Profitability Analysis of Seaweed (*Eucheuma denticulatum* (N.L.Burman) F.S. Collins & Hervey) Enterprise in Dawahon Island Bato, Leyte: A Green Value Chain Approach

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**Abstract**

Seaweeds are significant aquaculture products among farmers of Dawahon Island Bato, Leyte, Philippines. Unfortunately, the farmers suffer problems that in effect reduce the income they receive from their produce. This study analyzed the existing interrelationship among players and stakeholders and the impact of value chain activities on the environment using an environmentally extended value chain analysis (VCA). Key informant survey data were analyzed using participant observation, and participatory systems analysis to examine and assess the profitability and efficiency performance of an environmentally extended value chain for seaweed in Dawahon Island. Detailed value chain mapping showed that as the product moves along the value chain segments, losses were experienced due to factors like post harvest losses, theft, ice-ice disease and transport damages. Performance analysis revealed that traders were the most benefited along the seaweed value chain. Participatory systems analysis identified several elements which were recognized to be potential starting points for development activities. The environmentally extended analysis also identified activities in the value chain which have considerable impact to the environment.

**Keywords:** seaweeds, green value chain analysis, participatory systems analysis, chain mapping and upgrading

**Introduction**

The Philippines has abundant aquatic resources. Among these are the seaweeds which are of great value to the country. Seaweeds like the carrageenan are very versatile products widely used as ingredients for the global food and cosmetic industries, as well as fertilizer and as an animal feed additive. They also act as contributors to natural food chains and habitats supporting commercially important marine fish and shellfish (McHugh, 2003). In addition, they provide livelihood opportunities to thousands of families along the coastal areas of the country.

Seaweeds specifically *spinoum* (*Eucheuma denticulatum* (N.L.Burman) F.S.Collins & Hervey) are significant aquaculture products of Dawahon Island Bato, Leyte. Locals living in the island are greatly dependent on seaweed farming as their primary source of income to support their daily living expenses, although fishing, abalone and sea cucumber collection supplement their earnings. Unfortunately, these farmers suffer problems that in effect reduce the income they receive from their produce. Among these problems are the occurrences of diseases (ice-ice), insufficiency of capital, overcrowding in farm areas, unfavorable weather condition, insufficient support from enablers and the environmental consequences of seaweed. These issues remain pervasive in the industry severely affecting all players and stakeholders especially the essential livelihood of the farmers. Hence, there is a need to analyze or examine more closely the existing interrelationship among players and stakeholders and the impact of value chain activities on the environment.

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using an environmentally extended value chain analysis (VCA). This is a more targeted and focused method of identifying appropriate and sustainable intervention measures to improve the profitability and competitiveness of the industry to ensure a more sustainable stream of economic benefit to all chain actors in the future preserving the viability of essential livelihood of stakeholders in the seaweed value chain.

Generally, the study aimed to assess the profitability of seaweed enterprise in Dawahon Island, Bato Leyte using an environmentally extended value chain analysis. Specifically, it aimed to: 1) provide an overview of the seaweed industry in Bato, Leyte; 2) identify and map-out the specific value chains of the seaweed industry in Bato, Leyte; 3) analyze the performance of players at each stage of value chain; 4) evaluate the activities and practices of the value chain players and its impact on the environment; and 5) draw policy implications to develop the seaweed value chain for enterprise sustainability and competitiveness.

Methodology

The study was conducted on December 2013 to March 2014 in the island of Dawahon involving key informants of the seaweed value chain; farmers (15), farmer-traders (5), and final buyers from Cebu (3) and Tacloban (1). Industry assessment which involved obtaining secondary data from various government agencies such as the Bureau of Agricultural Statistics (BAS), Department of Agriculture-Bureau of Fisheries and Aquatic resources (DA, BFAR), Seaweed Industry Association of the Philippines (SIAP) and other agencies was done to put VCA to proper context.

