Article

Horticultural Farmer Empowerment Strategy Based on Good Agricultural Practices (GAP): an Analytical Hierarchy Process (AHP) Approach

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Abstract
This research aims to develop a Horticultural Farmer Empowerment Strategy Based on Good Agricultural Practices (GAP): an Analytical Hierarchy Process (AHP) Approach. This research took place in Semarang Regency, precisely in Kopeng Village, Getasan Subdistrict, in accordance with the targets and objectives of the research. The research uses primary data and secondary data. Data collection methods in this research are observation, interviews, documentation, and questionnaires. Key persons in this research are academics, government, farmers, communities, community institutions, and business actors. The analytical method used in this research is the Analytical Hierarchy Process (AHP). The research result shows that the priority order of strategies that can be implemented are human resource development, government policy, and institutions. Meanwhile, the order of priority for alternative strategies is sustainable guidance and training for farmers and agribusiness actors in creating business innovations, promotional and marketing training using information and communication technology, and increasing the capacity of farmers and agribusiness actors in the use of tools, production based on renewable technology. The suggestion that can be given in this research is that implementing good agricultural practices requires strong commitment from stakeholders so there is a need for motivation and collaboration between farmers, government, and business actors. The implementation of good agricultural practices needs to be carried out with a consistent strategy so strict supervision is needed.

Keywords
Good Agricultural Practices (GAP), Analytical Hierarchy Process (AHP) Approach, Horticulture, Kopeng Village

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INTRODUCTION

Indonesia is an agricultural country that has abundant natural resources so it highly supports agricultural development. Agriculture is one of the sectors that absorbs the largest labor. Moreover, agriculture also contributes to providing export commodities for Indonesia. One of the areas that has abundant agricultural potential is Semarang Regency. The agricultural sector in Semarang Regency is mostly concentrated at the foot of Mount Merbabu and the foot of Mount Ungaran. Kopeng Village is a village that has abundant agricultural potential. Almost the majority of residents in this village depend on the agricultural sector for their livelihood. The agriculture that is widely developed in this village is the horticulture sub-sector in the form of vegetables and fruit. Horticulture is one of the export commodities that has a good market share in various countries (Leong et al., 2020; Oo & Usami, 2020). However, being able to penetrate the export market is not an easy thing. In the current era of globalization, many importing countries demand good quality and environmentally responsible agricultural products (Kilic et al., 2020; Alzeer et al., 2020). This is definitely a challenge for farmers in Indonesia considering that there are still many agricultural commodities that have not implemented eco-friendly agriculture.

The current agricultural system is still oriented towards productivity without regard for environmental sustainability. As a result, agricultural land is increasingly degraded due to erosion and excessive use of fertilizers and pesticides. In fact, this will be a time bomb for the agricultural sector in the long term (Ochieng et al., 2019; Senthilkumar et al., 2018; Ranjbar et al., 2021). If we want to be able to penetrate the international market, the agricultural sector must start improving to improve production quality and be responsible for the environment.

Domestic and global market demands for agricultural products currently not only lead to demands for visible product quality but also towards safety and nutrition as well as environmental responsibility. If excessive use of fertilizers and pesticides continues, it will be difficult to meet market demands. As a result, local agricultural products will be less competitive with agricultural products from abroad. Kopeng Village has a conventional farming system that is still relied on by farmers. This is because the need for chemical fertilizers and pesticides for horticultural crops is very high. To be able to improve the quality and quality of agriculture in Kopeng Village, appropriate efforts and strategies are needed. One of the efforts that can be implemented to face existing challenges is to implement Good Agricultural Practices (GAP). GAP is the answer to consumer demands. The character of this agricultural practice is the responsibility of food producers (farmers) towards (1) consumers (the products produced have good quality and safety, and the production method can be traced/there is traceability; (2) themselves (high productivity); (3) social (safety, security, and welfare of farm workers), (4) environment (wise use of pesticides, fertilizers, and agricultural business facilities) Singh & Baldi, 2018; Sennuga et al., 2020).

