Development of Supply Chain Model for Small Scale Farmer Producers of the Carrageenan Industry in the Philippines

Mary Christy O. Mendoza and Raphael Joesh P. Layug
School of Industrial Engineering and Engineering Management
Mapua University
Intramuros, Manila
mcomendoza@mapua.edu.ph, rplayug@mapua.edu.ph

Abstract

The growing industry of carrageenan continues to be characterized by small-scale farmer producers whose collective production of agar is the major supply source of the marine produce in the city. However, the multiplicity of farmers engaged in the production contributes to what is an emerging industry in the city as it is in many southern islands. The aggregate production of the agar farmers in the city is sufficient to make local farmers potentially competitive and a major source of supply for the marine product. Thus, the study aims to identify and evaluate the various factors to the market conditions of carrageenan in the southern Philippine area – production, price, and distribution channels – and to design solutions that would reduce the cost of distribution in the seaweed supply chain. The process involved the conduct of a survey and interviews of several stakeholders in the industry who acted as the study's key informants. Statistical tools and other analytical tools were likewise employed to further identify the factors that contribute to the current supply chain of the carrageenan industry in the country. Statistical tools were employed in the analyses to identify the factors and optimal distribution cost and based on the results. Three specific areas were considered for the farmer-producers: quality standards, growth and maintenance, and harvest conditions. As with the buyers: quality, transport, and selling. The final group – the assemblers - the areas include quality, transport and selling. However, the least two groups seemed almost identical, the specifics in each of the areas covered had varied operational conditions. As with the farmers, 77% was lopsided for E. espinosum variety; 1005 for the use of the floating planting method, and 85% for water movement as a special maintenance concern of the plants. In reference to growth and maintenance, a majority over 80% opted for planting of cultivars within the 1.5-2 meters deep and of cultivars within 15 to 20 centimeters in length. Farmers opt to do once a day inspection of the farms and there is almost 100% preference for still water conditions in the planting area; a significant 81% of framers prefer water temperature of around 25 degrees Celsius, salinity of 20-25 parts per million and all opt for sandy sea bottom. For the buyers, in reference to quality, a high 80% prefer agar to be sold to them with 25% moisture content; note that most sold to them are combined with sand; and prefer E. espinosum and E. cottonii. In reference to transport, distance from farm to buying station is on the 16-km. distance on the average; the use of truck by all of them; and prefer that seaweeds be covered in the course of transport. With the assemblers and bodegas, all have shown preference for 25% moisture content of the agar and have noted the mix of sand in most of them; there is a very high preference for E. espinosum over other species; and their storage areas are 0ver 800 square meters. In reference to distance, the similar 16 kilometers average is noted; the trucks are generally covered during transport; and the movement of produce is done daily. As with selling, storage prior to actual sale takes between 2 to 3 weeks; these are sacked; sale is preferably done during the drier days and frequency of sale is done twice to thrice a week.

Keywords
Supply chain model, carrageenan industry, small-scale farmer-producer

1. Introduction

The seaweed supply chain in the Philippines is largely subject to disruptions in yield, quality, price, and infrastructures. The volatility of the market, compounded by uncontrollable natural interventions, creates unexpected downturns. If there is a disturbance in one part of the supply chain, it can affect the whole chain. To ensure a sustainable seaweed industry, long-term planning is needed. Here, supply chain risk management can help. In the process, four critical

steps are considered: identifying seaweed supply chains, identifying and categorizing risks, assessing risks, and mitigating risks.

Carrageenan and agar manufacturers have been steadily growing in the country from simple family ventures. While its original subsistence character has moved to become a surplus-creating industry, it is evidence enough that its economic prospects are increasing. It is within this perspective that supply must be sustained and increased. With Indonesia, the Philippines claims supply leadership to the 80% level of world carrageenan supply and the way to go is to further increase production level – an aspect that can only be possible with increase in supply volume by the producers.

