

The profitability ratio analysis of fresh dried seaweed and processed KD foliar fertilizer in Punta Biao, Cogon Digos City, Davao del Sur

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Abstract: *This study determined the profitability ratio analysis of fresh seaweed, dried seaweed, and processed KD foliar fertilizer in Punta Biao, Cogon, Digos City, Davao del Sur. Specifically, the study evaluated net profit sales, return on investment (ROI), net income profit margin, and break-even analysis of the different seaweed products. The research employed a descriptive research design and was conducted from December 2017 to February 2018 among eight identified seaweed farm sites that were beneficiaries of the Integrating Social Entrepreneurship through KD Foliar Fertilizer with Seaweed Farmer Organization (ISE-KD) Project funded by the Commission on Higher Education (CHED). Data were gathered using structured survey questionnaires and analyzed through frequency counts, percentages, and regression analysis.*

Results revealed that dried seaweed processed into KD foliar fertilizer generated the highest net profit sales amounting to ₱3,371.00 compared to fresh seaweed and dried seaweed alone. It also obtained the highest return on investment at 81.6% and the highest net income profit margin of ₱10.13 per unit, indicating that value-adding activities significantly increased profitability. Break-even analysis showed that fresh seaweed required 200.67 kilograms, dried seaweed required 67.9 kilograms, and KD foliar fertilizer required 55.05 liters to recover production costs. The findings suggest that processing seaweed into value-added products such as KD foliar fertilizer provides greater economic returns for seaweed farmers. The study recommends strengthening value-adding initiatives, improving farming practices, increasing production inputs, and providing financial management training to enhance profitability and sustainability in the seaweed industry.

Keywords: Health Economics, Enterprise Growth, FEM, REM

Introduction

The farming of seaweed has expanded rapidly as demand has outstripped the supply available from natural resources (FAO, undated). Growing seaweeds is not only found in Asia but also in other parts of the world, such as in Europe. The worldwide seaweed industry provides a wide variety of products for direct or indirect human uses that have an estimated total value of US\$10 billion per year (Bixler and Porse 2011; FAO 2013). Sea vegetables for human consumption constitute about 83 % of production (Craigie 2011), while the remainder is used as fertilizers and animal feed additives, medical applications (Zimmermann et al. 2005; Ehrhart et al. 2013), and biotechnological applications (McHugh 2003).

Products derived from seaweeds, from various red and brown seaweeds, are three hydrocolloids, namely: agar, alginate and carrageenan. Alginate, agar and carrageenan are water-soluble carbohydrates that are used to thicken (increase the viscosity of) aqueous solutions, to form gels (jellies) of varying degrees of firmness, to form water-soluble films, and to stabilize some products, such as ice cream (they inhibit the formation of large ice crystals so that the ice cream can retain a smooth texture) (FAO, undated). In addition, seaweeds are increasingly seen as an alternative to land-grown products in food and feed applications (van der Burg et al., 2012).

In the Philippines, the seaweed industry is growing around 10 percent to 14 percent annually churning earnings of 3 billion to 4 billion US dollars from both domestic sales and export shipments benefiting around 160,000 Filipino fishermen, coastal farmers and island dwellers, a statement by seaweed industry consultant Ronald Simbahon published by Pena (2009). By 2010, the Philippines became the world third largest producer of aquatic plants including seaweeds having produced 10.03% or 1.74 million metric tons of the world total production of 17.34 million m.t. (FAO, undated).

Seaweed farming in the Philippines does not only augment income to small-scale fishermen in the coastal areas by also generates jobs for the surrounding households. Braun (2016) agreed that seaweed farming has grown into an industry offering sustainable employment in developing and emerging economies, notably China (which produces over half of the world's seaweed harvest – 12.8 million tonnes), Indonesia (27% of world production – 6.5 million tonnes), the Republic of Korea and the Philippines.

Davao Region is an upcoming seaweed producing area and currently, according to Dr. Bacaltos (Fusilero, 2014) the region can produce about 3,600 metric of seaweeds. In value-adding the seaweed, it can produce different products like seaweed powder, food products, cosmetics, soaps and seaweed fertilizer.

Although, the region is suitable to seaweed growing, seaweed farmers remain poor despite the economic benefits they obtain from the industry (Romero, 2002). To be able to provide data on the current economic status of the seaweed industry in the Davao del Sur, this profitability research will be conducted.

