# Pineapple peel industry determination with weighted location method

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**Abstract**. This study discusses alternative fuels to replace gasoline with bioethanol. Bioethanol can be produced including pineapple, where the peel can be used to be converted into bioethanol instead of gasoline. The use of pineapple peel for small-scale production in this study was the main focus, so that the community would get benefit from the economic value. The community to use pineapple peel is the main concern, to get information about the capacity of an area. Measurement of capacity is carried out by taking into account transportation, raw material, land, energy, labour, waste, and market factors. The assessment was carried out on five zones of pineapple farming using analytical hierarchy process (AHP). Each area is determined by its coordinates, then multiplied by the weight of each region produced. The calculation results show that the determination of area was chosen to be a small-scale bioethanol production area concerning with dependent on the policy, raw materials, and transportation factor, it show that policy factor must be exist to support the operation of bioethanol industry with pineapple peels material.

## 1. Introduction

Pineapple (*ananas comosus*) is a tropical plant which has the potential to produce bioethanol [1]. Bioethanol organic compound is one ingredient that can be used to reduce the use or replace gasoline. Indonesia is one of the second largest pineapple producers in the world, which has an area of around 18 million hectares, spread over twelve provinces [2]. The use of pineapple is more for the consumption of flesh of fruit used for candied, jams, desserts or traditional light snack as called *dodol* [2]. The forgotten condition after the utilization of pineapple is the accumulation of pineapple peels, which left to rot in the environment that causing pollution and pollution to the environment, if not quickly treated. In order to deal with environmental pollution caused by pineapple peels, it is necessary to find a way out without leaving the problem of pollution and environmental pollution besides, being able to provide welfare to the people who live around pineapple plantations, one of which is utilizing pineapple peels waste converted into bioethanol.

The use of pineapple peels is inseparable from the strategy of obtaining a sustainable supply of pineapple peels raw materials to the bioethanol industry, as well as distribution to gasoline filling stations. This phenomenon is related to the determination of the location of the bioethanol industry which should be placed near a pineapple plantation, taking into account aspects of transportation and improving the quality of life of the community [3]. In this study the determination of the location of the bioethanol industry is focused on focusing on the factors that are capable of, improving the welfare

of the community around pineapple plantations as we called as economic factors, as well as efforts to preserve the environment from the dangers of pollution and environmental pollution caused by spoilage of pineapple peels waste as we called environmental factors [4].

Economic factors that were considered in this study consisted of five sub factors, namely transportation [5-7], raw materials [8,9], land [7,9,10], energy [11,12], and workers [4,9-11,13]. The availability of transportation in the form of sending raw materials and production results to consumers becomes a component to determine the location of the bioethanol industry, as well as providing a guarantee of continuous supply to maintain, bioethanol availability to consumers [6]. The availability of pineapple peels raw material, which is an important commodity for the ongoing operation of the bioethanol industry, is especially important to note the commitment of industry owners who use pineapple and pineapple plantations to maintain a stable, uninterrupted supply chain [9]. Land is an important component that is used as a reference for the scale of production, so maintaining the availability of land so that pineapple production can be maintained from time to time is a major concern in this study [7,10]. Energy is a component that is needed to drive the bioethanol-producing industry, so the supply chain is needed to be maintained, by finding alternatives to the use of industrial technology that can use bioethanol as a source of energy to drive the industry [11,12]. The last economic factor is the availability of workers, where it is important to raise awareness to utilize pineapple peels waste as something that can, improve their lives, and maintain a healthy and clean environment in a sustainable manner [9-11,13].

Environmental factors considered in this study are the level of public understanding of the dangers of environmental quality degradation [13], caused by pineapple peels waste left to rot in the environment they live in, as well as efforts that have been made to overcome the dangers posed by pollution [7,14], namely changing pineapple peels into bioethanol . The second thing to note is an understanding of the importance of a government policy that fully supports the operation of small-scale bioethanol run by the community [7,10,13,15]. Noting the phenomenon that arises in the area of society and pineapple plantations, this study aims to obtain the location of the bioethanol processing centre from the basic ingredients of pineapple peels, which is sought by the community on a small scale.