Owing to the industry's character as aquatic agriculture, it thrives mostly in the Mindanao area where coastal communities are widespread and residents turn to it as a major source of income – some on a part-time basis while others are on full scale. While carrageenan has long been produced in many islands of Western Mindanao, it has been noted to have slowly spread in some areas of the Visayas. The cumulative production of the seaweed contributes to the country's becoming a major emerging source of carrageenan in Asia. However, the Philippine carrageenan production volumes still pales against those of Indonesia and Malaysia whose phenomenal production volumes have increased by 200% to 500%.

Aside from the islands of Sulu and Tawi-Tawi, the Zamboanga provinces have also registered yields of carrageenan. Specific focus has been on the city of Zamboanga where many small communities have families that are traditionally exposed to seaweeds production.

In 1972, Tawi-awi, Jolo and Zamboanga fishermen started the first Eucheuma commercial farms in the country. Then in 1978, seaweed farming reached Bohol, Cebu and the Leyte-Samar area.

In 1990, the country's total seaweed farm production reached a high of about 400,000 metric tons of fresh Eucheuma seaweeds planted by about 80,000 seaweed farmers/families.

An estimated 70% to 80% of carrageenan worldwide is being produced today from two species of seaweed, Eucheuma cottonii and Eucheuma spinosum. Carrageenan is produced from these species for two reasons: First, only the Eucheuma specie have thus far been cultivated successfully on a large scale in underwater seaweed farms. Other species of seaweed that can be used to produce must be gathered in their wild state from the sea. Second, by using the carrageenan produced from these particular species in different proportions, producers can easily obtain different blends with different gel strengths and textures to meet different product needs. Unlike other carrageenan- containing seaweeds, E.cottonii produces only kappa-carrageenan and E. spinosum produces only iota-carrageenan.

Just as all other produce, there are factors that affect the supply chain. Special focus is on the variations in demand that directly have bearing on supply. As demand has direct bearing on supply, the latter must capitalize on every factor that may influence its conditions that would better promote it: reduced production and marketing costs as well as the interacting forces of the actual market. This would eventually mean reduced production costs that would result to positive increments that would be in favor of the producers. In the end, if producers see a more positive position in the market, the greater is the impetus for supply and therefore guaranteed production. It is a market phenomenon that when decreased profits are observed, there will be the resultant decrease in production.

Thus, the focus of this study is the supply chain conditions of carrageenan in Zamboanga City – the major urban center in Western Mindanao and the central trading area of the aquatic produce. The analysis of the supply chain involved the survey of the farmer-producers, the buyers, and the trader-assemblers or "bodegas." The three groups of respondents are the identified sources of information that can best capture the supply chain of carrageenan.

2. Methodology

2.1. Phase 1: Assessing the Prevailing Supply Chain of the Carrageenan Industry

In Phase 1, the researcher identified and assessed the current supply chain of the carrageenan industry by conducting an industry analysis and distribution pipeline mapping. In the conduct of the industry analysis, the researcher looked at the supply chain players and their functions to properly understand access their roles in the system. By using distribution pipeline mapping, the researcher can better visualize the flow of materials and information from the suppliers up to the end-customers.

Any analysis of the supply chain for any purpose – simple assessment for plain descriptive purposes or assessment for improvement must always revolve around prevailing conditions as starting points. While the idea for supply chain improvement remains the focus, first-hand or primary data must be obtained from those who are directly immersed in the industry – the very players themselves. This would mean the farmers as the starting data sources up to the final supply chain players – the assembler-exporters. This does not, however, exclude the intermediary players along the chain. It is important to stress that data must be drawn from within the industry. It is important to underscore further that any unknown or blind areas of the chain can only be identified by players within the industry which is far important than describing the industry from the perspective of those from without the industry.

The output of phase 1 shall be the detailed current supply chain in the carrageenan industry. Emphasizing on the ideal supply chain conditions vis-à-vis the actual processes, it is vital to expose the possibility of flaws in the current supply conditions since much of the adopted practices have evolved sans the adoption more efficient methods based on more scientific applications. It must always reference that the purpose of an efficient supply chain is to create as much advantage to the major players in the line to guarantee continuous supply of the produce and, in the long run, guarantee the life of the industry.