Objectives of the Study

Commonly, this study aimed to determine the profitability ratio analysis of fresh dried seaweed and processed KD foliar fertilizer in Punta Biao, Cogon Digos City, Davao del Sur. Specifically, this study aimed to answer the following questions:

1. To determine the net profit sales from fresh seaweed, dried seaweed and processed KD foliar fertilizer in Punta Biao Digos, Davao del Sur.
2. To determine the return on investment (ROI) from fresh, dried seaweed and processed KD foliar fertilizer in Punta Biao Digos, Davao del Sur.
3. To determine the income (loss) profit margin from fresh, dried seaweed and KD foliar fertilizer in Punta Biao Digos, Davao del Sur.
4. To determine the break even analysis from fresh, dried seaweed and KD foliar fertilizer in Punta Biao Digos, Davao del Sur.
5. To develop the production models for seaweed products in the form as fresh seaweed dried seaweed and dried seaweed plus KD foliar fertilizer.

Significance of the Study

The profitability ratio analysis of, fresh ,dried seaweed and processed KD foliar fertilizer in Punta Biao, Cogon Digos, Davao del Sur. The seaweed farmers are the beneficiaries of the result, since it will provide reflections on their hard works and diligent farming. The information will benefit the farmers to help them how to generate substantial income out of seaweed. This study may serve as a guide to new and old farmers on how profitable the seaweed farming is. It is also one way of encouraging, uplifting farmers to be more productive, and helping the economy in the locality and country as a whole.

In government sector specifically in the Department of Agriculture (DA), the information out of the study may help them to conduct more sessions, trainings to help the growers maintain their production successfully. The Department of Agriculture has the potential power for the development of a competitive innovative and market-orientated agriculture based on the production of the top quality wholesome products. The researcher will also benefit from the study in a way that, it will provide enough data and information as they want to conduct the study.

Scope and Limitation of the Study

The study is restricted only to the seaweed farmers in Punta Biao Cogon, Digos, and Davao del Sur.

The study is a descriptive research and was conducted last January 2018 in Punta Biao Cogon, Digos City, Davao del Sur by using a prepared survey questionnaire. There were 8 identified farm sites in the study all of them are the beneficiaries of the ISE KD Project funded by the Commission of the Higher Education (CHED).

Definition of Terms

The following terms are defined operationally for clearer and better understanding of this study.

Break Even analysis - it is measured in terms of the total variable cost was computed by using the variable cost per unit divided the number of units. The number of units refers to average volume produced/harvested.

Net Income (loss) Profit Margin – it is measured in terms of production cost per unit minus prevailing price per unit.

Net Profit Sales - It is measured in terms of the total fixed cost minus the gross income.

Price - refers to the quantity of payment or compensation given by one party to another in return for goods or services.

The profitability ratio analysis of fresh dried seaweed and processed KD foliar fertilizer in
Punta Biao, Cogon Digos City, Davao del Sur

Production - it is the ways and means on producing something wherein proper care and maintenance is observe.

Return on Investment (ROI) – it is measured in terms of the average net income divided by Average production cost.

Review of Related Literature

Importance of Seaweed Growing

Norambuena (n. d.) reported that in the last fourteen years the production of seaweeds in Chile has ranged from 74 000 to 229 000 wet metric tons per year and has included about twenty species belonging to Phaeophyta and Rhodophyta. Initially most of the raw material was exported but currently important quantities of *Gracilaria* and several carrageenophytes are being processed by local industry. Changes in production of the main resources are analyzed with consideration of potential demand, level of knowledge about natural beds, and the situation of total *Gracilaria* farming, in order to attempt predictions for the supply.

According to Troell et al. (2006) Kelp seaweed will continue to play an important role as feed and kelp areas previously not utilized may become cost-effective to harvest. There are many benefits from on-farm seaweed production and it will probably be a part of future expansion of the abalone industry.

Samonte-Tan (2007) declared that coastal ecosystems are rich in biodiversity and provide economic opportunities to the coastal communities. Tourism and the municipal fisheries are the most important direct use values of the coastal and marine resources.

Branch et al. (2010) reported that the marine resources could be divided into those of high value and those of lower value. It is argued that high-value resources are best used to create micro- and small-scale commercial enterprises that can serve to uplift poor fishers. Low-value resources constitute subsistence resources, for which preferential rights should be established for subsistence fishers, including development of exclusive-use zones where necessary. Emerging characteristics of fishing communities that were helpful in defining subsistence fishers context were poverty, harvest for self-use (whether by consumption or sale to meet basic needs of food security), use of low-technology gear, and concentration of effort on or from shores or in estuaries.