## 2. Method

In this study five pineapple plantation areas located in Indonesia, precisely in West Java Province, Subang Regency. We took five pineapple-producing plantations as observations. The five regions were assessed by five economic factors for five sub-factors, and environmental factors for two sub-factors. Determination of the weight of the five regions, by referring to seven factors, is a characteristic of making decisions influenced by multi criteria or called multi criteria decision making (MCDM), in which in this study a model called analytical hierarchy process (AHP) [16,17] was used. After obtaining weights, the x and y axis coordinates were determined from each region, pineapple plantations were observed, then the location was assigned to be a suitable location for the bioethanol industry with a two dimensional scaling method location determination model [18].

Previous research in the field of AHP which is based on transportation factors that is in line with the research of, discusses the supply of raw materials from suppliers to producers [5-7,11], as well as strategies for forming a logistics distribution chain from consumers, and supported by current research [18,19], contributed consideration of the selection of the importance of transportation aspects in determining the location of the industry. Research that focuses on the availability of raw materials, is more focused on efforts to determine the location with a commitment to be able to provide pineapple peels raw materials on an ongoing basis, in line with [8,9] research that focuses on the location of storing raw materials to support the process of an industry, while [18-20] which contributes to an efficient site selection approach based on the availability of raw materials. Research in the field of land is more specialized in the presence of landowners' commitments [9,10], in order to ensure the availability of land for pineapple plantations does not experience shrinkage, which causes pineapple production to decrease over time [7]. Research on the energy factor that is in the spotlight is, getting

cheap and efficient fuels [11] to drive industrial operations on an ongoing basis [12], so that a consistent supply of bioethanol to consumers is obtained. The development of research on determining worker factors is directed towards the development of the nature, knowledge [9,11] and skills [10,13] of utilizing waste to be converted into renewable energy, which is able to guarantee the quality of life of the community.

Research on environmental factors is more directed at preventing the emergence of hazards caused by the accumulation of waste [4,13], as well as finding solutions to utilize waste to improve the quality of life [4,14,19], for people who live around plantations. These conditions need to be supported by the existence of research that observes the existence of policies that provide strong support for, the operation of an industry that is undertaken by the community [4,13,15], by utilizing waste as the main raw material to produce energy.

With regard to the achievement of the objectives of the study, namely obtaining the location of the bioethanol industry in a pineapple plantation zone, this research will utilize the collaboration of two models, namely AHP and the two dimensional scaling location determination model. The operation stages of the two models are explained as follows:

### *2.1. Step 1*
Distributing questionnaires to pineapple peels bioethanol stakeholders who are around the plantations, namely: the community, plantation workers, garden owners, industrial owners who use pineapple, and the government. Questionnaires were distributed in five areas in the pineapple plantation zone, with 40 respondents in each plantation area.

### *2.2. Step 2*
Processing the results of the questionnaire by using AHP [7,16] using expert choice software version 11.0, so we get the weight of each pineapple plantation area.

### *2.3. Step 3*
Processing weights with the coordinates of each area in the pineapple plantation zone, with a location model for determining two-dimensional scaling using the POM-QM software version 4.0 [21].

### *2.4. Step 4*
Analysing results.

## 3. Result and discussion
The first step before implementing the questionnaire is to form a hierarchy diagram to get the weight of the pineapple plantation area that has the pineapple utilization industry. In this study conducted on a zone, which has five pineapple plantation areas called Area A, B, C, D, and E. The five areas are assessed by five two factors, namely the economy which has five sub factors consisting of transportation, raw materials, land, energy and workers. While environmental factors include pollution sub factors and policies. Next, a hierarchical diagram is drawn showing the relationship of influence between sub factors on each area, as shown in Figure 1.