2.2. Phase 2: Identifying the Factors Affecting the Supply Chain

In the second phase, the researcher identified the significant factors affecting the supply chain gained in phase 1, from production, local trading and processing by using the generic supply chain factors and sub-factors (refer to related literature). Analysis of variance and Test of Differences were used to process the data.

Means were determined based on the factors for each group of respondents. For the Farmer-Growers, three activity classifications were referred to – Quality, Growth and Maintenance, and Harvest. Each of the activity had specific indicators. Buyers and Traders/Assemblers had identical activity classifications: Quality, Transport and Selling. However, given the variations in the nature of their activities, each of the activity groups had different indicators.

The responses of the study's subjects determined the sub-groupings from which the mean values were determined with reference to the following output volume measurements: kilograms in the case of the Farmer-Growers; and, metric tons with the Buyers and Assemblers.

Means were then compared and tested for differences. Where responses had two groups, two means were determined and compared using the T-Test; where more than two groups of responses were realized, there means were computed and compared using the Analysis of Variance (ANOVA). Where mean differences could be directly determined using the T-test, the ANOVA required further test to determine among which means the difference/s lie/s. This was done using the Scheffe Test. The Tukey's Test for post-hoc testing purposes was not applicable for the data since it does not satisfy the requirement that it can only be used for means of groups with equal sample sizes. All tests utilized a test of significance at p = .05.

In cases where no response variations were observed – with homogeneous responses – only one mean was observed thus, no further test was conducted except the descriptive measure of the percentage.

The critical factors were observed to commence with the planting/growing phase of Euchema. Since price is a major factor to consider, it is imperative that the choice of Euchema variety is a major starting point and which factor can only be fully taken advantage of if farmers have enough financing to afford them the better variety. In such case, the all-embracing financial factor is to be seriously considered. After all, total Euchema supply starts with the farmers and whom assistance if both vital and critical. Other planting considerations are manageable given the farmers'

familiarity with the industry save for the uncontrollable factors to which they subject to such as water conditions, salinity, movement, and the like. Growth and Maintenance conditions among farmers show almost similar practices. However, harvesting conditions must be seriously looked into in the process of professionalizing the industry. There is an obvious convergence of traditional and new practices. While it may not connote the complete abandonment of one type of practice over the other, some are preferred and must be encouraged as drying practices. This is the final phase of the farmers' involvement in the growing process prior to marketing and which would determine the quality of their produce and the price. After all, it is accepted knowledge that price is critical as this would lead farmers to the decision to reduce or continue production. Or even the possibility of pushing them to the extreme of halting production and shift to other activities or industries.

With reference to the Buyers, much of their activities are the same and would likely appear to have little effect on their supply. However, a potential factor to drive the wedge among Buyers would be the relative distance of their buying stations to the farming/planting areas. As such it could entail higher transport cost and even transport volume given the mode of movement. While it is not easy just to set up new buying stations, this should be a major concern since the condition would a potential reason for the entry of middle men who would make the greatest profit in the process. This is the major reason why it is potentially advantageous that farmers organize themselves into cooperatives to increase their bargaining position in the market. The formal organization of the farmers is a long-standing proposal of government and non-government organizations that are assisting the farmers in the field.

2.3. Development of Supply Chain Model

In the final phase, the researchers developed a supply chain model/framework and strategy that best suits the current environment and situation. This was achieved by conducting a supply chain analysis where in the key drivers of the supply chain was identified. After which the network design was analyzed to find a proper strategic fit that suits the current system.

The final output was an improved supply chain model/framework and a supply chain strategy that is best suited for optimal benefits for all players in the system. An improved supply chain where in suppliers' (small-scale farmers) bargaining power is better than the previous and where the suppliers have more value adding activities that contribute to the product.

The start of the supply chain must be the concern for the production levels with the growers. The acquisition of planting materials should be the starting area from which the actual growth and planting must take-off. Apparently, the choice of the cultivars commences the care aspect of production. The fact that current situation only concerns itself with the volume of which planters mostly act independently of each other is a concern that must be addressed. Cooperative farming, although might take time, is worth the effort. Organizing them with the pooling of resources would result to better production conditions that would ensure volume.