Hayashi et al. (Undated) Global warming is of increasing concern worldwide. The question of how to mitigate the CO₂ released into the atmosphere is the most topical issue, and sustainable solutions are constantly being sought. Aquaculture has been proposed as one method for the sequestration or immobilization of CO₂ through filtration or mechanical/chemical processes for long-term storage (Carlsson et al., 2007). However, the development of new sustainable technologies are but in their infancy, as the aquaculture sector moves to becoming more efficient and sustainable.

According to Hill et al. (2012) alternative occupations are frequently promoted as a means to reduce the number of people exploiting declining fisheries. However, there is little evidence that alternative occupations reduce fisher numbers. Seaweed farming is frequently promoted as a lucrative alternative occupation for artisanal fishers in Southeast Asia.

Seaweed are considered versatile industrial material, Jang (Undated) The major component of *Ulva pertusa* (green seaweed), *Laminaria japonica* (brown seaweed)

and *Gelidium amansii* (red seaweed) is carbohydrate which can be converted into variety of sugars using sulfuric acid with hot-compress treatment. Rhamnose (37.89 wt %) and glucose (16.14 wt %) were extracted from dried *U. pertusa*, while galactose (49.32 wt %) and glucose (12.62 wt %) were extracted from dried *G. amansii*. Mannitol (31.53 wt %) was produced from dried *L. japonica*. Van der Wal et al. (2012) added that green seaweed *Ulva lactuca* was characterized as feedstock for acetone, ethanol and ethanol fermentation. Solubilization of over 90% of sugars was achieved by hot-water treatment followed by hydrolysis using commercial cellulases. A hydrolysate was used for the production of acetone, butanol and ethanol (ABE) by *Clostridium acetobutylicum* and *Clostridium beijerinckii*. Hydrolysate-based media were fermentable without nutrient supplementation. *C. beijerinckii* utilized all sugars in the hydrolysate and produced ABE at high yields (0.35 g ABE/g sugar consumed), while *C. acetobutylicum* produced mostly organic acids (acetic and butyric acids). These results demonstrate the great potential of *U. lactuca* as feedstock for fermentation. Interestingly, in control cultures of *C. beijerinckii* on rhamnose and glucose, 1,2 propanediol was the main fermentation product (9.7 g/L).

Profitability Analysis of Seaweed

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 maybe because of the factors affecting to it like postharvest losses, theft, ice-ice disease and transport damages. Performance analysis revealed that traders were the most benefited along the seaweed value chain (Galco et. al, 2014) while Holmyard (2011) believes that a combination of labour costs, lack of access to the large areas required, a lack of investment into methods of mechanization and no history of growing what is seen as a low status product are also major consideration why the income of the our seaweed industry fluctuates time to time.

Seaweed Production

Currently, seaweed is not produced at a significant scale in the North Sea. According to FAO data, the countries bordering the North Sea produced no seaweed at all until 2007. The latest data report 40,000 tons of seaweed production in Denmark. Various research projects investigated the technical feasibility of seaweed production in marine temperate waters including the North Sea, using different culture methods. In the first section, ongoing projects are reviewed, looking for information on the cost of seaweed production. In the second section, the costs of seaweed production in the North Sea are estimated based on expert judgment. However, Valderrama et al. (2015) stated that the economics of kappaphycus seaweed cultivation in developing countries showed large differences in the economic performance of seaweed production in the countries studied (Indonesia, Philippines, Tanzania, India, Mexico, Solomon Islands) seaweed farming is a profitable business.

Profit Net/Loss Analysis/ROI

Fixed cost is estimated to Php 15,400 or equivalent to cash outflows of php600 for paddling or flat-bottom boat 2ftx 4ftx16 ft (hwl) + php6, 000 pump boat (to bring wet seaweed to shore if farmers does not have drying platform) + php5, 000 (100 kg stock 1-ha) + php1, 000 for stakes+ php1, 000 for nylon+ php1, 800 for tools (canvas spread for drying, tarpaulin, baskets, sledge hammer, digger bars etc). the operation or variable cost is estimated to be php 19,400 or equal to a total of php10, 000 for labour (1-ha require 4 persons or 0 if family members are drawn upon for labour) + php5, 000 for food (cost of food for 4 persons at php4.00 per person per day) + php 1,400 (30 liters diesel per month x php48 per liter, farmers uses