Primary data gathering employed snowball sampling technique wherein collection of data started from the downstream players (relevant market) up to the upstream players (farmers) using the conventions of six key questions for value chain analysis i.e: 1) Who are the key customers and what are their product requirements in terms of species, volume, quality, packaging, delivery schedule, as well as grades and standards? 2) Who are the key players in the chains and what are their respective roles? 3) What are the activities and processes along the chain? 4) What is the flow of product, information and payment along the chain? 5) What are the logistic issues? and 6) What are the external influences (e.g. ordinances, regulatory requirements, police, etc.) (Brown, 2010)? Given the homogeneity of the population, only 15 farmers and five farmer-traders were interviewed. The survey also included four final buyers.

The study introduced a green approach in the analysis using the guide questions derived from the six parameters enumerated by the United Nations Industrial Development Organization (UNIDO, 2011) in diagnosing sustainable production and energy use were also used to determine the externalities of the value chain on the environment. These were namely: 1) What types of materials are used in the value chain? Are they toxic, polluting or in any other way harmful to people and the environment? 2) Are the raw materials used in the value chain produced in such a way that biodiversity could be reduced? 3) Do the various processes in the value chain produce many side products and waste? Is this waste treated or re-used?

Participant observation and focus group discussion (FGD) were also conducted to ensure high degree of validity and reliability of the data obtained from the value chain actors. Chain mapping was done to identify opportunities for chain upgrading using the six key questions in VCA. On the other hand, activity based costing, estimation of value additions and cost and return analysis were done to analyze and examine the performance of the seaweed value chain.

Moreover, participatory systems analysis was employed to determine what factors in the context of increasing seaweed production
can be potential starting points for project activities and which ones may require further investigation and better understanding for enterprise sustainability and competitiveness. A focus group discussion (FGD) involving 12 participants was used to carry out the PSA exercise where participants were asked exhaustively to identify the factors that would lead to the increase in production in the value chain of seaweeds as this was what the participants envisioned to happen for the seaweed industry in the island.

Opportunities and constraints along the value chains were identified and examined using the market maps, estimates of value additions, and insights drawn from the PSA exercise, key informants and other stakeholders. These set of opportunities and constraints constituted the primary basis of upgrading strategies. Opportunities were in terms of improving the value chain efficiency for value chain upgrading.

Results and Discussion

Industry Overview of Seaweed Industry in Leyte

Industry data showed an increase in the production of seaweed in Leyte from 2002 to 2012. The increase in production volume was mainly attributed to the expansion of areas for seaweed farming in the area. Currently, two hundred thirty nine (239) hectares were utilized for seaweed farming in Dawahon, Bato, Leyte (Municipal Agriculture Office, Bato Leyte, 2013) Expansion of farm areas is credited on high market demand and better price of seaweed and its products.

This paper is drawn from theory on Dewey’s philosophy of education. According to Dewey, education is not an isolated enterprise but one closely connected with, affected by, and achieved with and for social change. Education is largely shaped and determined by social needs, consciousness, and circumstances, and in turn plays an important role in social formation. The close relationship between school and society is clearly indicated in Dewey’s My Pedagogic Creed which explicitly declared that “education is the fundamental method of social progress”. Henceforth, it is believed that any educational institution is committed to social reforms, and that students should be aware of the world in which they live and know how to interact with the world in meaningful ways that have a real sense of purpose.

However, to date, seaweed processing plants in the country have to import around 80,000 metric tons (MT) of raw seaweed or its carrageenan equivalent mostly from Indonesia because local farms could no longer supply their requirements (Seaweed Industry Association of the Philippines)

Prices of seaweeds vary depending on the form. Dried seaweeds at farm gate are priced at Php 20.00 currently, while fresh are priced at Php 3.50 per kilo. Prices of these products are significantly dictated by demand and supply.

