DETERMINATION OF SUPPLY CHAIN LOCATION SEAWEED INDUSTRY WITH DYNAMIC PROGRAMMING

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ABSTRACT

Activities to proceed natural results into a product, start by determining the potential location, to manage raw materials, processes, until the product is ready to consume. Location determination is strongly influenced by characteristics owned by an area, especially with regard to raw materials derived from agriculture. Location determination is usually influenced by similarities characteristics that are owned by several places in the same area, so that it is important to determine the role of a location, to cultivate natural results. The research will be observed on location determination, for seaweed commodities which consist of the region, seaweed farming, industrial base, industrial processing, and distribution. The Analytic Hierarchy Process (AHP) is used to determine the weight priority location to proceed seaweed, *which focus on aspect natural resources, infrastructure, labour, technology, policy, education, and economy*. The weight of each subsequent location is used, to determine supply chain with the largest sum of weights. Determination of the largest sum of weights, formulate by utilizing the dynamic programming, As well as assigning of an effective supply chain for seaweed industry on a region. The results with a dynamic programming model, show that supply chain performed by changing weight result from AHP to proceed effectively by minimum function of stagecoach dynamic programming model, and final result normalized to find maksimum sum of weight that show the best location with potential processing industry for seaweed in each area.

Keywords: Location, Supply Chain, Industry, Seaweed, Dynamic Programming

1. INTRODUCTION

Seaweed is a plant that belongs to the family, algae multicellular in *thallophyta* division. Basically seaweed is a commodity derived from coastal waters that can be consumed, which characterized with living on the ocean base, reached by sunlight, no roots, stems, and leaves (Hurtado, et al., 2017). Seaweed can be classified into four classes: *chlamydomonadales* (green algae), *rhodophyceae* (red algae), *cyanophyceae* (blue algae), and *phaeophyceae* (brown algae) (Tiwari & Troy, 2015). The type of seaweed that is generally used as industrial raw material comes from the *rhodophyceae* of the group *gracilaria gelidhum* as the manufacturer of *gelatine*, *chondrus eucheuma gigartina* as a producer of the *carrageenan*, *Fulcellaria* as a producer of *Fulceran* (Tiwari & Troy, 2015). Meanwhile, among the phaeophyceae, acephyllum *laminaria macrocystis* as a producer of *Alginate* (Tiwari & Troy, 2015).

Indonesia is one of the countries that has a seaweed plantation area about 1.1 million Ha, with a production of 10.5 million tons/year (Pudjiastuti, 2018), as well as contributing number two to the needs of the world (Salim & Ernawati, 2015). Seaweed demand increased between five to ten percent per year, especially for the *euchema cottonii* type, that recorded 274,100 in 2010 tonnes which Indonesia contributed 80,000 tonnes or 29.19%. While the type *glacilaria sp* amounted to 116,000 tons, which Indonesia accounted for 49.57% (Salim & Ernawati, 2015). Seaweed is utilized by the industry as a basic ingredient of food, fertilizer, biofuels, cosmetics and pharmaceuticals (Hendrawati, 2016).

The processing of seaweed can be divided into three parts: first as the raw materials that processed into *gelatine*, so that it can be utilized by the pharmaceutical industry, cosmetics, food, animal feed, tissue culture, and dental mold, second, it processed into *carrageenan*, which obtained by the end products dairy, beverages, dressing, sauces, diet food, animal feed, and pharmaceutical, third as raw materials are processed into *alginate* as a base material for the manufacture of dairy bread, textiles, cosmetics, beverages, and Pharmacy (Tiwari & Troy, 2015; Hendrawati, 2016). The seaweed processing industry is divided into three groups: first is upstream industry that produces basic materials such as paper, second is downstream industries that produce advanced base materials such as *alginate*, and third is derivative industries produce derivative products such as cosmetics, pharmaceuticals and energy (Salim & Ernawati, 2015;Hendrawati, 2016; Tiwari & Troy, 2015).

