

## Priority Analysis of The Integrated Pest Management (IPM) Implementation on Vegetable Cropping in Bumiaji Subdistrict, Batu City, East Java

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### Abstract

Pest control in vegetable cropping by using chemical pesticides intensively can have a negative impact on human health and environmental health. The IPM approach was an innovation that farmers need to adapt to reduce the use of chemical pesticides. This study was conducted to formulate the priority strategy for implementing IPM in Bumiaji Subdistrict. Determination of priority strategies to implementing IPM uses the Expert Choice in processing data. The method used in this study is Analytical Hierarchy Process (AHP) with the criteria used are: (1) IPM Knowledge and Perception, (2) Human quality improvement, (3) Agriculture Extension and (4) Technologies availability. Based on the result of AHP, the most decisive criteria in implementing IPM in vegetable cropping in Bumiaji Subdistrict, criteria of human quality improvement, in turn, the sub-criteria of training and behavior are the two sub-criteria that are highly prioritized.

**Keywords:** Pesticides, IPM, AHP

### INTRODUCTION

The farmer's perception of the emergence of pest and disease disorders is one of the causes of crop failure. Most farmers consider inorganic pesticides to still be the most effective input for controlling plant pests and diseases, and plant pest organisms [1]. Vegetable farmers usually use pesticides as a preventive measure, spraying pesticides is done from 1-7 days after planting [2]. After that, the concentration of pesticides is increased, the frequency of spraying becomes more frequent in the event of a severe attack, and mixing several types of pesticides.

The high frequency of pesticide use and inappropriate application methods can have a negative impact on plants, farmers, the environment and the community as consumers of crop products. [3] suggested that the frequency of spraying and the high volume of pesticides used showed the importance of the role of pesticides in crop production so that the use of pesticides could not be avoided in planting vegetables. Continuous use of pesticides can

result in poisoning for farmers, accumulation of pesticide residues in the soil, pesticide residues in water, and plants sprayed on plants can be absorbed by plants and accumulated in leaves, stems and other parts of plants [4] [5] [6] [7] [8] [9] [10] [11] [12] [13].

Public awareness of the importance of healthy agricultural products is quite high. As the vision of the development of horticultural plant areas in East Java is "The realization of East Java as a center of horticultural plant agribusiness that is competitive and environmentally friendly". [14] said that environmentally sound cultivation, namely agricultural cultivation that pays attention to the nature, conditions, and preservation of the environment so that it can be utilized as well as possible, environmental deterioration can be avoided and can preserve the usefulness of natural resources and the environment. As consumers of agricultural products that are intelligent, they can understand the dangers of pesticides on their bodies. [15] suggested that the 2003 AFTA, 2015 AEC, APEC 2010 and GATT / WTO 2020 had been established to encourage the emergence of "green consumers" where consumers demand and require agricultural products that are environmentally sound and do not contain pollutants that endanger health [16] [17] [18] [19] [20] [21] [22].

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The concept of integrated pest control (IPM) is a concept developed by the government in order to reduce the use of pesticides in the agricultural sector. [23] concerning crop cultivation systems and [24] which has established a basic policy that plant protection is implemented through an integrated pest control system (IPM). According to the law, the IPM system uses pesticides as the last alternative [25]. The principle of IPM consists of healthy plant cultivation, utilization of natural enemies, periodic observations and farmers as IPM experts. IPM has a positive impact on the economy of farmers because it can reduce the use of chemical pesticides and indirectly increase farmers' knowledge and skills [26] [27] [28] [29] [30] [31] [32].

The IPM program in Indonesia is provided through counseling and training activities for the community, especially farmers. The development of the ecological-based IPM concept begins with the Integrated Pest Management Field School (IPM) program. The city of Batu is called the city of agriculture because of the topographic and climate conditions that support it as well as its main livelihood, namely in the agricultural sector. The area of Batu City is divided into three sub-districts, namely Batu, Junrejo and Bumiaji. Sumberbrantas and Tulungrejo Villages are villages in Bumiaji Subdistrict which implement pest and disease control strategies with the concept of IPM through IPM Field School activities on vegetable farming.

So far, farmers still use pesticides unwise and this behavior is considered an unimportant problem. Pollution of pesticide residues has an impact on human health and environmental health. In addition, Sumberbrantas and Tulungrejo villages are a number of villages in Bumiaji sub-district that have implemented a pest control strategy that implemented an IPM program in Batu City through extension activities such as the Integrated Pest Management Field School (IPMFS) on vegetable cropping. Based on the background above and there are not many publications for this problem, so this research needs to be done. Therefore, the main objective of this study was to formulate the priority strategy for implementing the IPM in Bumiaji Subdistrict.