Value Chain Mapping

Key Customer and Product Requirements

Seaweeds are traded in fresh and dried form. Key customers of dried seaweeds involve carrageenan processors (4) from Cebu (3) and Tacloban (1). Estimated volume of dried seaweeds traded among these buyers ranges from 40-60 metric tons per month per buyer. Specific product requirements for dried spinosum seaweeds were required by these buyers from farmer-traders. Among these were the following: moisture content = 38% max, impurities that come from the inclusion of other seaweeds, wood, dirt, and other foreign matters other than sand and salt = 3% max, salt = 20% max and sand = 3% max. Results however, showed that the latter aren’t able to meet quality requirements due to poor post harvest practices resulting to an overlay of costs to carrageenan processors and lesser income to farmers and farmer-traders. For
fresh seaweeds, green colored spinosum is required by retailers and walk-in-buyers from neighboring towns and cities of Bato.

**Key Players and their Roles**

Input suppliers, farmers, farmer-traders and final buyers were the major industry players in Dawahon Island performing important roles along the different segments of the value chain (Figure 2). Planting materials, wood stakes and straws were the most important inputs in seaweed farming and it was the role of input suppliers to provide these necessary materials for seaweed production. Production activities were carried out by farmers. Then after, produce are transported to farmer-traders. Dried seaweed produced by farmers moved and converged at farmer-traders level. Storage of dried seaweeds was carried out after procurement of produce from farmers to accumulate a volume that can warrant trade to final buyers from Cebu and Tacloban. An annual average volume of 192,000 kilograms of dried spinosum seaweeds were traded and distributed by a single farmer-trader to final buyers.

Across the value chain of seaweeds support services are needed by players because they alone can’t provide all the necessary inputs they need in farming. Hence, the involvement of enablers that provide and support the provision of needed inputs. However, assistance given were inadequate for farmers to become competitive in the industry.

**Activities/Processes and Cost**

A number of activities were carried out in the production, transformation and trading of dried seaweeds. These activities have corresponding costs hence were examined to identify unnecessary costs that may be eliminated to enhance the overall functioning of the chain.

Results showed that pre-planting activities contributed the highest percentage (69 %) to total cost per kg (Php 10.4) (Figure 3). This mainly resulted due to the cost of seedlings. On the other hand, planting activities gave the lowest cost contribution to total cost per kg with a 5 % or Php .48 per kg.

Materials and labor costs were the highest contributors to the subtotals of each major activity (Figure 4). Sixty seven (67 %) of the total cost per kg was contributed by material costs which include planting materials, wood stakes, straws and fuel followed by labor costs which contributed sixty percent (60 %) to
Figure 2: Value Chain Map for Fresh and Dried Seaweeds in Dawahon Island, Bato, Leyte.

Figure 3: Production Activities and their Percentage (%) Contribution to Total Cost/Kg.
In trading seaweeds, dried seaweeds several activities were also performed. These involved procurement, weighing, storing, sacking, and transporting. Among these, the largest portion (91%) of the total cost per kg was attributed to the purchase of dried seaweeds. At an average annual traded volume of 192,000 per farmer trader, average cost for trading dried seaweeds is at Php 16.26 and Php 16.68 for trading dried seaweed to Tacloban and Cebu respectively.

**Product, Information and Payment Flow**

Different types of flows drive the overall performance of the value chain. These include product, information, and payment flows. These flows also assess the effectiveness and efficiency of the value chain.

**Product flow along the seaweed value chain**

Product flows include the flow of the product from the farmer including the several transformations undergone by the product till it reaches the final buyer. It also includes the quantity of dried seaweeds flowing along the chain. After harvest, produce will undergo drying for two (2) to three (3) days, four (4) at most depending on the weather condition. A ratio of 6:1 fresh to dry weight ratio i.e for every six (6) kilograms of fresh seaweeds, recovery is only one (1) kilogram after drying. Results showed that before reaching final buyers, produced dried seaweeds pass the intermediation of farmer-traders. It also showed that there is a 67.12% gap between the desired volume by final buyers and actual volume dried seaweeds traded by farmer traders. The 2,880,000 actual volume traded is not enough to satisfy the desired volume of dried seaweeds by final buyers. Hence, there is a need for an increase in production.