Ensuring supply and production must be complemented by a careful analysis of the current chain – enhancing the areas that are advantageous while replacing those that need to be. The market conditions show complementation among the players. Apparently, the life of the industry spells the life and sustenance of the players. Enhancing each without downplaying the other segments may be too ideal but must be real. After all, all of them rely on the same industry.

3. Results and Discussion

3.1. Supply Chain of Seaweed

The supply chain mainly consists of suppliers of seaweeds: the seaweeds farmers and key consumers include traders and assembler-traders. All are located in Zamboanga City. Tracing the flow of the players result to the following chain: nursery operator – seaweed farmer – local trader – assembler/trader – processor – exporter.

Likened to many other aquatic products that concentrates on the production of quality products, improvement of better varieties has become one of the most important features in their propagation. In this end, the establishment of nurseries has slowly become a necessity where better stocks could be relied upon. The nursery has become the source of better and sturdier varieties that could be planted. The nursery stocks end up with the farmers who use them for propagation purposes. These are the same stocks that are planted in farms.

The suppliers in the supply chain are the farmers who plant and harvest the seaweed which is the primary ingredient in making carrageenan. They plant seedlings of seaweed that in turn grow to become seaweed upon maturity. The farmers harvest the seaweed and dry it until the moisture content is 25%-35%. From there the seaweed is sold to traders who in turn proceed to dry the seaweed further and is eventually sold to processors. The processors in turn make the raw dried seaweed into carrageenan by the process discussed earlier. The final output which is Philippine grade carrageenan is then exported to buying countries around the world.

3.2. Factors Affecting the Supply Chain

The following are the survey results that covered all respondents in the survey. Each group of respondents is shown their positions in the specific variables involved in the identified factors of their roles in the supply chain.

A. Farmer-Producers

For farmer-producers, three sets of factors are identified: Quality Standards, Growth and Maintenance, and Harvest.

The standard with reference to quality show greater preference for the use of E. spinosum variety over E. cottonii. This overrides the fact that even when E. cottonii is more expensive it is less preferred with farmers given the cost of seedlings and the requirement of less maintenance. The floating method is more preferred as it easier to monitor the seedlings without necessarily diving. Apparently, for the farmers, water movement is considered more detrimental to the growth and quality of the seaweeds.

For growth and maintenance, given the many trainings given to the farmers by both government and private organizations who have stakes in the industry, farmers have learned how to follow the requirements. This is further reinforced by constant monitoring that further enhances their production skills. However, the scientific farming methods taught them are further re-enhanced by their innate skills in the industry that they have been familiar with over the years.

The harvest conditions remain the major factors that determine the supply and price of the seaweeds in the market. Apparently, given the fast-growing character of the seaweeds, harvests are usually twice weekly thus resulting to more than 10 harvests per year depending on the growth conditions. The best harvest months are the summer months where the dry weather condition is best for harvest until the required drying. While the old conditions and methods was mostly done in shore drying, the current practice is doing it on racks. This method prevents the contamination of other materials and the produce is sand-free.

B. Buyers

With reference to the buyers, there major sets of factors affect them and the supply chain of carrageenan. These include Quality, Transport, and Selling. The latter refers to the conditions that must be complied with in the buyers' domain.

With reference to quality, buyers maintain the requirement of 25% to 30% moisture with most of the buyers preferring the 25% moisture requirement. In many cases – from the wet to the dry forms of the seaweeds, 90% of the actual weight is lost after drying. That means that for every 100 kilograms of wet seaweeds, only 10 kilos are left after drying.

One major aspect of transportation is the number of trip done in a week. This area would also have to depend on the production volumes in the planting areas. Common frequencies are once to twice a week or 3 to 4 times weekly. Much of the latter are for nearby areas and the farther areas have lesser trip frequencies. This would mean accumulation the agar produce first before trips are conducted.