The implementation of GAP is considered highly appropriate for creating effective and efficient agriculture, responsible for consumers, farmers, and definitely the environment. The implementation of GAP is expected to help farmers to increase the income they earn. However, being able to implement GAP is not an easy thing because it requires strategies and efforts that are designed appropriately and consistently. The implementation of GAP also requires awareness among stakeholders regarding agricultural practices from upstream to downstream. So that in practice, the agricultural process can be closely monitored and can produce qualified products. Therefore, this research aims to develop a Horticultural Farmer Empowerment Strategy Based on Good Agricultural Practices (GAP): an Analytical Hierarchy Process (AHP) Approach

METHODS

This research took place in Semarang Regency, precisely in Kopeng Village, Ge-

tasan Subdistrict, in accordance with the targets and objectives of the research. The secondary and primary data were used in this research. Primary data are obtained through data collection using a structured questionnaire, while secondary data are obtained from publications from government agencies or the results of previous research. The deepening of the problem is carried out through Focus Group Discussions (FGD).

We used questionnaires, observation, interviews, and documentation to collect the data. The questionnaire in this research is used to analyze supporting factor elements in implementing GAP. The questionnaire contains a list of closed questions and is addressed to key persons who have been determined based on the sample in the research.

The key persons who are given questionnaires and interviews in this research are as follows: Development Planning Agency at Sub-National Level of Semarang Regency; Department of Agriculture of Semarang Regency; Department of Environment of Semarang Regency; Non-Governmental Organization (NGO); Agricultural academic; Environmental Activists in Semarang Regency; Farmer Groups of Semarang Regency; Agricultural Cooperative; Village-Owned Enterprises; Local Village Apparatus; Farmers

We used Analytical Hierarchy Process (AHP) as the analytical method. AHP is well-known as comprehensive decision-making which consider the qualitative and quantitative methods. AHP generated priorities and goals from various options based on some criteria with comparisons in each element. The comparison is formed as matrix. The matrix was filled by choosing the numbers that describe the relative importance of one element above the others. The scale is from one to nine. Through the AHP, some strategies will be produced to empower agribusiness-based farmers using the Good Agricultural Practices (GAP) approach.

Basically, the mathematical formulation of the AHP model is done using a matrix. This is explained as an example of operational elements A1, A2, A3,.....,An contained in an operating subsystem, the result of the comparison will form a comparison matrix. This comparison will start from the highest hierarchy which is then used as the basis for comparison. The matrix is marked with the symbol A and its form is as follows:

$$A = [a_{ij}] = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{bmatrix} = \begin{bmatrix} 1 & a_{12} & \cdots & a_{1n} \\ \frac{1}{a_{12}} & 1 & \cdots & a_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ \frac{1}{a_{1n}} & \frac{1}{a_{2n}} & \cdots & 1 \end{bmatrix}$$

The respective value in matrix A (aij) refers to the extent (how much) element xi is preferred over xj with respect to a particular feature (criterion, objective, etc.) which is a higher-ranked item (featured item). The matrix for the element aij gets the value x so that for the element aij (its opposite) it gets the value 1/x so that it is reciprocal.

The first thing done in the AHP analysis is the normalization process, namely the row operation by dividing the value of the matrix aij by the total value of the matrix in one column (n) and the column operation to

Table 1. Pairwise Comparison Scale

Score	Information
1	Both factors are equal
3	One factor is more important than the others
5	One factor is essential than other factors
7	One factor is most important than other factors
9	One factor is absolutely more important than the other factors
2,4,6,8	Intermediate values, between two adjacent consideration values

Source : Saaty in Prajanti, 2013

get the weighting value (wi).

$$w_i = \sum_{i=1}^{n} a_{ij}/n$$

Wi : weighting value; aij/n: row normalization matrix.

The second way is to calculate the eigen value (λ) and eigen value maximum (λ_{max}).

$$\lambda_i = \sum_{i=1}^{n} a_{ij}/w_i$$

$$\lambda_{max} = \sum_{i=1}^{n} (a_{ij}/w_i)/n$$

The next step is to test its consistency using the consistency index (CI).

$$CI = \frac{(\lambda_{max} - n)}{(n-1)}$$

λ_{max} : eigen value maximum; n : the number of matrix.

The last thing is to Calculating the Consistency Ratio (CR). Saaty (2008) sets the CR value ≤ 10% for acceptable consistency data standards and if CR >10% then the data is inconsistent so that data collection is repeated for pairwise comparison and priority ranking is based on the highest weighted score. The formula used is:

$$CR = \frac{CI}{RI}$$

CR : Consistency Ratio; CI : Consistency Index; RI : Random Consistency Index

In determining priority strategies, the following steps are required in the Analytical Hierarchy Process (AHP) method:

