Location determination model for depot based capacity on seaweed industry distribution

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Abstract. Seaweed is the base material that can be processed into, food, drugs, and cosmetic. Utilization of seaweed into excellent products, particularly in Indonesia who become the second exporter of the world, meet some obstacles including determining main depot which cultivate seaweed into the base material, before being made an advanced product. This research proposed a model by considering the factors that affect to determination of depot which utilize as distribution point. There are five industries that observed in this paper as plant, warehouse, packing, initial product, and final product which influence by seven factors, namely natural resources, infrastructure, labour, technology, policy, education, and economy, for the six areas that will be used as depot, as source location of seaweed, and then the selection proceed with analytic hierarchy process (AHP) to determine weight of priority industry as a depot for seaweed industry on specific area. The results of AHP for six areas then proceed by assignment method, and the result showed that the depot is more determined by the maximum weight. Final result show that plant, final product and packing is the big three of priority industry that have to considered to be develop on seaweed industry, with respect to economy condition, technology existing, and sustain natural resources of seaweed.

1. Introduction

The era of globalization has offered a terminology that is the ability to compete, which became the reference for all industries in the manufacturing sector as well as good service [1]. The ability of competing innovation activity in order to give birth to, embody the activity of the competition in the form of producing goods and services. Competition in the era of global focus to performance to meet the needs of consumers, which is characterized by the fulfillment of consumer needs the special character [1,2]. Needs customer need support production facilities that have characterized the high flexibility, as well as being supported by the availability of resources, especially of raw materials which guarantee the production continued.

The existence of a production facility in the industry 4.0 relies heavily upon a reliable supply chain [1]. The supply chain is composed of several interacting actors who, providing value [2,3]. In this study observed a group of industries that make use of seaweed as raw material. At the moment the industry that utilizes seaweed still do not have a supply chain that can be cross-interaction of each actor to carry out business. This condition, if continued, will eventually turn off business in the field of seaweed.

Supply chain industry that utilizes seaweed farm business, starting from the seaweed known as plant [4-6] which was attempted by the farmers living around the coast that produce basic materials. Next base material stored in the form of dried seaweed in a shed known as warehouse [5-7]. Warehouse not
only serves to save but also do activities distributing to industries that turn it into the base material. Actors from the industry that utilizes seaweed is an industrial raw material referred to as initials product [3,5-7] change the dried seaweed into shaped paper, flour or jelly. Next base material is packaged and distributed, where the part is referred to as the transport industry or the packing or hereafter packing [2,7,8] and eventually basic materials arrived at the industries that turn it into products that are ready hereinafter referred to as the final product [5-7] such as the food and beverage industry, cosmetics or drugs.

The phenomenon on industry group, that utilizes seaweed as raw material is the relationships between the actors comprising plant, warehouse, initials product, packing, and the final product does not yet have a supply chain network to carry out the business transactions that providing value. Pay attention to the conditions of the supply chain on the seaweed industry must be focused to The factors that influenced the existing of depot that determined by natural resources [6], infrastructure [4,9] that supported the depot, technology [5,14] existed to proceed seaweed, labour availability [10,5], education [7,9] existed that support the knowledge and skill of labour, government policy [7] to develop seaweed industry, and economic condition that affect the social welfare [1-3] on depot area, then it is important to build a supply chain to define the areas that are suitable for industrial-based seaweed. Based on the phenomenon of industry based on seaweed, then research is focused to determine the network supply chain between the area defined as the area of actors who make use of seaweed as raw material.

On the research of the theory of analytic hierarchy process utilized (AHP) [8], to assess the readiness of the area as the area of the plant, warehouse, initials product, packing and final product. The development research of AHP was more focused on the effort, combined with a linear programmer, as carried out by Ehie et al. which discusses about the criteria of improving economic growth [9], deals with election logistics provider with combining the AHP by linear programming [10]. Research conducted by He et al. [11], focused effort to choose best transportation to ship the goods, while Kannan et al. [5] and Kumar et al. [6] deals with the selection of the supplier, in the field of logistics.

On the research results of the AHP next relied upon to take a decision, by utilizing the assignment method as a method to assess the feasibility of each region with a kind of seaweed processing industry is needed. Some research developments that is used as a reference in the study of which is Bokal et al. [12] which discussed the utilization of assignment method, in order to form a distribution network, while Idriss and Hussein [13] research development assignment method in order to get the best profit having regard to the selection of a proper, and resources [14] deals with the application of the assignment method for determining, the formation of the machine on the route.