As to the selling conditions, the slim difference between 1-2 weeks and 3-4 weeks could well refer to, at least, a month's storage by buyers. Any period longer will subject the dried agar to contamination to microorganisms that could downgrade the quality of the seaweeds. The common packaging method is still sacking and all activities are preferably done during dry weather.

C. Traders-Assemblers/Bodega

The final sector in the chain prior to export is the trader-assemblers. This is the sector that has to prepare the marine produce to meet the standards of exportation. This is the sector that is required to address the specifications of the global industry. This is based on some defined conditions that need to be addressed: Quality, Transport, and Selling Standards.

The quality aspect has to be satisfied by the assemblers and which condition must be addressed at the very point of purchase. Foremost condition is the satisfaction of the moisture content that must be at the minimum possible – 25%. The danger of purchasing agar with high moisture content is its susceptibility to deterioration with the growth of micro flora.

Four areas were covered in the aspect of transport. However, this only covered domestic transport and excludes exportations costs. Primary is the distance between the bodega and the buying stations. This is done by all assemblers using the truck and on everyday basis. In the process, this is done by totally covering the stock to avoid contamination by waste and dust.

3.3. Result of Regression Analysis

Regression analysis was used to determine which factors identified are significant for each of the players in the supply chain. Regression analysis using Minitab was used for ease of solving. The Step-wise Backward elimination was used to arrive to the significant factors. The results show that the factor that hold most significance to the total output are the following: Planting Interval, Temperature of water, species of the seaweed planted, Growth conditions, and type of drying bed. These factors, when altered has direct effect to output.

Table 1. Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
216.805	67.82%	57.66%	31.53%

The R-sq value is 67.82%, meaning the data are 67.82% closely fitted to the regression line whose equation can be seen below. This means the model explains that amount of variability of the responses around its mean.

Table 2. Coefficient Summary

Term	Coef	SE Coef	T-Value	P-Value	VIF
Constant	-710	633	-1.12	0.276	
lanting Interval	46.9	18.7	2.5	0.022	1.15
Temperature	43.1	20.4	2.11	0.048	1.23
Species E. Spinosum	238	105	2.26	0.036	1.09
Growth Conditions Replace	488	137	3.56	0.002	1.06
Drying Bed Rack	39	118	0.33	0.745	1.65
Shore	-299	184	-1.63	0.12	1.9

Table 3. Regression Equation

Species Conditions	Growth	Drying Bed			
E.Cottonii	Fasten line	Conc.	Output	=	-710 + 46.9 Planting Interval + 43.1 Temperature
E.Cottonii	Fasten line	Rack	Output	=	-671 + 46.9 Planting Interval + 43.1 Temperature
E.Cottonii	Fasten line	Shore	Output	=	-1009 + 46.9 Planting Interval + 43.1 Temperature
E.Cottonii	Replace	Conc.	Output	=	-223 + 46.9 Planting Interval + 43.1 Temperature
E.Cottonii	Replace	Rack	Output	=	-184 + 46.9 Planting Interval + 43.1 Temperature
E.Cottonii	Replace	Shore	Output	=	-522 + 46.9 Planting Interval + 43.1 Temperature
E.Spinosum	Fasten line	Conc.	Output	=	-472 + 46.9 Planting Interval + 43.1 Temperature
E.Spinosum	Fasten line	Rack	Output	=	-433 + 46.9 Planting Interval + 43.1 Temperature
E.Spinosum	Fasten line	Shore	Output	=	-771 + 46.9 Planting Interval + 43.1 Temperature
E.Spinosum	Replace	Conc.	Output	=	15 + 46.9 Planting Interval + 43.1 Temperature
E.Spinosum	Replace	Rack	Output	=	54 + 46.9 Planting Interval + 43.1 Temperature

3.4. Result of T-Test for Equality of Means

The T-test was employed to determine whether significant differences exist between means in the operational variables of the defined categories among the 3 groups of respondents. All tests conducted using the T-test was done in the non-directional/2-tail condition which did not necessarily identify which group had the larger or smaller mean. They were done only with the objective of determining whether differences exist between the compared means. All tests were conducted at the 95% confidence level.

