of shallot farming is 26.66% higher than IPM, this shows that IPM farmers are lower in the use of production costs. The amount of income that will be obtained from a farming activity depends on several factors that influence it such as, land area, production level, identity of entrepreneurs, cropping, and efficient use of labor in carrying out farming activities, farmers hope to increase their income so that their daily needs can be met (Waluyo, 2020).

Table 1 – Path Coefficient

No	Connection	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T statistic (IO/STDEV)	P Values
1	X1 → Y1	0,841	0,888	0,072	10,821	0,000
2	X1 → Y2	0,844	0,839	0,091	10,483	0,000
3	X2 → Y1	0,848	0,847	0,049	17.248	0,000
4	X2 → Y2	0,966	0,873	0,096	10,681	0,000
5	X3 → Y1	0,818	0,856	0,059	11,115	0,000
6	X3 → Y2	0,862	0,850	0,095	8,657	0,003
7	Y1 → Y2	0,868	0,860	0,091	9,548	0,000

Source: Primary data processed (2024).

The results showed that the revenue and costs incurred by non-IPM farmers were 6.85% and 14.07% higher than IPM farmers, respectively, but the income of shallot farming was 26.66% higher than IPM, indicating that IPM farmers were lower in the use of production costs.

The results showed that internal factors affect production. This means that the better internal factors such as age, level of education, length of farming, land area and number of family dependents will further increase production. Highly educated farmers more quickly understand and understand the use of new technology, so that the higher the level of education of farmers, the more efficient he works. Educated farmers can be wiser in making decisions in their farming activities (Agatha & Wulandari, 2018). This is in line with the research results Dewantoro et al (2021) who also concluded that internal factors affect production.

The results showed that external factors affect production. Farmer groups have an inherent role for members who are members of it. One of the roles of farmer groups is as a learning class, including in the process of technology adoption in farming used to improve efficiency. The role of farmer groups is related to the mastery of cultivation technology by group members (Yani et al., 2010). According to (Wiradi, 2000) that land tenure will not be successful if it is not supported by supporting programs such as irrigation, credit, extension, education, marketing. The better the external factors such as extension assistance, farmer institutions, government policies, credit use and pesticide use, the more production will increase. This is in line with the research results Syaifullah et al (2014) who also concluded that external factors affect production.

Factors influencing farmers' decisions to adopt technology in the form of relative advantages (including higher economic benefits), suitability of technology to socio-cultural values, ways and habits of farming, the complexity of technology implementation, and farmers' perceptions of the influence of interpersonal media/information as communicative technology conveyors for farmers to increase production (Indraningsih, 2011). The process of adopting farmer innovations at the knowledge stage through field schools by extension workers, the persuasion stage of farmers evaluating from farmers who have implemented, the decision and confirmation stages are if the innovation is profitable after being applied by other farmers then the innovation is accepted (Warnaen et al., 2013)

The results showed that, in general, land is the only asset of farmers to obtain income, with the condition of the level of ownership and control of household land is relatively narrow and there is a tendency to increase the gap in land ownership, then one solution to increase farmers' income so that they prosper or at least out of the group of poor households is through improving the structure of ownership, control and use of land (Susilowati & Maulana,

2012), Internal factors affect income. This means that the better internal factors such as age, education level, length of farming, land area and number of family dependents will further increase income. This is in line with the results of research Primyastanto et al (2013) which concluded that internal factors affect income.

The results showed that external factors affect income. This means that the better external factors such as extension assistance, farmer institutions, government policies, the use of credit and the use of pesticides will further increase income. This is in line with the research results Putra & Sunarwijaya (2016) which also concluded that external factors affect income.

The results showed that the adoption of IPM technology affects income. This means that the better the adoption of IPM technology such as relative advantage, complexity, compatibility, triability and observability will further increase income. This is in line with the results of research Tirtosuprobo & Wahyuni (2016) The adoption of shallot cultivation technology has a real relationship to income, where farmers who have higher incomes will find it easier to accept and apply a new technology (Manongko et al., 2017).

The results showed that production has an effect on income. This means that the better production such as the number of seeds, the amount of subsidized fertilizer, the amount of non-subsidized fertilizer, the amount of manure and labor will further increase income. This is in line with the research results Sari et al (2023) which concluded that production has an effect on income.

The results showed that internal factors indirectly affect income through production. This is in line with the research results Irmeilyana et al (2021) which also concluded that internal factors affect income through production. The results showed that external factors indirectly affect income through production. This is in line with the research results Srimenganti (2023) which also concluded that external factors affect income through production. The results showed that IPM technology adoption indirectly affects income through production. This is in line with the results of the study Lubis & Siregar (2022) who also concluded that the adoption of IPM technology affects income through production.

CONCLUSION

Farmers' income in Mijen Sub-district by applying integrated pest management (IPM) is greater than those by not applying integrated pest management (non-HP).

Internal factors, external factors and IPM technology adoption have a positive and significant influence on production. Production variables are able to mediate the significant influence of internal factors, external factors and the adoption of IPM technology on farmers' income.

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