2. Methods

The design of the research in this article is attempt to combine the approach of AHP and assignment method. The function of AHP on this research is determining the weights of each area that has the potential to be developed, such as: industrial plant, warehouse, initials product, packing and final product for potential areas in the six region, then results weighting evaluate by assignment method, that can be formed on the industry supply chain form of seaweed which sign on the Indonesia east zone. This research utilizes the 37 respondents, who interact actively with the seaweed industry, including: Government agencies from the Department of industry, and industry peers whom involved with seaweed industry. As for the stages of research are described as follows:

2.1. Step 1 (define the problem)

At this stage the field survey was conducted in order to get the phenomenon of problem, which occurred in the seaweed industry supply chain, as well as determined the respondent from the authorities, and industry peers.

2.2. Step 2 (literature search)

At this stage of the study undertaken to incorporate the approach of AHP and assignment method.
2.3. **Step 3 (deploy and extracting questionnaire)**
At this stage do the dissemination of questionnaires against 37 respondents, which is contained in the service industry of certain area as well as industry peers.

2.4. **Step 4 (result and discussion)**
At this stage it is done processing the questionnaires by using expert choice version 3.0, amount six times for area A, B, C, D, E, and F, followed by POM-QM version 4.0, with the following stages:
- Conecting Hierarchy Diagram.
- Insert the results into the questionnaire Expert Choice extract version 3.0
- Execute with POM-QM version 4.0

2.5. **Step 5 (conclusion)**
At this stage it summerized the resut and discussion of the construction industry supply chain, seaweed.

3. **Results and discussion**

3.1. **Hierarchy diagram**
The first step in the approach of AHP is to describe the relationship between the potential location of industry, with the type of industry that will be developed. Figure 1 shows the hierarchical relationship that exists between the location and the type of industry that is observed in this research. The data concern with this research only perform for location A, because it needs more space for performing all data, so that location B, C, D, E, and F will be performed in the case of weight from expert choice version 3.0 and ready to proceed with POM-QM version 4.0. Detailed data for location A performed in expert choice version 3.0 sheet form, as depicted on figure 2.

![Figure 1. Location and industry relationship hierarchy diagram.](image-url)
Figure 2. Data for priority industry location A.
3.2. Analytic hierarchy process result

Based on the processing done using expert choice version 3.0 after six times return to proceed for six area namely A, B, C, D, E, and F. The weighted for six location, concerning with priority location in each area presented in table 1 as follows:

| LOCATION                | A   | B   | C   | D   | E   | F   |
|-------------------------|-----|-----|-----|-----|-----|-----|
| PLANT                   | 0.345| 0.337| 0.345| 0.395| 0.274| 0.232|
| WARE HOUSE              | 0.164| 0.166| 0.165| 0.197| 0.164| 0.151|
| PACKING                 | 0.25 | 0.249| 0.248| 0.14  | 0.187| 0.291|
| INNITIALS PRODUCT       | 0.087| 0.089| 0.088| 0.2   | 0.207| 0.055|
| FINAL PRODUCT           | 0.154| 0.159| 0.153| 0.068| 0.168| 0.271|

Based on the test results by using the expert choice obtained critical ratio (CR) for six area observed has a span from 0.3 until 0.9, which gives the sense that the misperceptions of the respondents is under 10% which show that responden perception concerning priority industry was objective enough to determine depot for seaweed industry, so the results of weighting can be used. Depot for Plant on location A, B, C, and D was tight enough as the candidat as plant depot, Warehouse depot would be for location D (0.197), packing depot deliver to location F (0.291) ininitals product depot deliver to E (0.207), and final product depot deliver to F (0.271). There are a confused choice to determine plant depot because there were a high weight for four location (A, B, C, and D), while how to determine ininitals product and final product was also confused, because only one area signed as F. Considering a confused condition to determine plant depot, ininitals product depot, and final product depot, the research take an advantage from assignment method to determine a certain depot, as explain in assignment method result.