**Payment flow**

As the product moves from each segment of the value chain, losses were incurred, reducing supply. A percentage loss of 10% was incurred at farmer’s level. Post harvest losses, theft, and the occurrence of “ice-ice” were the main cause of the loss. Another 5% was lost at farmer-traders level caused by transport damages e.g., the increase in moisture content due to poor stacking pattern. A price difference of Php 6.00 was observed between farmers and farmer-traders. This mainly resulted as the difference between the selling price of fresh (farmers) and dried seaweeds (farmer-traders). Cash on delivery is the typical mode of payment practiced by players in the value chain of seaweeds wherein it was agreed that farmers carry-out production activities while farmer-traders handles transportation expenses to agreed trading places by final buyers.

**Information flows along the chain**

Critical information flows along the value chain include price and technical information flow. Across the seaweed value chain, final buyers, farmer-traders, and co-growers were the primary source of price information. These informations were determined using comparison or prevailing market prices and were communicated to other players along the chain using direct communication and text messaging.

Technical production information that included planting techniques, site selection criteria, prevailing diseases, harvest and post harvest (drying) and marketing (pricing) information were sourced out from their own and other growers experiences. These informations however, need validation.

**Logistic Issues and External Influences**

Several logistic issues have been identified that exert strong influence on the overall performance of the chain, affecting the movement of the product from farmers to the
reliable market. Decline in the productivity of farms caused by the occurrence of “ice-ice” disease had been the primary problem of stakeholders in the seaweed industry. Thefts, typhoons and the insufficiency of capital were also identified as major problems affecting farm operations that in effect reduce the supply of seaweeds.

On the other hand, low supply of quality dried seaweeds mainly caused by inefficient post-harvest activities was the major logistic issue affecting final buyers. This in turn affects the demand of dried seaweeds from Dawahon Island, affecting the income of farmers and farmer-traders. Strengthening inadequate external support services e.g input and capital provision for seaweed farming by enablers (BFAR, DA, Municipal Agriculture, farmer-traders and etc.) were still needed to allow the chain to perform better and be more competitive through the succeeding years.

### Value Chain Performance Analysis

Chain performance was assessed by analyzing value added and cost and return at each node of the chain including the examination of the externality of the value chain on the environment.

**Value Added along the Chain.** Value added i.e. price of Php 15.00 minus total cost per kg of Php 10.43, at the farmer’s level was estimated at about Php 4.57. This implies that for every kilogram harvested and traded by farmers to the next player in the chain, an amount of Php 4.57 per kilogram was left to the farmer to cover up expenses and realize profit. A value addition of Php 4.74 per kg was observed at trader’s level for trading.
seaweeds to Tacloban and Php 4.32 per kg for trading dried seaweeds to Cebu (Figure 6). Performance analysis was done using activity based costing. A significant Php 0.41 per kg difference in total costs for trading dried seaweeds between Tacloban and Cebu was observed hence calculation of value addition was separated. This mainly resulted due to considerable difference in overhead costs. This difference in cost had discouraged farmer-traders in trading dried seaweeds to Cebu City. High demand of dried seaweed from final buyers in Cebu however restrains farmer-traders to discontinue trading to Cebu.

Cost and return analysis Cost and return analysis was used to assess the profitability performance of each segment of the value chain. Along the value chain, highest net return was observed at trader’s level particularly trading in Tacloban (Figure 6). Positive ROIs and NPMs along the value chain of seaweeds were also observed with farmers recording the highest at 45 % ROI and 31 % NPM. This implies that farmers were effective by 45 % in terms of generating profits with its available assets and 31 % effective in turning sales to profit. Meanwhile farmer-traders were still considered the most benefited along the chain due to the fact that they are less constrained by the produce of their farms and higher trading volume capacity.
Figure 6: Value Chain Performance Analysis of Dried Seaweeds in Bato, Leyte.