The next step is to test the hierarchy diagram with data obtained from respondents, with the AHP model with the stages of making a matrix between sub factors as shown in Figure 2, as well as the relationships between areas within the sub factors as shown in Figure 3. The data in this paper are not all displayed in part only, in order to provide an opportunity for a more comprehensive explanation of the results to be achieved, namely the determination of location.

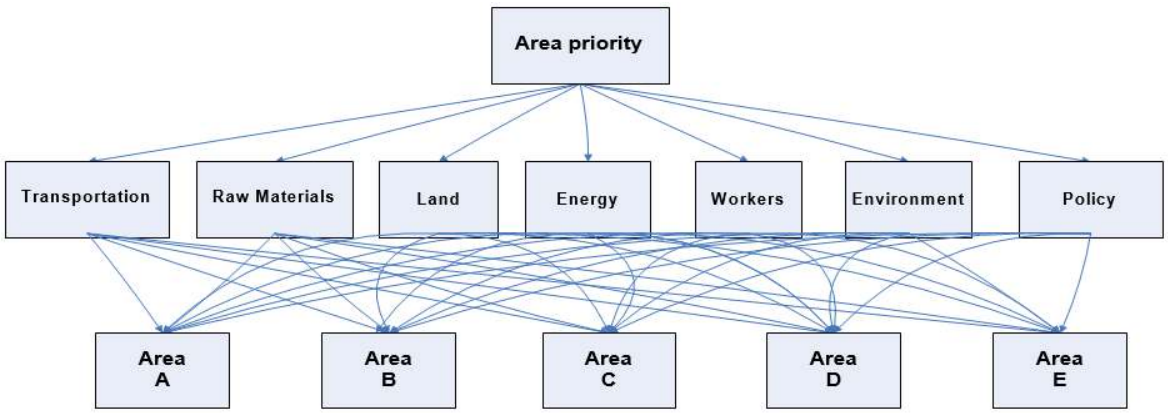


**Figure 1.** Hierarchy diagram.

After obtaining a hierarchy diagram, the next step is to enter the hierarchy and data from respondents to be tested on the AHP model with expert choice software version 11.0. Data for AHP is shown in Figure 2 for Goal priority preferences, while comparison preferences between areas are presented in Figure 2. In this paper, data comparison between areas is not displayed at all just for transportation sub factor only, in order to provide a comprehensive discussion room for results.

| | Transportation | Raw Materials | Land | Energy | Workers | Pollution | Policy |
|---|---|---|---|---|---|---|---|
| Transportation | | 1,0 | 7,0 | 3,0 | 2,0 | 3,0 | 2,0 |
| Raw Materials | | | 7,0 | 3,0 | 4,0 | 3,0 | 2,0 |
| Land | | | | 2,0 | 2,0 | 2,0 | 7,0 |
| Energy | | | | | 2,0 | 2,0 | 7,0 |
| Workers | | | | | | 3,0 | 5,0 |
| Pollution | | | | | | | 8,0 |
| Policy | Incon: 0,06 | | | | | | |

**Figure 2**. Global priority comparison for priority industry.

| | A | B | C | D | E |
|---|---|---|---|---|---|
| A | | 2,0 | 2,0 | 3,0 | 7,0 |
| B | | | 2,0 | 2,0 | 4,0 |
| C | | | | 5,0 | 6,0 |
| D | | | | | 2,0 |
| E | Incon: 0,02 | | | | |

**Figure 3**. Comparison preference matrix for transportation.

The results of processing by expert choice show (Figure 4) that, area C selected has the greatest weight, 30.2%, followed by B (25.5%), A (18.1%), D (16.1%), and E (10, 1%). the selection of area C with the highest weight is influenced by policy (37.3%), raw materials (20.1%), and transportation (18.1%). This phenomenon shows that according to stake holders the selection of areas for the bioethanol industry is more determined, by the availability of government policies, which support the operation of the bioethanol industry by using environmentally-based pineapple peels, where the policy provides comfort and comfort in doing business. Another dominant factor is the availability of raw materials supplied from industrial owners, pineapple users through a commitment that guarantees a sustainable supply. It is also important that stakeholders look for good transportation facilities, to ensure the distribution of products from producers is guaranteed to consumers.