This research will be observed supply chain from upstream industry, towards downstream for seaweed commodity in a region that has potential management on upstream industry, such as agricultural area, drying, and basic materials, downstream, there is an area of advanced base materials and a producer of derivative products. Efforts to build supply chain network to arrange the flow of seaweed raw materials (Beamon, 2008; Sodhi & Tang, 2008; Hudnukar, et al., 2017; Pujawan, 2017), thus forming an economic in order that improve the welfare of people, in addition to helping the government to determine the industrial area of seaweed utilization. At this time the arrangement management of seaweed industry is not neatly organized, namely: making it difficult for consumers, producers, and suppliers to obtain information (Zailani, et al., 2008; Schmitt, et al., 2010), the delivery route (Spens & Wisner, 2009; Doan, et al., 2018; Mujkic, et al., 2018;), order volume (Surjanfrom, et al., 2010), and transport equipment (Mouloua & Oulamara, 2007; Singh & Acharya, 2014) needed to distribute seaweed material from suppliers in the upstream industry, until the consumer in downstream industries.

Based on the phenomenon of the seaweed economic arrangement, it is important to build a supply chain network by observing the potential area measured, by the aspect of natural resource availability (Lin & Juang, 2008; Pudjiastuti, 2018), seaweed processing support infrastructure (Ganguly & Kumar, 2019; Pudjiastuti, 2018), labour availability (Sodhi & Tang, 2008; Spens & Wisner, 2009; Pudjiastuti, 2018), an industry supporting technology (SINGH & Acharya, 2014; Pudjiastuti, 2018) seaweed, government policy support (Zailani, et al., 2008; Spens & Wisner, 2009; Surjanof, et al., 2010; Pudjiastuti, 2018) on the processing of seaweed, the level of public education (Mujkic, et al., 2018; Pudjiastuti, 2018) in the Seaweed industrial processing environment, and the economic condition of the community (Beamon, 2008; Lin & Juang, 2008; Hudnukar, et al., 2017; Pudjiastuti, 2018). In this research we observed potential five areas in a potential area, to be developed into a seaweed farming area (plant) as a supplier, the area of seaweed drying (warehouse), the processing area of basic materials (innitial product), processing area of advanced basic materials (packing), and the processing area of derivative products (final product) (Hendrawati, 2016; Tiwari & Troy, 2015).

2. METHODOLOGY.

The construction of supply chain network in this research was built, by how to measure the potential in five areas, with seven aspects of regional potential, in order to determine the five potential areas of industrial management of seaweed industry. The *Analyitic hierarchy Process* (AHP) in this research is used to determine the potential of the five assessed areas, weighted preference (Lin & Juang, 2008; Digalwar, et al., 2014; Ganguly & Kumar, 2019; Singh & Acharya, 2014) obtained through surveys, with a closed question of the forty respondents, consisting of the stakeholders of the seaweed industry, with respect to seven aspects of industrial potential assessment (Lin & Juang, 2008; Digalwar, et al., 2014; Schmitt, et al., 2010) of seaweed on six observation areas. The preference weight of each potential area is further formed into the network, which is identical with the completion of *shortest route problem* (SRP), but in this research supply chain network will consist a set of areas, with sum weighting the biggest potential of area as the final goal of the research, so that the approach model used is *longest route part* (LRP).

The use of LRP changed to be SRP that used to find maximum potential weight from five areas of observation. Basically the weight produced by AHP is worth to determine maximum close to the value of spesific area, so the model of LRP converted into SRP can be done, by reducing the value of spesific area, with each weight owned in the region of seaweed processing industry. After SRP table obtained, the next process is to get the potential of seaweed processing industry that is contained in every area of observation, by using model *stagecoach* dynamic programming. Here is the detailed step approach of obtaining a supply chain network by utilizing AHP and dynamic programming conducted on this research:

Step 1: Construct Hierarchy Diagram.

The hierarchy structure in the study was built with the potential Industry that existed in six areas of A, B, C, D, E, and F. Subsequently the six areas had five potential seaweed processing industries, ranging from upstream to downstream, which assessed by seven aspects of the industries potential feasibility. The relationship between the five industry potentials in six areas, with seven aspects is aimed to obtain the industry priority that must be built in an area, based on the weights owned by any industry potential, as material to determine the supply chain that will be built in the region. Figure 1 shows the relationship between industrial potential and the feasibility assessment aspect of seaweed management industry in an area.

Step 2: Gain Preference Weight with AHP Model.

Each area is rated for its preference using AHP. In this research we used *expert choice software version 11.0* to get the preference weight value of any potential seaweed processing industry owned.

Step 3: Built Changed Tabel LRP to be SRP.