Figure 7: Production activities and its possible impact to the environment.

Figure 8: PSA Quadrant, Increasing Productivity of Seaweed Farms in Dawahon Island, Bato, Leyte.
Value Chain Externality to the Environment

The result of the assessment focused on the input and production activities performed by value chain actors. Figure 7 shows production activities and the possible impact it have on the environment that may affect the sustainability of seaweed farming. Pre-planting activities which include the removal of eel grasses, stones, rocks, sea urchins and starfishes may result to the potential loss of native species and habitat diversity. (Juanich, 1989) and (Pullin, 1989) as cited by (FAO, 2014) reported that site preparation for Euchuema species which involves the removal of rocks and other obstructions and potentially competitive grasses or predators could result in some damage to coastal ecosystems, and in some instances the loss of some species of conservation interest, such as sea grasses and corals.

Meanwhile, FAO reports overcrowding in farm areas or intensified farming to significantly reduce water movement affecting the transport of nutrients to the crops and may cause rising in seawater temperature adversely affecting the productivity of the crop (lowered growth rates), a precondition of the occurrence of two important farm problems, the occurrence of “ice-ice disease” and bloom of epiphytes. These conditions also exert a negative impact on associated flora and fauna (FAO; Fisheries and Aquaculture Department, 2014).

The use of wood stakes and straws as structural supports and monolines was considered as one of the biggest threat seaweed farming has on the environment. Results of the survey showed that about 5,736,000 wood stakes were being utilized per year in Dawahon Island that if continued may result to the disturbance of the forest itself in the neighboring areas of Dawahon affecting terrestrial ecosystems. These wood stakes were made from tree species such as guava, “caimito”, ”tsa” and mangroves. As for straws, disposal was the major problem and was very evident in the Island. The abundance of used straw materials can be seen everywhere in the island. The thing about straws is that they are only utilized for a cropping season and are not recycled or re-used for the next cropping since the practice is laborious. However, it is important to consider the impact the use of straws have on the sustainability of seaweed farming. For an area of one (1) hectare, twelve thousand (12, 000) straw lines are being used per year for six (6) cropping seasons per year. Considering the areas of seaweed farms recorded by the Municipal Agricultural Office in Bato, Leyte, a considerable two million eight hundred sixty eight thousand (2,868,000) of straw lines are being utilized per year for six (6) cropping seasons per year and are disposed elsewhere in the islet since there are no proper dumping site for waste materials in the islet. Domestic pollution from farmhouses (human-waste disposal) is also a problem in the islet and may also have a negative impact on the environment. These issues have to be addressed for sustainability of the seaweed enterprise through the succeeding years.

Value Chain Vision and Upgrading Strategies

Seaweed farmers have envisioned bringing the seaweed enterprise to a higher level of productivity for the success of seaweed enterprise in Dawahon Island. Results of value chain mapping, performance analysis and participatory systems analysis were used to generate upgrading strategies. Six (6) factors were identified during the PSA exercise wherein participants were exhaustively asked to identify the factors that have high and low influence over the other factors in the context of increasing farm productivity (Figure 8). Capital, unfavorable weather condition, and diseases were identified as critical elements. Critical elements are accelerators or catalysts in the system meaning addressing them can
Table 3: Upgrading Strategies for Seaweeds in Bato, Leyte.