## **MATERIAL AND METHOD**

This study uses quantitative methods. The object of this study is the application of Integrated Pest Management (IPM) carried out

by vegetable farmers. The research was located in Sumberbrantas Village and Tulungrejo Village, Bumiaji Subdistrict. The location is determined purposively according to the research objectives and based on the two villages are vegetable production areas.

### **Data Collection**

Data collected consists of primary and secondary data. Primary data was obtained from external parties through questionnaires and in-depth interviews. The determination of respondents was chosen by considering the knowledge capacity of the IPM in Vegetable cropping. The respondent consists of an agricultural extension agent. Secondary data was obtained from periodic reports or the annual Agricultural Extension Agency, journals and other literature related to research.

Data in this study were collected through questionnaires, observations and in-depth interviews. Questionnaires data collection was conducted on 2 respondents who were selected based on their task for guide farmers in each of the study locations as an agricultural extension agent from Agricultural Extension Agency, Batu City. The selection of the respondent was focused on experts who knew about IPM in vegetable cropping.

Data obtained from questionnaires and interviews, then analyzed using AHP to determine the alternative strategies to be carried out. [33] stated that in completing Analytical Hierarchy Process (AHP) there were several principles including identification of systems, structuring, making comparison comparisons in pairs, conducting the comparison and assessment stages. Processing data in this study using the Expert Choice program version 11.

According to [33], decision-making procedures in AHP include:

1. Define and determine the types of problems at the research location through literature studies and interviews.
2. Arrange a decision hierarchy from the top level (containing objectives), middle level consisting of the next element criteria and leads to policy strategies.
3. Create sets of pairs in matrices. The elements at the top level will be compared to the elements at the lower level.
4. Comparisons obtained will be used to consider priorities at the lower levels. Repeat the steps for each element to get the overall priority value.

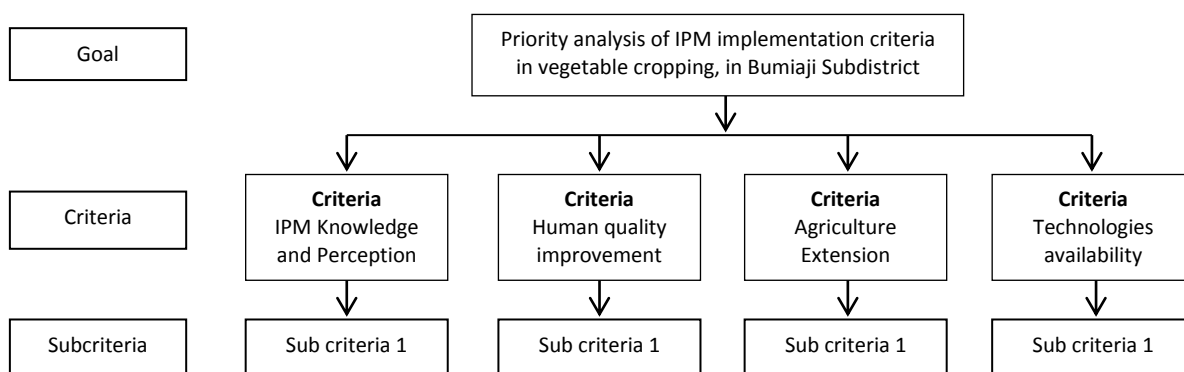


Figure 1. The AHP framework of Integrated Pest Management (IPM) on vegetable cropping, in Bumiaji Subdistrict

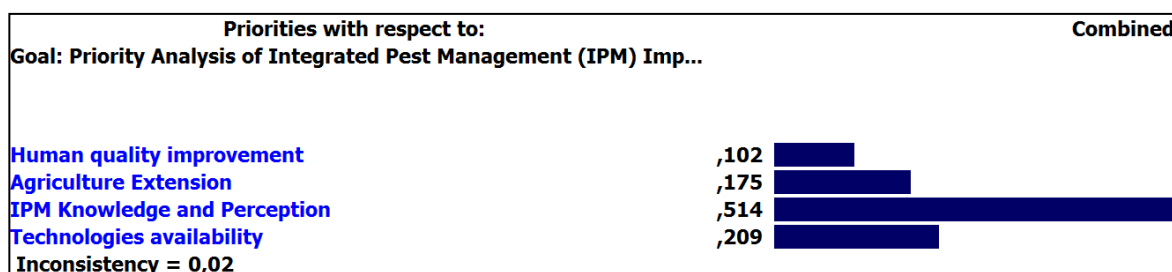


Figure 2. Weight value of the IPM implementation in Bumiaji Subdistrict with expert choices program. Source: Research data in 2019.