At this stage every cell is given by value of one, further reduced by weight. This process is intended to be processed using a stagecoach dynamic programming model which has the goal minimum function of determining the shortest route. While the initial research was established the lowest weight accumulation or changing the maximum function of the LRP to a minimum function in the SRP. The weight changed is then multiplied by the value of one hundred, in order to simplify obtaining the final result using the dynamic program. Here is a formula to get the total minimum weight:

$$Weight_{change} = (1 - Weight_{normal}) \times 100$$

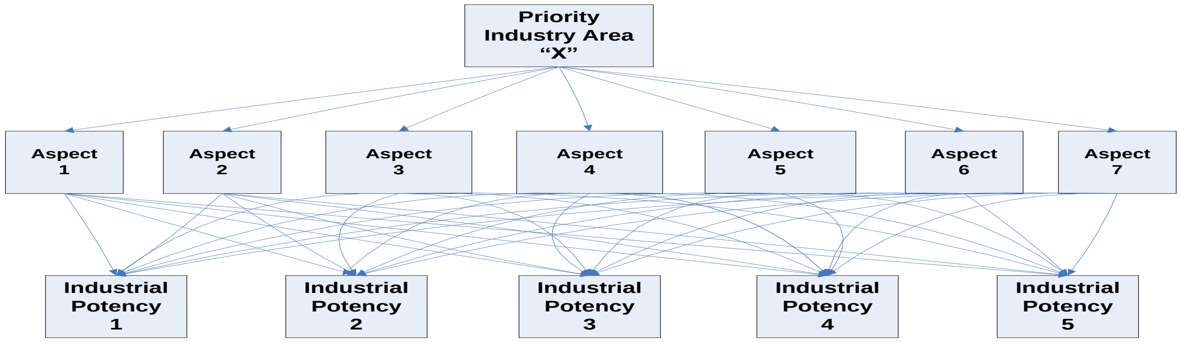

Figure 1. Hierarchy Diagram of Priority Industry Area.

Step 4: Determine Potential Industry with Dynamic Programming.

In this part we arrange the search for the potential of seaweed processing industry owned by each area observed, using the dynamic program model (Ali & Nakade, 2015; Tundys, 2018) stagecoach. Completion assisted with *WinQSB software version 2.0* (Chang, 2003). Potential regional search formulations are carried out by obtaining optimum weights from each observation area, through a stage called *T*. At each stage there is an input (*I*), the optimal decision of the previous step (*K*), and the optimum weight result (*H*) . The optimal function lookup is described as the Minimum accumulation of *H* which is the accumulation of the currently observed *K* stage, coupled with the optimal decision of the previous stage in the form of a f_T (I_T) input. The formulation at this stage is described as follows (Moore, et al., 1993):

$$Min\ f_{T+1}(I_{T+1}) = Min_{KT}\ (H_{T+1}) + f_{T-1}(S_{T-1})$$

Dynamic programming formula for stagecoach model in this research, can be describe as illustrated on Figure 2.

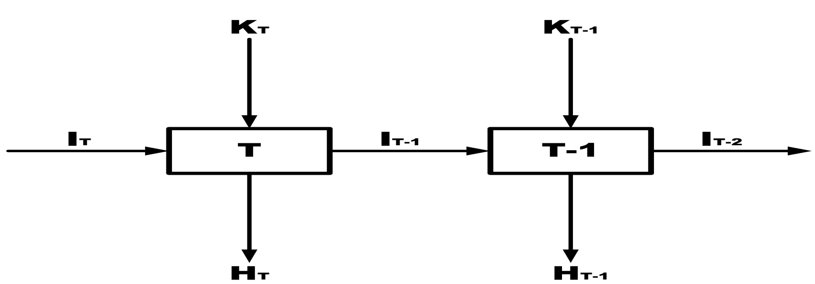

Figure 2. Dynamic Programming Formulation.

Step 5: Built Supply Chain.

In this stage we formulate, normalizing the weight of selected values by decreasing the value of one, against the chosen weight. After the normalization result is then formed into supply chain network, which connects one area with other area based on the potential of seaweed management industry.

3. RESULT AND DISCUSSION.

The first step of the study is determining the potential weight of the industry, which is in every area of observation. Every potential of seaweed management industry contained, in an area will be assessed based on the results of the survey which processed, so that the largest weight of seaweed processing industry potential should be built in an area consisting of five are: seaweed farming area called as plantation or plant (*P*), seaweed drying area is called as warehouse (*W*), the processing industry of basic materials called innitial product (*IP*), the processing industry as advanced basic ingredient called packing (*PC*), and the processing industry of derivative products called final product (FP).