The profitability ratio analysis of fresh dried seaweed and processed KD foliar fertilizer in
Punta Biao, Cogon Digos City, Davao del Sur

paddle or rafting to save fuel) + php3, 000 for others (raffia, stakes, maintenance, depreciation and contingencies). the revenue is calculated based on 3 harvests per year (or six months January to August). according to those with at least 12 years farming experience, on average propagules grows 10% or least double (slow growing strains or infected with ice-ice disease) within 45 days. at the end of round(r) 1, farm incurred loss or deficit php 200 which is derived from revenue php 35,000 (saving = 300kg wet for next round seedlings) minus total cost php34, 800. at the end of r2, farm reached break even and made profit php15, 600 derived from php35, 000 minus only variable cost of php19, 400. the 1-ha farm profit margin at r3 is 100 percent. the payback period is at least four good months and internal rate of returns on investment (ROI) was at 101% (Alin et.al., 2015).

Seaweed Farming as Opportunity for Coastal Families

Hill et al. (2012) found out that respondents thought seaweed farming and low fish catches had reduced fisher numbers, at least temporarily. In one of these villages, there was a recent return to fishing due to declines in the price of seaweed and increased theft of seaweed. In another four villages, fisher numbers increased as human population increased, despite the widespread uptake of seaweed farming. Seaweed farming failed for technical reasons in two other villages. Our results suggest seaweed farming has reduced fisher numbers in some villages, a result that may be correlated with socioeconomic status, but the heterogeneity of outcomes is consistent with suggestions that alternative occupations are not a substitute for more direct forms of resource management.

Sievanen et al (2005) suggested that seaweed farming is a popular alternative livelihood. It concludes that in some cases seaweed farming has reduced certain types of fishing activities, but it should not be assumed that seaweed farming alone will result in reduced fishing effort. Appropriately combined with other resource management tools, seaweed farming can contribute to an integrated seascape management approach by providing one component of a diversified household livelihood strategy.

Neori et al. (2003) Today's integrated intensive aquaculture approaches, developed from traditional extensive polyculture, integrate the culture of fish or shrimp with vegetables, microalgae, shellfish and/or seaweeds. Integrated mariculture can take place in coastal waters or in ponds and can be highly intensified. Today's technologies are well studied and documented. They are generic, modular and adaptable for several culture combinations of fish, shrimp, shellfish, abalone, sea urchin and several species of commercially important seaweeds and vegetables. A 1-ha land-based integrated seabream–shellfish–seaweed farm can produce 25 tons of fish, 50 tons of bivalves and 30 tons fresh weight of seaweeds annually. Another farm model can produce in 1 ha 55 tons of seabream or 92 tons of salmon, with 385 or 500 fresh weight of seaweed, respectively, without pollution. Preliminary calculations show a potential for high profitability with large integrated farms. Therefore, modern integrated systems in general, and seaweed-based systems in particular, are bound to play a major role in the sustainable expansion of world aquaculture.

Troell (2009) identified that the marine aquaculture sector is growing rapidly. Simultaneously, there has also been increased interest in both land-based and nearshore aquaculture systems which combine fed aquaculture species (e.g. finfish), with inorganic extractive aquaculture species (e.g. seaweeds) and organic extractive species (e.g. suspension- and deposit-feeders) cultivated in proximity. A variety of technologies have been developed to deal with these constraints in offshore environments, but there remains a number of challenges in designing farm sites that will allow extractive species (e.g. seaweeds and shellfish) to be

integrated in fed aquaculture systems and be able to withstand the strong drag forces of open oceans.

Braun (2016) cited that “with fisheries stagnating, cultivating seaweed helps fill a gap and is widely perceived as one of the most environmentally benign types of aquaculture activity, as it does not require additional feed or fertilizers”. Consequently, it has been actively promoted by government initiatives, particularly in many developing countries where communities have reduced access to alternative livelihoods or are involved in destructive fishing methods like dynamite fishing. He further presented that: increasingly, seaweed cultivation is also being integrated with intensive fish farming to provide nursery grounds for juvenile commercial fish and crustaceans, and to filter undesired nutrients and improve the marine environment and reduce eutrophication; indirectly, seaweed farming has reduced over-fishing in many regions, providing coastal communities with an alternative livelihood and in some places, women have become economically active for the first time. Braun added that “in the last decade, seaweed cultivation has been expanding rapidly thanks to growing demand for its use in pharmaceuticals, nutraceuticals and antimicrobial products, as well as biotechnological applications”. “Seaweed today is used in some toothpastes, skin care products and cosmetics, paints and several industrial products, including adhesives, dyes and gels. Seaweed is also used in landscaping or to combat beach erosion.”