In this study the preparation of the hierarchy level used in the Analytical Hierarchy Process (AHP) method consists of 3 (three) levels, namely:

1. Level I (goal), was to determine the priority analysis of IPM implementation criteria in vegetable cropping, in Bumiaji Subdistrict.
2. Level II (Criteria) consists of several criteria in determining the priority of IPM implementation in vegetable cropping, in Bumiaji Subdistrict. These criteria were: IPM knowledge and perception criteria (A), Human quality improvement criteria (B), Agriculture extension criteria (C), Availability technologies criteria (D).
3. Level III (Development of Level II, called sub-criteria), Sub criteria serve Training, Behavior, IPM technologies, Materials, IPM Ecology, Methods, Knowledge, Media, Meetings and Perception of farmers. The AHP framework in this study can be seen in Figure 1.

## RESULTS AND DISCUSSION

### Priority Analysis in implementing Integrated Pest Management (IPM)

Based on the results of AHP analysis using Expert Choice, the criteria that determine the

handling of roads are the criteria for Human quality improvement with a value of 51.4%. This indicates that the criteria for Human quality improvement are crucial for implementing IPM in vegetable cropping. Human quality improvement is a factor that has the highest preference value in the strategy of IPM implementation among the five factors formulated above. In accordance with the policy in [23] concerning crop cultivation systems in chapter VII concerning guidance and participation of the community containing the government to carry out human resource development in the field of plant cultivation through education and training activities and encourage and foster the community to carry out these activities. Next is based on the Technologies availability, Agriculture Extension and IPM Knowledge and Perception with each value being 20.9%, 17.5%, and 10.2%. Weight of Criteria of the IPM Implementation in Bumiaji Subdistrict with AHP Analysis can be seen in Figure 2.

IPM Knowledge and Perception criteria occupy the fourth priority, this needs to be increased again, considering that farmers' knowledge and perceptions of IPM are

determined by farmer characteristics including age, education and farming experience. This extension aspect is needed to teach and understand the principles of IPM to farmers. The participation of farmers in IPM Field School can increase their knowledge in the application of IPM cultivation. The higher level of education affects the reasoning and thinking of the power of farmers to receive and examine existing information [34]. Factors to improve the quality of human resources are important factors that determine the success of IPM implementation. If IPM Knowledge and Perception is prioritized, Government Programs related to the implementation of Integrated Pest Management will be more successful.

Based on AHP results on all sub-criteria, the most prioritized sub-criteria are training with a value of 88.4%. The highest priority of the sub-criteria for Human quality improvement, it turns out, leads to improved quality of farmers through training. This is because, through training activities, farmers can increase their knowledge, skills, and creativity in managing their farming land in adopting IPM technology. Agricultural extension in vegetable cropping in Bumiaji Subdistrict also needs to be improved from aspects of farmer involvement and extension content.

The final value of the criteria hierarchy for the application of IPM in the Bumiaji Subdistrict can be seen in Figure 3.

The Indonesian government is obliged to provide information services that support crop cultivation, encourage and foster community participation in the provision of information services [23] concerning the Plant Cultivation System. The results of the study prove that agricultural technology information services by government institutions largely determine the success of crop farming carried out by farmers [35] [36]. There are weaknesses in crop protection in Indonesia, including inadequate crop protection technology, the number, and quality of implementing resources are still lacking in the ranks of government, private sector, and farmers, lack of supporting research, weak institutional coordination, and IPM policies not yet institutionalized among farmers.

The value of the criteria for implementing the IPM and its sub-criteria shows that there are priority scales from the highest to the lowest and obtained from the weighting by the expert team analyzed by AHP. After the weight value is obtained, it can be seen that the priority and highly prioritized value, so that the criteria and sub-criteria that have the lowest weight value must be increased again and get more attention so that the implementation of IPM can be applied and the use of pesticides and chemical fertilizers can be reduced.