Every potential industry owned by an area, assessed by seven aspects, namely: natural resources, labour, infrastructure, technology, education, policy, and economy, to determine the potential priorities of the industry that can be developed. Figure 3. Demonstrating the relationship between industrial potential in an area with the assessment aspect of area A.

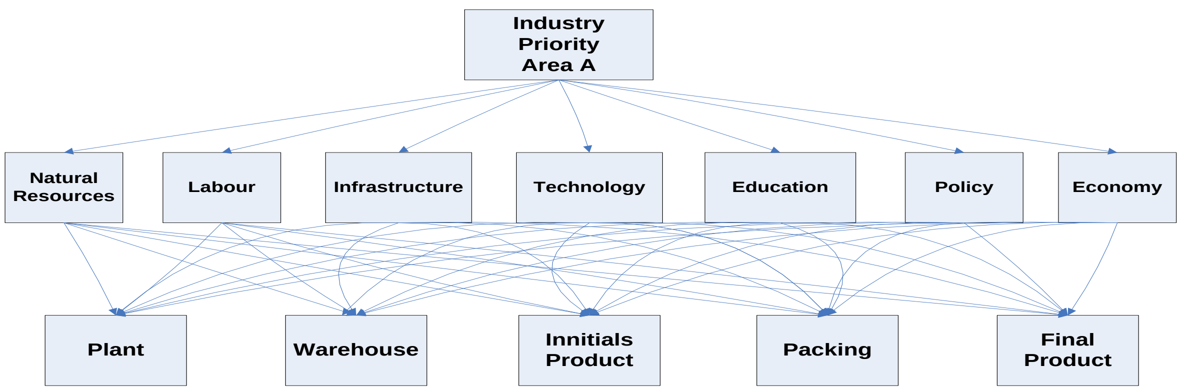

Figure 3. Hierarchy Diagram of Priority Industry Area.

The next step is to determine the weight of industry priorities in area A by using AHP. In this research *software expert choice version 11.0* utilized to get the priority weight of industry priorities contained in six areas. The weighted result for any potential seaweed processing industry, found in area A is shown in Figure 4.

Based on Figure 4, it is presented that area A has a high priority (30.2%) to be used and developed as the place of the advanced basic material management industry (PC), because it has a high perception of the community economic support aspect who have a tendency to try the basic ingredients of suppliers of pharmaceutical and cosmetic industry. Economic conditions (37.3%) also supported by infrastructure (20.1%) adequate industry, where the community with its own capital build a small medium enterprises in the form carrageenan and alginat, although from the availability aspect of seaweed availability is not the largest compared to areas B, C, D, E, and F. While the educational aspect has not been adequate (7.4%) to utilize technology (6.7%) health and safety factors, so that the availability of skilled manpower is difficult to obtain (3.3%), coupled with the support of the regional government in the form of policy (6.8%) that, requiring encouragement and incentives from the government to develop the potential of the seaweed management industry in area A. Industrial priorities of potential seaweed processing are developed in area A is the drying industry (*W*), which weight 25.5%, agriculture (*P*) by 18.1%, industrial advanced Materials Processing (*IP*) of 16.1%, and product Derivative (*FP*) amounted to 10.1%.

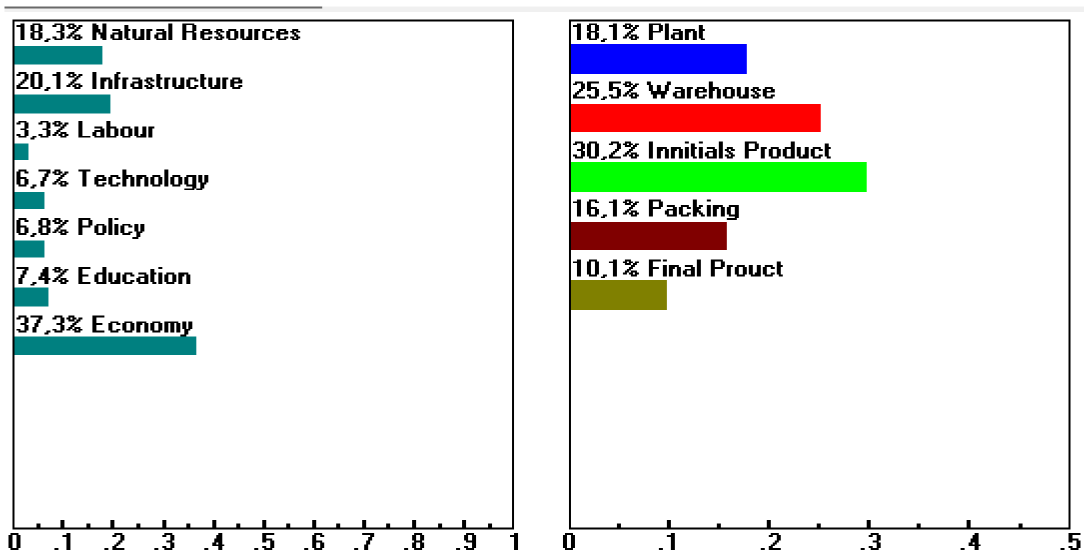

Figure 4. AHP Result for Area A.