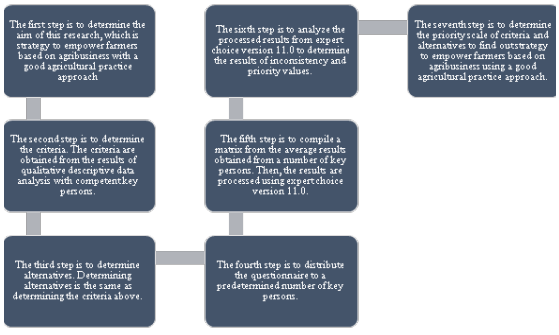


Figure 1. AHP Analysis Steps

The AHP model used in this research is explained in the chart below:

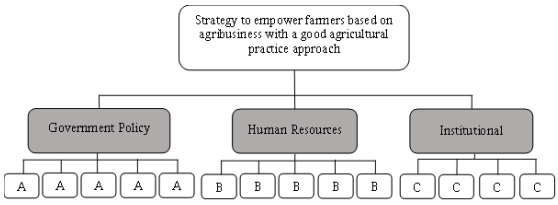


Figure 2. AHP Hierarchy Framework

Information:

Government Policy

Government policy in this case is a policy decision formulated by the local regional government to provide an agribusiness-based farmer empowerment strategy with a Good Agricultural Practice (GAP) approach. In this aspect, there are five alternatives including:

A1: Providing capital needs for integrated and sustainable agricultural businesses with alternative financing models and soft interest

A2: Providing information, promotion, and market guarantees for farmers and agribusiness actors

A3: Providing assistance with vital production equipment

A4: Providing easy access to information and communication technology to farmers and agribusiness actors

A5: Provision of supporting infrastructure for integrated and sustainable agricultural development

Human Resources

Human resources in this case are focused on the human resources of farmers and agribusiness actors. In this aspect, there are five alternatives, including the following:

B1: Providing motivation to farmers and agribusiness actors to improve abilities and skills in running a business

B2: Increasing managerial abilities and business management

B3: Continuous guidance and training for farmers and agribusiness actors in creating business innovation

B4: Increasing the capacity of farmers and agribusiness actors in using production

tools based on renewable technology
B5: Promotion and marketing training using information and communication technology

Institutional

Institutions in this case are focused on accompanying institutions, groups, and cooperatives for farmers and agribusiness actors. In this aspect, there are four alternatives, including the following:
C1: Increasing the capacity and quality of specific agribusiness assistance institutions
C2:Establishment of an organization/community forum to establish cooperation between farmers and agribusiness actors
C3: Management training for cooperatives and organizations of farmer and agribusiness actors
C4: Increasing business partnerships between local agricultural cooperatives and entrepreneurs/investors

Research Stages

This research is carried out through several stages in preparing an agribusiness-based farmer empowerment model using the Good Agricultural Practice (GAP) approach. The stages in carrying out this research are as follows:

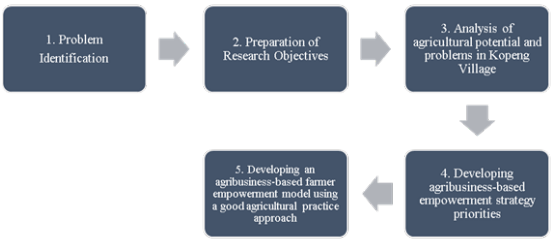


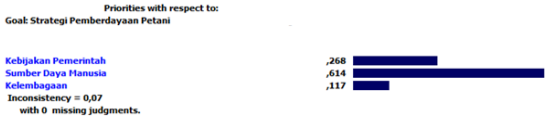
Figure 3. Research Stages

The final research objective of this research is to empower farmers based on agribusiness with a good agricultural practice approach.

RESULTS AND DISCUSSION

The analytical tool we used in this research, AHP, is used to develop strategic priorities of agribusiness-based farmer empowerment using a Good Agricultural Practice (GAP) approach. The key persons involved in this research consist of Department of Agriculture of Semarang Regency, Agricultural Extension Officers, Academics, Farmer Groups, Agribusiness Actors, and Village Officials. The following are presented the results *:*

Based on the calculation, the following result is obtained:



Source: Processed Primary Data, 2021
Figure 4. AHP output of Strategy to empower farmers based on agribusiness with a good agricultural practice approach.

Based on Figure 4, it can be seen that human resource development is the most prioritized criteria which Kopeng Village needs to concern. Human resource development has the highest value at the weight of 0.614. Government policy is the second priority and the last criteria that needs to concern is institutions with each weight value are 0.268 and 0.117. The value of inconsistency in this result is 0.07 which means lower than 0.10 that the answers are consistent.