3.3. Assignment method result

This section will be used POM QM software version 4.0, to perform evaluations against AHP for weighting, each location for each type of industry. Before the weights are included in the POM-QM software version 4.0, the first results of the weighting value is multiplied by a thousand, so that data can be received in the POM-QM system input. The result of processing by using the assignment approach method do with the amount of weights, so maximize the conclusion drawn is the allocation of the areas and types of industry with the largest total numbers, as presented in table 2:

| LOCATION                | A   | B   | C   | D   | E   | F   |
|-------------------------|-----|-----|-----|-----|-----|-----|
| PLANT                   | 345 | 337 | 345 | 395 | 274 | 232 |
| WARE HOUSE              | 164 | 166 | 165 | 197 | 164 | 151 |
| PACKING                 | 250 | 249 | 248 | 140 | 187 | 291 |
| INNITIALS PRODUCT       | 87  | 89  | 88  | 200 | 207 | 55  |
| FINAL PRODUCT           | 154 | 159 | 153 | 68  | 168 | 271 |

The conclusions from the final result, mark by blue colour as presented in tabel 3. In this research assignment method set as maximize probelem, in order to achieve the biggest accumulative weighing value. Table 3 give final result of location and industrial relationship for all opportunities against the depot.

| Industry                  | Location | Weight |
|---------------------------|----------|--------|
| Plant                     | D        | 395    |
| Warehouse                 | B        | 166    |
| Packing                   | A        | 250    |
| Ininitals Product         | E        | 207    |
| Final Product             | F        | 271    |
| Total Weight              |          | 1289   |
Based on the results presented in Table 3, the network supply chain will start from the location of D as the agricultural hub of seaweed. According to Figure 3, on location D factors economy [1-3], technology [5,14] and natural resources [6], was the best three to consider because the weighing was above 90%. It indicates that the development of location D will be potentials as plant depot, if supported by good development of economy [2], efficiency of technology [5] and sustainable of natural resources [6].

**Figure 3.** Factors affected to location D.

Second Place goes to location F, which collected 271 points to assign final product. According to Figure 4 location F assigned as final product depot, which dominated by strong natural resources [6], moderate economy [1-3], and supported by government policy [7]. Considering location F as final product depot was a difficult decision, because it needs high investment to build the infrastructure of final product. As we know the main industry that used seaweed as raw materials almost placed in Java. According to that information, so the opportunity of location F to be the depot of final product must be strong enough in construction of natural resources [6], create a society that used seaweed as main industry to build economy [1], and also create a political good will to support development of final product depot [7].

**Figure 4.** Factors affected to location F.

On the third place goes to packing, that second biggest weighting as 250. Packing depot deliver to location A as performed in Table 3, and dominated by economy was reason why as presented on Figure 5. Economy [1-3] must be supported by government policy [7], and also sustain natural resources [6] of seaweed. The condition on location A as packing depot have to focus on reconstruction of economy first [3] which supported by policy government [7] and sustain natural resources of seaweed [6].

**Figure 5.** Factors affected to location A.
On the fourth placed take by location E which amount weighing as 207. According to this information location E certainly appoint to be the candidate of place of ininitials product, which dominated by strong natural resources [6], economy [1-3], and govenment policy [7]. As presented on figure 5, factor economy dominated by agile natural resources [6] according to build ininitial product depot, which must be care handling by good development economy [2], and supported by simple policy from govenment [7].

![Figure 6. Factors affected to location E.](image)

The last position goes to location B as warehouse depot. On location B economy take an important thing to rule the warehouse depot [1-3], which push natural resources sustain to be better [6], and must be supported by friendly govenment policy [7]. The position of natural resources, economy and policy, presented on figure 6.

![Figure 7. Factors affected to location B.](image)

The final supply chain for seaweed industry, begin from location D as a plant depot, and store in location B as warehouse depot. From location B distributed to location A as ininitial product depot which require raw materials, before it proceed by final product at location F, packing at location E is the important one to keep the quality of semi raw materials of seaweed.

4. Conclusion
The supply chain an industry heavily influenced by location and industry-owned facility. In this research the potential location of each processed product yield from seaweed, is observed to built a network of supply chain. Construction of a network of supply chain based on the sequence of the plant (location D), warehouse (location B), ininitials product (location A), packing (location E), and final product (location F), where the plant, final product, and packing are the largest weight gain from the respondents and strongly dominated by economy, technology, and natural resources, so the emphasis of the seaweed industry development should be focused on the development of strong construction of economy, innovative technology, and packing creativity, in order to build seaweed industry.

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