Overall a weighted result by utilizing the Software expert Choice version 11.0, for industry priorities in areas A, B, C, D, E, and F, presented in Table 1

Tabel 1. Industry Priority Weight.

		AREA					
		A	B	C	D	E	F
ASPECT	**P**	18.1%	20.3%	20.2%	18.7%	17.6%	18.6%
	W	25.5%	20.6%	17.7%	13.2%	16.6%	15.4%
	PC	16.1%	18.3%	17.9%	19.8%	11.8%	11.5%
	IP	30.2%	29.1%	29.6%	33.2%	35.8%	31.5%
	FP	10.1%	11.7%	14.5%	15%	18.2%	23%

The next step after getting the weight of the industry priority from each region is to reduce the value of one to all values and multiplied by the value of a hundred. This effort is done to get the value that can be received by the dynamic programming stagecoach model, such as presented in Table 2. Completion using stagecoach of dynamic programming model approach, needs to be preceded by the creation of a network diagram, which shows the inter-regional relationship. Each region has the potential of the seaweed management industry, which already has a priority weight. To simplify the completion, each region is divided into stage (*T*) so that there are six stages, in which each state there are five potential industries to choose from. Activity on node construction use to proceed the problem, where the weight is placed on the circle, there are two dummy nodes used namely 1 and 2, which are given zero value as presented in Figure 5.

Tabel 2. Industry Priority Weight Change.

		AREA					
		A	B	C	D	E	F
ASPECT	**P**	81.9*	79.7	79.8	81.3	82.4	81.4
	W	74.5	79.4	82.3	86.8	83.4	84.6
	PC	83.9	81.7	82.1	80.2	88.2	88.5
	IP	69.8	70.9	70.4	66.8	64.2	68.5
	FP	89.9	88.3	85.5	85	81.8	77