A. Farmer-Producers

As with planting distance, a significant difference was also noted at the same significance level; similar analysis was observed in the area of growth conditions where mean differences were analyses between fastening the line and replacement. This likewise holds true for observed difference in the temperature desirable for growth of either 20 or 25 degrees Celsius.

With reference to harvest, significant differences were likewise observed in the frequency of weekly harvest and either once a week or twice a week. Number of harvests per year showed significant mean differences between 8-9 harvests and >10 harvests annually.

E.Spinosum yields more output compared to the other two choices of seaweed specie. And the monitoring of water movement should be the priority. In terms of growth and maintenance, the planting interval that has the higher mean is 15cm with a mean output of 1441.14, compared to 20 cm's mean output of 1243. For growth conditions, replacing lost seedlings results to higher output than just fastening the lines. Temperature also has an effect on the seaweed where in 20 degrees Celsius has a higher mean output of 1241, compared to 25-degrees Celsius mean output of 1027. Frequency of harvest also will directly affect the output since the more you harvest, the more you gain in total.

B. Buyers

In the area of Quality, two separate t-tests were done: for moisture content, and specie of agar. In both cases no significant differences were noted when tested in the .05 level of significance. With only two means showed in the operational side, all the operational variables only demanded the use of the T-test.

With reference to Quality, the comparison of moisture content showed no significant difference between 25% and 30%. However, a significant difference was noted in Seaweed Specie – between E. spinosum and E. cottonii. Where in E. Spinosum has a mean of 725, compared to 675 of E. Cottonii.

In the area of Transport, comparing distance from farm of 1-2 and 3-4 kilometers showed no significant difference but mode of transport indicated a mean difference between the use of Jeep and Truck. Actual preference for truck is clearly shown but the apparently higher mean value.

As to Selling, Period of Storage mean values were compared between 1-2 weeks and 3-4 weeks. No significant difference was, however, recorded. Both tests were conducted at the 95% confidence level.

C. Assemblers/bodegas

In the area of quality, only Agar Species warranted the use of the T-test. In the conduct of the test, a significant difference was observed.

The area of Transport, it warranted no need for the T-Test as all other sub-variables only needed the percentage analyses and use of the ANOVA.

With reference to the tests done in the area of quality – Type of Cltivar and Monitoring – both showed significant differences at the .05 level of significance. That means that yield was observed to be significantly different based on the mean yield values between E. spinosum and E. cottonii and the monitoring of diseases and water movement in the planting area.

In the Selling category, the T-test was used in the Period of Storing before Sale, and the Frequency of Sale. The test conducted on Storage showed a significant difference between 2 weeks and 3 weeks while the test done on Frequency of Same showed no difference in the results of the test. Assemblers seem to prefer the specie E. Cottonii because it has the higher mean of 950.

3.5. Development of New Value Chain Map

The general framework of the proposed value chain of carrageenan has two major phases: Farming/Seaweed Production and Marketing. However, given the breadth of marketing's scope in the process, it is divided into two areas – the Intermediate Sale Phase and the Final Domestic or Foreign Market. The last ramification detail is mainly based on the existence of both local and international markets for the marine produce.

Farming is mainly dominated by locals – either trained or honed by experience. However, in recent industry development, BFAR has undertaken massive campaign for more scientific farming trainings given the increasing need for greater production as a logical reaction to an expanding foreign market. Three specific activities are identified in this phase of the chain: Farm development, Harvest and drying, and Seaweeds handling. Specific activities are identified in each of the major farming activities. Farming development is mainly aimed at the necessary preparation of the area for planting. As much importance is placed on the quality of beginning cultivars, the correct planting conditions must likewise be secured. Much of the conditions that are demanded for productive cultivation depend on correct farming conditions. While this is monitored by cooperating public and private agencies, monitoring by trained technicians are provided.
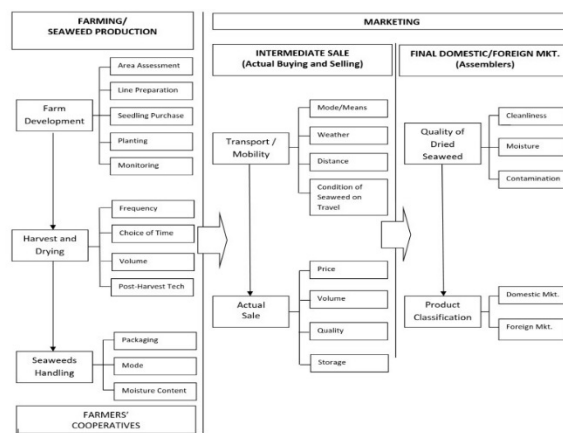