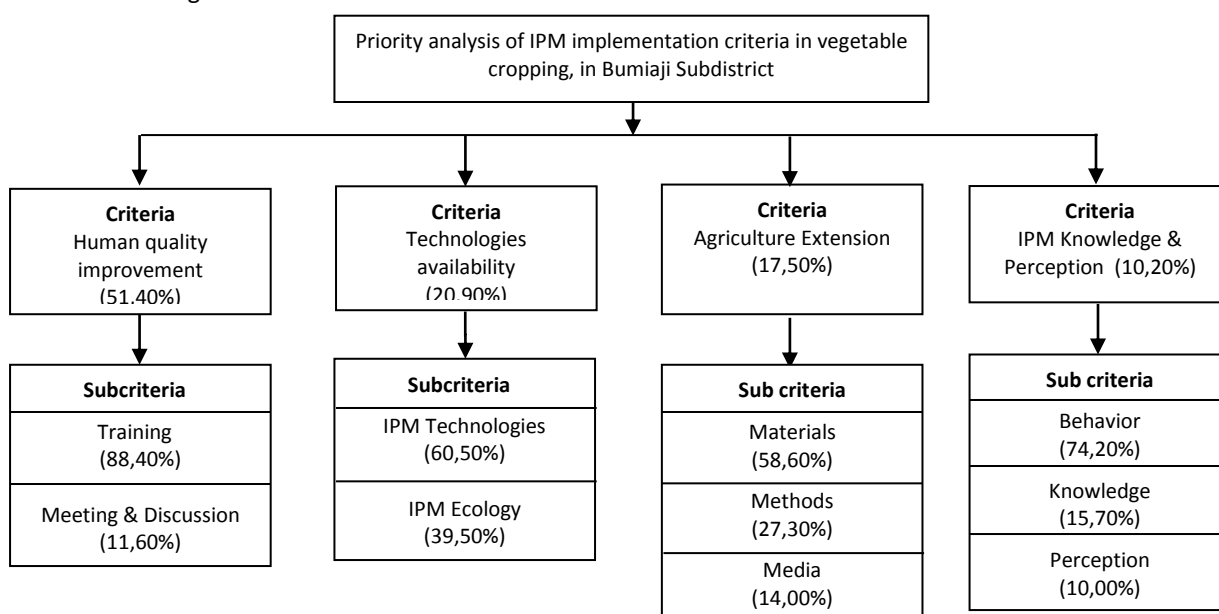


Figure 3. Weight of Criteria and Subcriteria of the IPM Implementation in Bumiaji Subdistrict.

Source: Research data in 2019.

Based on the results of the study, it was found that the need for coordination from agricultural extension officers with farmers because the value of the criteria and sub-criteria already mentioned can be applied well so that the implementation of IPM can be successful and sustainable so that human and environmental health can be felt by future generations.

Sub-criteria then are behaviors, IPM technologies, materials, IPM Ecology, Methods, Knowledge, Media, Meetings and Perception of farmers with each value being 74.2%, 60.5%, 58.6%, 39.5%, 27.3%, 15.7%, 11.6%, and 10.0%. Behavior is a second priority criterion in implementing IPM in vegetable cropping because farmers' behavior towards the application of IPM is still not implemented. This is because farmers' knowledge regarding the application of IPM is still low. So that it needs counseling content that is right on target and in accordance with environmental conditions. Meanwhile, farmers' perceptions have the lowest value, which means they need to be considered. From the results of the study, farmers' perceptions were very much determined by social and field conditions. Correct perception will lead to good behavior in implementing IPM. The sub-criteria priority sequence for all criteria found in the hierarchy of IPM implementation in the Bumiaji Subdistrict can be seen in Table 1.

Based on the analysis that has been done, the results show that to IPM implementation, the main factor that needs to be considered is improving the quality of human resources related to the training that will be provided. Training carried out with frequent time intensity and the Technologies availability and Agriculture Extension, farmers' IPM Knowledge & Perception is increasingly high.

**Table 1.** The priority analysis of IPM Implementation sub-criteria

Priority Analysis of Subcriteria in the IPM implementation	Final Weight (%)	Rank
Training	88,40	1
Behavior	74,20	2
IPM technologies	60,50	3
Materials	58,60	4
IPM ecology	39,50	5
Methods	27,30	6
Knowledge	15,70	7
Media	14,00	8
Meeting	11,60	9
Perception	10,00	10

**Source:** Research data in 2019.

Agricultural extension has an important role that determines changes in farmer's behavior in developing farming. In agricultural extension activities, extension agents guide and assist farmers directly to produce expected changes in knowledge, perceptions and behavior [37] [38] [39] [40] [41] [42] [43] [44].

## CONCLUSION

In addition, Integrated Pest Management (IPM) Implementation on vegetable cropping in Bumiaji Subdistrict has been implemented but in its implementation, it has not been optimal. Based on the AHP results, it was found that the most decisive criteria in the implementation of the IPM on vegetable cropping in the Bumiaji Subdistrict, namely the next Human quality improvement, technology availabilities, Agriculture Extension, and IPM Knowledge and Perception. There are 6 sub-criteria of the IPM implementation on vegetable cropping namely training, behaviors, IPM technologies, materials, IPM Ecology, methods, knowledge, media, meetings and perception of farmers.

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