*Annotation: * {1- 18.1% (from Tabel 1)} x 100 = 81.9*

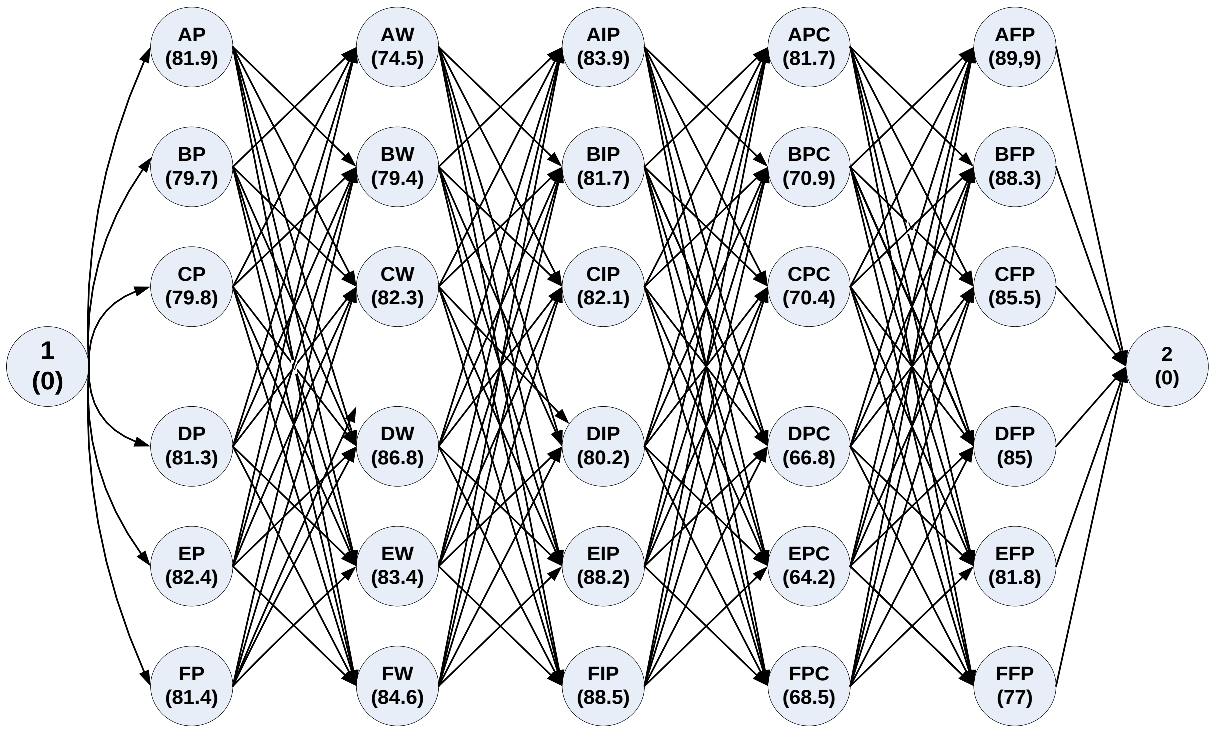

Figure 5. Network Diagram

Annotation: AP = Area A with potencial Industry as seaweed plantation.

After the network diagram is obtained, the next step is to find a rusult using the dynamic programming stagecoach. Completion has a level of complexity in which emerging possibilities, the establishment of a supply chain network that amounted 5x5x5x5x5 = 15.625, which deserves a solution. In anticipation of this condition, the subsequent final result will be gain by operating Win QSB version 3.0 (Chang & Desai, 2003), to anticipate errors in calculations. The results obtained from the calculation operation are displayed in table 3.

Based on the results of the calculations using Win QSB software version 3.0 (Chang & Desai, 2003), obtained that the optimal result gained by means of accumulating the weight of minimum industry priority as 375.6. Furthermore, a summary of results calculation result, as well as normalization of weights, so that the maximum function of the expected, such as presented in Table 3.

Tabel 3. Result Of Dynamic Programming Stagecoach

09-30-2019 01:45:55	Stage	From Input State	To Output State	Distance	Distance to 2	Status
1	1	1	BP	0	375,60	Optimal
2	2	AP	BW	81,90	382,70	
3	2	BP	AW	79,70	375,60	Optimal
4	2	CP	AW	79,80	375,70	
5	2	DP	AW	81,30	377,20	
6	2	EP	AW	82,40	378,30	
7	2	FP	AW	81,40	377,30	
8	3	AW	DPC	74,50	295,90	Optimal
9	3	BW	DPC	79,40	300,80	
10	3	CW	DPC	82,30	303,70	
11	3	DW	BPC	86,80	309,70	
12	3	EW	DPC	83,40	304,80	
13	3	FW	DPC	84,60	306	
14	4	APC	EIP	83,90	225,10	
15	4	BPC	EIP	81,70	222,90	
16	4	CPC	EIP	82,10	223,30	
17	4	DPC	EIP	80,20	221,40	Optimal
18	4	EPC	DIP	88,20	232	
19	4	FPC	EIP	88,50	229,70	
20	5	AIP	FFP	69,80	146,80	
21	5	BIP	FFP	70,90	147,90	
22	5	CIP	FFP	70,40	147,40	
23	5	DIP	FFP	66,80	143,80	
24	5	EIP	FFP	64,20	141,20	Optimal
25	5	FIP	EFP	68,50	150,30	
26	6	AFP	2	89,90	89,90	
27	6	BFP	2	88,30	88,30	
28	6	CFP	2	85,50	85,50	
29	6	DFP	2	85	85	
30	6	EFP	2	81,80	81,80	
31	6	FFP	2	77	77	Optimal
	From 1	To 2	Minimum	Distance =	375,60	CPU = 0,01

Tabel 4. Industrial Priority Weighted Normalization.

Stage	From	To	Weight	Normalization Weight
6	2	FFP	77	100 – 77 = 23 (0.230)
5	FFP	EIP	64.2	100 – 64.2 = 35.8 (0.358)
4	EIP	DPC	80.2	100 – 80.2 = 19,8 (0.198)
3	DPC	AW	74.5	100 – 74.5 = 25.5 (0.255)
2	AW	BP	79.7	100 – 79.7 = 20.3 (0,203)
1	BP	1	0	0
			Total Weight	124.4 (1.244)