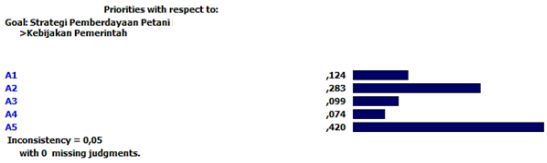
The results of human resource development criteria is obtained:

Source: Processed Primary Data, 2021
Figure 5. AHP Output of Human Resource Development Criteria

Information:
B1: Providing motivation to farmers and agribusiness actors to improve abilities and skills in running a business
B2: Increasing managerial abilities and business management
B3: Continuous development and training for farmers and agribusiness actors in creating business innovation
B4: Increasing the capacity of farmers and agribusiness actors in using production

tools based on renewable technology

Based on the calculation of government policy criteria is obtained :

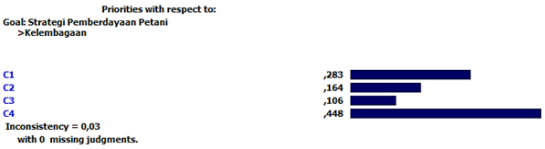


Source: Processed Primary Data, 2021
Figure 6. AHP Output of Government Policy Criteria

Information:
A1: Providing capital needs for integrated and sustainable agricultural businesses with alternative financing models and soft interest
A2: Providing information, promotion, and market guarantees for agribusiness farmers and players
A3: Providing assistance with vital production equipment
A4: Providing easy access to information and communication technology to farmers and agribusiness actors
A5: Provision of supporting infrastructure for integrated and sustainable agricultural development

According to Figure 6, the top priority under government policy is the development of infrastructure to support integrated and sustainable agriculture, with a weight value of 0.420. The second priority focuses on providing information, promotion, and market guarantees for farmers and agribusiness participants, assigned a weight of 0.283. The least prioritized alternative is ensuring easy access to information and communication technology for farmers and agribusiness actors, with a weight value of 0.074. The Analytical Hierarchy Process (AHP) analysis yielded an inconsistency ratio of 0.05, which is below the acceptable threshold of 0.10, indicating that the responses from key participants were consistent.

Based on the calculation from the analytical hierarchy process of institutional criteria, the following result is obtained:

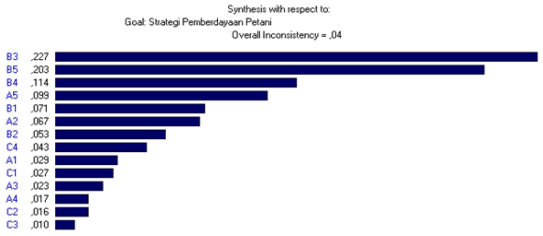


Source: Processed Primary Data, 2021
Figure 7. AHP Output of Institutional Criteria

Information:
C1: Increasing the capacity and quality of specific agribusiness assistance institutions
C2:Establishment of an organization/community forum to establish cooperation between farmers and agribusiness actors
C3: Management training for cooperatives and organizations of farmer and agribusiness actors
C4: Increasing business partnerships between local agricultural cooperatives and entrepreneurs/investors

Increasing business partnerships between local agricultural cooperatives and entrepreneurs/investors is a major policy priority that can be carried out on the Institutional criteria. This can be seen from the weight value of the AHP analysis results of 0.448 on the alternative. This alternative is followed by increasing the capacity and quality of specific agribusiness assistance institutions on the second priority policy that can be carried out, the weight value is 0.283. while the last alternative priority that can be carried out on the institutional criteria is training in the management of cooperatives and farmer organizations and agribusiness actors with a weight value of 0.106. The calculation of the institutional criteria has an inconsistency ratio value of 0.03, which means that the respondents' answers are consistent.

Based on the calculation from the analytical hierarchy process of all alternatives of strategies to empower farmers based on agribusiness using a good agricultural practice approach, the following result is obtained:



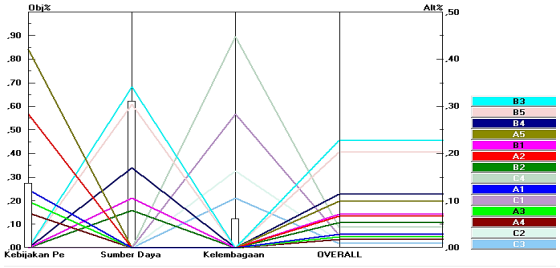
Source: Processed Primary Data, 2021

Figure 8. AHP Output of Overall Policy Alternatives

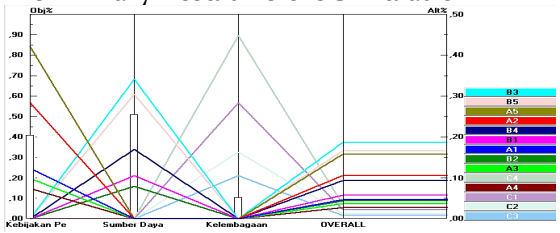
Based on the calculation result from the Analytical Hierarchy Process (AHP) in Figure 8, it shows that the most prioritized alternative in the strategy to empower farmers based on agribusiness with a good agricultural practice approach is continuous development and training for farmers and agribusiness actors in creating business innovation with a weight value of 0.227. The second priority alternative is promotion and marketing training using information and communication technology with a weight of 0.203. Meanwhile, the final priority alternative is training in the management of cooperatives and organizations of farmers and agribusiness actors with a weight value of 0.010. From the calculation result of the Analytical Hierarchy Process (AHP), the inconsistency ratio is 0.04 < 0.10, which means that the answers given by the key persons are consistent.

The next step is sensitivity analysis, the purpose of which is to check whether the alternative priorities in this study are stable. The method is to simulate variations in these alternatives. This analysis involves alternative criteria and sub-criteria. This analysis concerns stability if there is a change in input to the final results in the field of assessment and priority. This analysis also examines the changes whether they will change the alternatives. From the sensitivity analysis, the following results were obtained. (Figure 9)

Based on Figure 9, it can be seen that the initial result in the AHP calculation for the strategy to empower farmers based on agribusiness using the good agricultural practice approach shows that the most prioritized policy alternative is continuous development and training for farmers and agribusiness actors in creating business innovations as seen in Figure A. Then, after simulating by increasing government policy input from 0.268 or 26.8% to 40%, the prioritized policy alternative remains the same as seen in Figure B. This result shows that the assessment is stable.



Preliminary Result Before Simulation



Final Result After Simulation

Source: Data Processed, 2021

Figure 9. Sensitivity Analysis Results

Discussion

Based on the result of the AHP analysis, priority strategies have been obtained to empower farmers in Kopeng Village using the GAP approach. The application of GAP in the horticultural sub-sector is considered appropriate considering that the horticultural farming system is very vulnerable to land degradation due to excessive use of chemical fertilizers and pesticides and soil erosion which often occurs due to horticultural planting cycles which tend to be short (Sharma et al., 2019; Ng, 2017; Kurtaslan, 2021). The horticultural crops that are widely developed in Kopeng Village are cabbage, broccoli, mustard greens, carrots, potatoes, spring onions, and others.

The strategy of farmer empowerment using the GAP approach can start with improving the quality of existing human resources. The majority of farmers in Kopeng Village are currently elderly and have

a low educational background. In terms of competency, they may indeed be experts in the horticultural agricultural cultivation process but the competencies they have still tend to be conventional so it is needed to provide assistance regarding the importance of developing cultivation competencies that are more eco-friendly. Farmers also need to be given training on agribusiness so that they are not always manipulated by middlemen. The farmer empowerment strategy requires training for farmers that is consistent and in accordance with existing needs in the field (Nur et al., 2020; Paumgartten, 2021).

Efforts to create qualified and environmentally responsible agriculture certainly require innovation and the application of appropriate technology. There is a need for assistance with agricultural machinery, especially in the cultivation section, so that farmers can carry out cultivation more efficiently. There is also a need for innovation, especially organic fertilizer and pesticide innovation to be more eco-friendly. Research conducted by Hadi et al., (2021) explains that a sustainable farmer empowerment strategy needs to prioritize innovation aspects, especially innovation in making organic fertilizers and pesticides. Furthermore, farmers' abilities in using information and communication technology also need to be improved. Along with technological developments, currently the digital market has spread widely in society, so there is a need for innovation and digital marketing of agricultural products (Smulders et al., 2021; Dubey et al., 2021).