<table>
<thead>
<tr>
<th>Logistic Issues</th>
<th>Suggested Solutions</th>
<th>Upgrading Strategy</th>
<th>Product/ Process/ Market</th>
</tr>
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<tbody>
<tr>
<td>Insufficient Capital</td>
<td>Credit facilitation for production, trading</td>
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<tr>
<td>Declining productivity of seaweed farms</td>
<td>Farm expansion to new sites that conform to site selection criteria</td>
<td>Product/Process/Market</td>
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<td></td>
<td>Zoning-to avoid overcrowding</td>
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<tr>
<td>Less empowered farmers</td>
<td>Organization of farmers into associations</td>
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<tr>
<td>High incidence of “ice-ice” diseases</td>
<td>Adoption of new production technologies</td>
<td>Product/Process/Market</td>
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<td></td>
<td>Zoning-to avoid overcrowding</td>
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<tr>
<td>Low quality of dried seaweeds</td>
<td>Trainings on post-harvest techniques</td>
<td>Product/Process/Market</td>
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<tr>
<td>Insufficient support from Enablers</td>
<td>Intensification of support services from government agencies</td>
<td>Product/Process/Market</td>
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Table 4: Upgrading Strategies for Sustainable Seaweed Farming in Dawahon Island, Bato, Leyte.

<table>
<thead>
<tr>
<th>Issues for Sustainability</th>
<th>Suggested Solutions for Sustainable Seaweed Farming</th>
<th>Upgrading Strategy</th>
<th>Product/ Process/ Market</th>
</tr>
</thead>
<tbody>
<tr>
<td>The shortage and use of wood stakes</td>
<td>Adoption of steel bars as support</td>
<td>Process</td>
<td></td>
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<tr>
<td>Overcrowding in farm areas</td>
<td>Zoning</td>
<td>Process</td>
<td></td>
</tr>
<tr>
<td>Straw disposal</td>
<td>Adoption of nylon ropes as monolines</td>
<td>Process</td>
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be potential starting points for development activities. The shortage of wood stakes, area shortage and theft appeared to be buffers in the system; these elements are expected to have little impact on the context of increasing productivity.

Table 3 showed certain logistic issues identified in the PSA exercise that were needed to be addressed to upgrade the value chain to a higher level of productivity. Upgrading strategies were geared toward the vision of farmers for the seaweed enterprise in the island-increasing productivity. These involved credit facilitation, farm expansion to new sites that conform to site selection criteria, zoning, organization of farmers into associations, adoption of new production technologies, trainings on post-harvest techniques and the intensification of support services from government agencies.

Organization of seaweed farmers to an association was suggested to eliminate the intermediation of farmer-traders acting as converging point of dried seaweeds to acquire higher volume for trade in the chain. In addition, the organization can also act as a consolidating center wherein the quality of products in terms of moisture content, variety, impurities and etc are assured before transport to final buyers. Moreover, this also provides easier access to external support services.

Upgrading strategies for sustainable
seaweed farming were shown in Table 4. The adoption of steel bars was suggested to limit the use of wood stakes that in the long run may have damaging effect on the whole terrestrial ecosystem were wood stakes are sourced out. The use of nylon ropes instead of plastic straws was also suggested to solve the problems of straw disposal which was evident on the island. Zoning was also suggested to avoid overcrowding in farm areas.

Conclusion

Several issues, problems, gaps and constraints were found in the current value chain. Some of these include the occurrences of ice-ice disease, insufficiency in capital, unfavorable weather condition, thefts and insufficient support from enablers. Meanwhile, opportunities are available to upgrade the value chain to a higher level of competitiveness and profitability. These include the following: input provision or credit facilitation support program to farmers, zoning, farm expansions to new sites that conform to site selection criteria, organization of farmers into associations, extension support program to farmers relating post-production techniques and the adoption of steel bars and nylon ropes as support structures and monolines in seaweed farming.

In summary, value chain analysis was environmentally extended to identify appropriate and sustainable intervention measures to improve the profitability and competitiveness of the seaweed industry in Dawahon Island to ensure a more sustainable stream of economic benefit to all chain actors in the future preserving the viability of essential livelihood of farm households in the area. Further, recommended upgrading strategies should be studied further and implemented carefully since these may have unexpected and undesired side effects to the system.

References