Table 3 shows that the maximum accumulated value of the industry priority weights, starting from stage 6 consisting of six state with a choice of value 77 (Table 4), that select *F* (*FFP* from Table 4) as a potential area for developing processing industry for derivative products. This result is reasoned when the value of 77 is normalized will be the largest value among potential industries that can be developed area *F*, as shown in Table 1. The *F* area will be supplied by area

E (*EIP* from Table 4) which acts as potensial area for developing processing industri for intermediate basic material, which weighing at 64.2 (Table 4), so that if the value is normalized it will be obtained the largest value of 35.8% as presented in Table 1. Area *E* will be supplied by area *D* that act as, potensial area for developing processing industri with raw material from seaweed with a weight 80.2, this result is valuable when refer to Table 1 after normalization is done, although in the area of *D* is potential area to develop processing industri for advance base material (*I*), which is worth weight by 33.2 but still smaller when compared with the area *E*. The determination of the drying industrial area (W) falls in area A with a weight value 74.5, although these results look less satisfactory when referred to Table 1, because it turns out that after the value of the weight normalized, the weight of 25.5% (*AW*) is smaller than 30.2% (*AIP*), but the industrial area of the advanced processing materials has been appointed to area *E* which is bigger weight. The upstream industry in the form of seaweed farming area fall to area *B* with a value of 79.7 (Table 4), after normalization obtained a value of 20.3% which indicates the region with largest land and production of the six areas. In this research area *C* did not assigned on the supply chain of seaweed industry, although it has the potential to be developed as an area for the advanced processing materials industry with a weight of 29.6% which is greater than the area *B* is 29.1% (Table 1), but still smaller than the *E* area, so that the policy to be taken by decision makers is to make area *C* as the regulatory and supervisory area of the seaweed supply chain.

The form of seaweed supply chain in six areas is A, B, D, E, and F with respect to the potential of seaweed processing industry, starting from the upstream industry consisting of area B (P) as the area developed for agriculture, and area A (W) as a container of agricultural products to be dried before being shipped to downstream industries. In the downstream industry, the *D* (*PC*) area acts as an industrial area of the base material, while the E (IP) area serves as an advanced base materials (*IP*) industry, and the end of the industry that utilizes seaweed is in the *F* area which has a role as a region with a medicinal and cosmetic-shaped derivative product (*FP*) industry. Here is the supply chain network of seaweed industry, as presented in Figure 6.

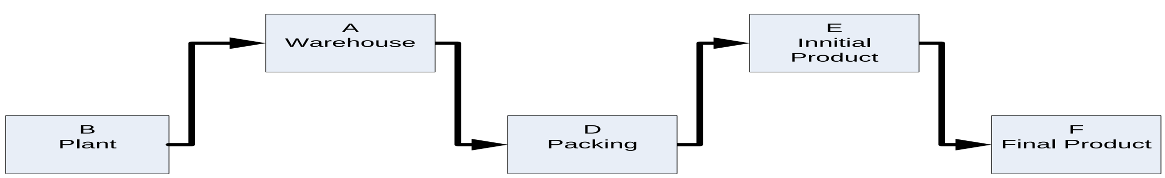

Figure 6. Supply Chain for Seaweed Industry

4. CONCLUSION

Determination of supply chain network in the region, involving several areas that have the potential of the management for the upstream seaweed industry in the form of agriculture and drying to the downstream form of basic processing, intermediate, and derivatives products, which produce medicines and cosmetics. The economic arrangement of society needs to consider several factors, natural resources, labour, infrastructure, technology, education, policy and economy. This research produced a supply chain network with attention to six areas, five potential seaweed processing industries, and seven aspects of judgment, with Analytical Hierarchi Process is used to determine how much potential a region has, in the form of weights, then the weight is first converted from maximum to minimum form to be processed by the dynamic programming stagecoach to determine potential seaweed processing industry.

5. REFERENCES.

Ali, S. & Nakade, K., 2015. A Mathematical Optimization Approach to Supply Chain Disruptions Management Considering Disruptions to Suppliers and Distribution Centers. *OPERATIONS AND SUPPLY CHAIN MANAGEMENT,* 8(2), pp. 57-66.

Beamon, B., 2008. Sustainability and The Future of The Supply Chain Management. *OPERATIONS AND SUPPLY CHAIN MANAGEMENT,* 1(1), pp. 4-18.

Chang, Y. L. & Desai, K., 2003. *Win QSB Version 2.0*. Denver. John Wiley & Sons, Inc.

Digalwar, A., Borade, A. & Metri, B., 2014. A Fuzzy AHP Approach for Supplier Selection. *OPERATIONS AND SUPPLY CHAIN MANAGEMENT,* 7(2), pp. 46-53.