The second aspect that needs to be considered is the need for government contribution to formulate pro-agriculture policies using the GAP system. The first policy that can be implemented is the need to provide supporting infrastructure for the implementation of GAP. The infrastructure intended can include cultivation technology infrastructure and agribusiness sub-terminals. Government intervention plays an important role in designing policies that encourage the adoption of efficient and environmentally friendly agricultural technology, as well as developing agribusiness subterminals that support the agricultural supply chain, from upstream to downstream. Agribusiness subterminals that function as local distribution centers, places for collecting, storing, and processing agricultural products, can improve logistics efficiency, reduce agricultural waste, and accelerate distribution to the market. Government intervention in this case includes the allocation of funds for agricultural technology research and development, providing incentives for agribusiness entrepreneurs who invest in new technologies, and the construction and improvement of transportation infrastructure and subterminal facilities to facilitate the distribution of agricultural products. Evaluation of these policies can identify the extent to which government policies have been effective in increasing agricultural productivity, reducing distribution costs, and improving the welfare of farmers and agribusiness actors. With the right policies, the government can encourage the agricultural sector to become more modern, efficient, and sustainable.

Moreover, the second policy is the need to provide information and communication facilities for promotion and marketing support. In this case, the most urgent thing is to facilitate the processing of eco-friendly product certification. A sustainable farmer empowerment strategy must prioritize aspects of easy access to information and communication technology to support promotion and marketing (Mulyaningsih et al., 2021; Bedano et al., 2016; Wongprawmas et al., 2015). Farmers also need capital assistance to carry out agricultural cultivation. Apart from direct assistance, the policy that can be implemented is assistance in easy access to financing with low interest so that it does not burden farmers.

The next aspect that needs to be considered is institutional. Agricultural businesses certainly involve various stakeholders. These stakeholders must definitely be able to play their roles effectively and efficiently. The problem is institutions at the farmer level, in this case farmer groups, still need optimal assistance, especially in implementing GAP which is relatively new. There is a need

to strengthen partnerships between farmer groups and various related stakeholders, both production input providers and marketing stakeholders.

The concept of economic sociology in the application of GAP analysis in horticultural agriculture can be seen from the formation of Gapoktan. Gapoktan is a collection of several farmer groups that have the same interests in developing certain agricultural commodities to raise common interests, or constitute a larger business. Gapoktan formed in each village must also use a local social capital base with the principle of local independence achieved through the principles of economy and empowerment. Gapoktan becomes a gateway institution that connects farmers in one village with other institutions outside it. Gapoktan is expected to play a role in fulfilling agricultural capital, fulfilling production facilities, marketing agricultural products, and including providing various information needed by farmers.

An analytical study on the contribution of institutions in formulating pro-agricultural policies using the GAP system highlights the role of various institutions in creating policies that support agricultural sustainability through environmentally friendly and efficient practices. The government, through the Ministry of Agriculture and Standardization Agency, plays a role in formulating GAP regulations and standards that must be adhered to by farmers to improve the quality and competitiveness of agricultural products. Research and development institutions also play an important role in providing technology and innovation that supports the implementation of GAP, such as more environmentally friendly and efficient cultivation techniques. In addition, financial institutions contribute by providing easy access to financing for farmers who want to adopt GAP technology, while the private sector and non-governmental organizations (NGOs) assist in extension and technical assistance. Strong coordination between these institutions is essential to ensure that GAP policies can be successfully implemented in the field, given the challenges faced by farmers in accessing technology and markets. With the joint contribution of these institutions, GAP policies can create more sustainable agriculture, increase productivity, and expand market access for products that meet sustainability standards.

CONCLUSION

Based on the results and discussions that have been described, it can be concluded that Kopeng Village, as one of the villages that has agricultural potential in the horticulture sub-sector, requires efforts to empower farmers considering that the welfare of existing farmers is still low. Agriculture which tends to be conventional and threatens natural sustainability needs to be addressed by implementing good agricultural practices so that it can have good quality and be environmentally responsible so that it can compete in domestic and global markets. To implement GAP, appropriate strategic priorities need to be developed. The priority order of strategies that can be implemented is human resource development, government policy, and institutional. Meanwhile, the priority order of alternative strategies includes continuous guidance and training for farmers and agribusiness actors in creating business innovations, promotional and marketing training using information and communication technology, and increasing the capacity of farmers and agribusiness actors in the use of production tools, based on renewable technology.

The suggestion that can be given in this research is that implementing good agricultural practices requires strong commitment from stakeholders so there is a need for motivation and collaboration between farmers, government, and business actors. The implementation of good agricultural practices needs to be carried out with a consistent strategy so strict supervision is needed. For further research, we can carry out a more detailed strategy analysis by paying attention to upstream and downstream aspects.

In developed countries such as the Netherlands or Japan, this commitment

is usually more structured and organized through clear policies and financial support from the government, which encourages effective collaboration between farmers, the government, and the private sector. The government provides supportive regulations, training, and financial incentives, while the private sector plays a role in providing technology and infrastructure that support GAP practices.

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