Figure 1. New Value Chain Map

4. Conclusion

The current supply chain in terms of its structure is not the optimal for the sustainability and maximization of its potential. There are many aspects where in there are much room for improvement but the integration of technology for the farming practices shall greatly affect the supply chain in a positive way. The involvement of the government in terms of microfinancing the needs of the farmers, continued education of updated farming techniques and improving infrastructure around the area will greatly increase the chances of making the supply chain sustainable. Introducing the private sector to get involved shall promote the improvement of the quality of living of the players in the chain. The first objective of the study was to assess the prevailing supply chain of the carrageenan industry in the Zamboanga region. The data-gathering process involved the assessment of the industry on-site with the employment of observations and interviews with the sample of three groups of major seaweed industry players in Zamboanga City. While the agar industry may be "old" and familiar to much of the current farmers, the industry has since changed given the demands of the market. It has become more specialized with the involvement of defined groups as the buyers and assemblers performing identified functions. The second objective of the study is to identify the factors affecting the supply chain. From careful research analysis, factors affecting quality, production volume and marketing were carefully investigated and analyzed. From the standpoint of the Farmer-Producers, three areas were identified: Planting Quality Standards, Growth and Maintenance, and Harvest Conditions. For the buyers, three factors were identified: Quality, Transport, and Selling. The last group of players – the assemblers, also involved three areas closely similar to those of the Buyers: Quality, Transport, and Selling. The factors that were identified to be significant that has the most effect on the output of seaweed are the following: Species of seaweed, monitoring of the plantation, planting intervals, harvest months, and type of drying beds. The species of seaweed affects the production because different types have varying amounts of growth time. The monitoring of the plantation, specifically line inspection and deceases have significant effects because these can reduce the output if not monitored. Harvesting months and type of drying meds are also significant because post-harvest practices entails the drying of the seaweed. And seaweed cannot be sold if it contains high moisture contents, so preferred months are peak of summer and mode of dry are racks to minimize contamination. The third objective was to develop a supply chain model/framework and strategy to improve the industry performance. The development of a new value chain map, were in there are two major phases. Farming activities and Marketing activities. Under the farming activities, will fall under the supervision of a farming cooperative made up of the farmers themselves. The creation of the cooperative to watch over the farming activities to be better facilitate the farmers. They could organize among themselves with government assistance. This is wanting given the need for their increase bargaining position in the market – securing their products and their prices. Moreover, they could be the more legitimate link to the actual local market. The intermediate marketing phase is focused on the domestic/local market that act as enablers and conduit to the assemblers, who, in turn links to the foreign market. The first line of quality control is the local market who is aware of the foreign market requirements. The major concern is the transport of the produce to the buyers/bodegas. In all phases, quality must be carefully secured. The "fate" of the farmers are ultimately sealed by the actual sale.

The link to the assemblers is the beginning of the entry of the foreign market. The assemblers hold the legitimate link to exportation where the ultimate crucible of quality is determined and reflected by the price paid for the produce. Again, the persistence of Quality is evaluated.

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Biographies

Mary Christy O. Mendoza graduated from Mapua Institue of Technology, Intramuros Manila, with a degree in B.S. Industrial Engineering and a professor in the same institution.

Raphael Joesh P. Layug is a graduate of Bachelor of Science in Service Engineering Management in Mapua Institute of Technology, Intramuros Manila.