Doan, L., Amer, Y., Lee, S. & Phuc, P., 2018. Optimizing the Total Cost of an E-waste Reverse Supply Chain Considering Transportation Risk. *OPERATIONS AND SUPPLY CHAIN MANAGEMENT,* 11(3), pp. 151-160.

Ganguly, K. & Kumar, G., 2019. Supply Chain Risk Assessment: A Fuzzy AHP Approach. *OPERATIONS AND SUPPLY CHAIN MANAGEMENT,* 12(1), pp. 1-13.

Hendrawati, T., 2016. *Pengolahan Rumput Laut dan Kelayakan Industrinya.* Yogyakarta: UMJ Press.

Hudnukar, M., Deshpande, S., Rathod, U. & Jakhar, S., 2017. Supply Chain Risk Classification Schemes: A Literature Review. *OPERATIONS AND SUPPLY CHAIN MANAGEMENT,* 10(4), pp. 182-199.

Hurtado, A., Critchley, A. & Neish, I., 2017. *Tropical Seaweed Farming Trends, Problems and Opportunities.* Amsterdam: Springer.

Lin, S. & Juang, Y., 2008. Selecting Green Suppliers with Analytic Hierarchy Process for Biotechnology Industry. *OPERATIONS AND SUPPLY CHAIN MANAGEMENT,* 1(2), pp. 115-129.

Mouloua, Z. & Oulamara, A., 2007. *DYNAMIC PROGRAMMING APPROACH FOR MINIMIZING TRANSPORTATION COSTS IN A SUPPLY CHAIN.* Sibiu-Romania, IFAC MCPL.

Moore, L.J., Lee, S.M. & Taylor, B.W., *Management Science, 4th Edition*. New York. Pearson.

Mujkic, Z., Qorri, A. & Kraslawski, A., 2018. Sustainability and Optimization of Supply Chains: a Literature Review. *OPERATIONS AND SUPPLY CHAIN MANAGEMENT,* 11(4), pp. 186-199.

Pudjiastuti, S., 2018. *Laporan Kinerja Kementrian Kelautan dan Perikanan.* Jakarta: KKP.

Pujawan, I., 2017. Operations and Supply Chain Management: Towards Ten Years of Journey. *OPERATIONS AND SUPPLY CHAIN MANAGEMENT,* 10(1), pp. 1-3.

Singh, R.K,. & Acharya, P., 2014. An AHP Model Approach to Supply Chain Flexibility: A Case Study of Indian FMCG Firm. *OPERATIONS AND SUPPLY CHAIN MANAGEMENT,* 7(2), pp. 64-69.

Salim, Z. & Ernawati, 2015. *Info Komoditi Rumput Laut.* Jakarta: Al Mawardi Prima.

Schmitt, R., Quattelbaum, B. & Falk, B., 2010. Distribution of Customer Perception Information within The Supply Chain. *OPERATIONS AND SUPPLY CHAIN MANAGEMENT,* 3(2), pp. 94-104.

Sodhi, M. & Tang, C., 2008. Is the East Following the West or Its Own Destiny for Industrial Development A Research Agenda on Supply-Chain Management. *OPERATIONS AND SUPPLY CHAIN MANAGEMENT,* 1(1), pp. 19-30.

Spens, K. & Wisner, J., 2009. A Study of Supply Chain Management Practices in Finland and the United States. *OPERATIONS AND SUPPLY CHAIN MANAGEMENT,* 2(2), pp. 79-92.

Surjandari, I., Sudarto, S. & Anggarini, S., 2010. Supplier Selection in JIT Automotive Industry A Multivariate Approach. *OPERATIONS AND SUPPLY CHAIN MANAGEMENT,* 3(2), pp. 83-93.

Tiwari, B. & Troy, G., 2015. *Seaweed Sustainability Food and Non-Food Applications.* London: Elsevier.

Tundys, B., 2018. Use of Quantitative and Qualitative Methods for Modelling Green Supply Chain. *OPERATIONS AND SUPPLY CHAIN MANAGEMENT,* 11(2), pp. 82-97.

Zailani, S., PremKumar, R. & Fernando, Y., 2008. Factors Influencing the Effectiveness of Operational Information Sharing Within Supply Chain Channels in Malaysia. *OPERATIONS AND SUPPLY CHAIN MANAGEMENT,* 1(2), pp. 85-100.