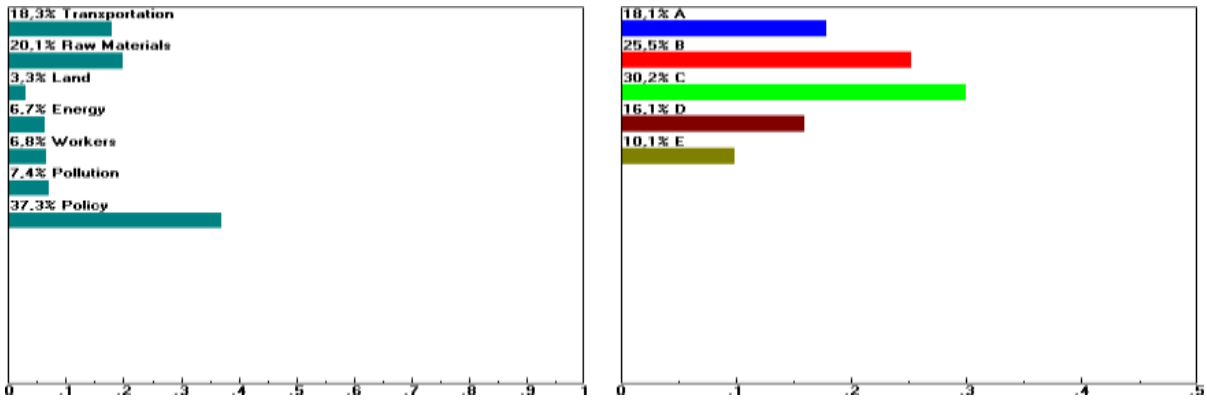


**Figure 4**. Result of AHP.

The next step is to enter the AHP results into the location determination model with two dimensional scaling, by first determining the coordinates of each region as shown in Figure 5. Then it is processed using POM-QM software version 4.0, the results of which can be seen in Figure 6.

| | Weight/# trips | x-coord | y-coord |
|---|---|---|---|
| A | 18,1 | 132 | 123 |
| B | 25,5 | 226 | 622 |
| C | 30,2 | 140 | 41 |
| D | 16,1 | 99 | 75 |
| E | 10,1 | 321 | 33 |

**Figure 5**. Data Weight and coordinate for location.

Location Results

(untitled) Solution

| | Weight/# trips | x-coord | y-coord | X multiplied | Y multiplied |
|---|---|---|---|---|---|
| A | 18,1 | 132 | 123 | 2389,2 | 2226,3 |
| B | 25,5 | 226 | 622 | 5763 | 15861 |
| C | 30,2 | 140 | 41 | 4228 | 1238,2 |
| D | 16,1 | 99 | 75 | 1593,9 | 1207,5 |
| E | 10,1 | 321 | 33 | 3242,1 | 333,3 |
| Total | 100 | 918 | 894 | 17216,2 | 20866,3 |
| Average | | 183,6 | 178,8 | | |
| Weighted Ave (COG) | | | | 172,16 | 208,66 |
| Median | 50 | | | 140 | 75 |

**Figure 6**. Result for location assigned.

Noting the results shown in Figure 6, it appears that the location of the bioethanol industry with pineapple peels base material, located at coordinates x = 172.16 and y = 208.66, which is located close to area C. Laying the bioethanol industry in area C is in accordance with the aphasias conditions the provision of relatively large raw materials, and adequate transportation infrastructure at these locations.

## 4. Conclusion

In this research, the stakeholders in the pineapple-producing regions emphasized the availability of policies that guarantee security and peace in the business and operation of the pineapple-based bioethanol industry. Another dominant factor is the availability of raw materials on an ongoing basis, as well as the transportation infrastructure that guarantees, smooth delivery of products to consumers.

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