However, according to Jensen (n. d.) the supply and demand of seaweed vary from balanced, in some, to disproportionate in other fields. World-wide shortage of agarophytes contrasts with huge, unexploited beds of brown seaweeds. These conflicting trends will decide the needs for algae and algal products and the growth in the human population, pollution, overexploitation of land and lack of freshwater will encourage use of seaweeds. Modern biotechnology will favor this development, but will also be a serious threat to industrial exploitation of seaweeds.

Seaweeds are increasingly seen as an alternative to land-grown products in food and feed applications. Interest in production of seaweeds in temperate waters is rising, in particular in combination with offshore wind energy generation. Successful marketing of seaweed as human food, and the development of biorefinery concepts can increase the value of the produced seaweed (van der Burg et al., 2012).

Rebours (2014) reported that aquaculture of seaweed is scarce outside of Asia, which triggered a worldwide search for hitherto unexploited natural seaweed resources. Rebours cited further that the worldwide seaweed industry provides a wide variety of products for direct or indirect human uses that have an estimated total value of US\$10 billion per year (Bixler and Porse [2011](#); FAO [2013](#)); sea vegetables for human consumption constitute about 83 % of production (Craigie [2011](#)), and the remainder is used as fertilizers and animal feed additives, medical applications (Zimmermann et al. [2005](#); Ehrhart et al. [2013](#)), and biotechnological applications (McHugh [2003](#)).

Profitability in Seaweed Farming

Bixler and Porse (2011) reported that seaweed hydrocolloid markets continue to grow, but instead of the 3–5% achieved in the 1980s and 1990s, the growth rate has fallen to 1–3% per year. This growth has been largely driven by emerging markets in China, Eastern Europe, Brazil, etc. Sales of agar, alginates and carrageenans in the US and Europe are holding up reasonably well in spite of the recession. However, price increases to offset costs in 2008 and 2009 have begun to have a dampening effect on sales, especially in markets where substitution or extension with less expensive ingredients is possible. These higher prices have been driven by higher energy, chemicals and seaweed costs. The higher seaweed costs reflect seaweed

shortages, particularly for carrageenan-bearing seaweeds. The Philippines and Indonesia are the dominant producers of the farmed *Kappaphycus* and *Eucheuma* species upon which the carrageenan industry depends and both countries are experiencing factors limiting seaweed production. Similar tightening of seaweed supplies are beginning to show up in brown seaweeds used for extracting alginates, and in the red seaweeds for extracting agar. The structure of the industry is also undergoing change. Producers in China are getting stronger, and while they have not yet developed the marketing skills to compete effectively in the developed world markets, they have captured much of their home market. China does not produce the red and brown seaweeds needed for higher end food hydrocolloid production. Stocking their factories with raw material has led to the supply problems. Sales growth continues to suffer from few new product development successes in recent years; although some health care applications are showing some promise, i.e., carrageenan gel capsules and alginate micro-beads.

Neori (2008) suggested that the aquaculture industry can protect its own interests – and reap major benefits – by understanding the importance of ecological balance, the potential of seaweeds as components in feeds, and the importance of the culture and R&D of low trophic level organisms. The industry should also accept the relevance of environmental, social, and image aspects of aquaculture to its success. Governments have the tools to reward multi-trophic farms with seaweeds by means of tax credits and nutrient credits and to penalize unbalanced monoculture approaches by means of ‘polluter pays’ fines, thereby providing the multi-trophic farms with a significant economic advantage.

Chopin et al (2001) presented that by integrating fed aquaculture (finfish, shrimp) with inorganic and organic extractive aquaculture (seaweed and shellfish), the wastes of one resource user become a resource (fertilizer or food) for the others. Such a balanced ecosystem approach provides nutrient bioremediation capability, mutual benefits to the co-cultured organisms, economic diversification by producing other value-added marine crops, and increased profitability per cultivation unit for the aquaculture industry. Moreover, as guidelines and regulations on aquaculture effluents are forthcoming in several countries, using appropriately selected seaweeds as renewable biological nutrient scrubbers represents a cost-effective means for reaching compliance by reducing the internalization of the total environmental costs. By adopting integrated polytrophic practices, the aquaculture industry should find increasing environmental, economic, and social acceptability and become a full and sustainable partner within the development of integrated coastal management frameworks.

Pena (2009) the Philippine seaweed industry is growing around 10 percent to 14 percent annually churning earnings of 3 billion to 4 billion US dollars from both domestic sales and export shipments benefiting around 160,000 Filipino fishermen, coastal farmers and island dwellers, according to seaweed industry consultant Ronald Simbahon. China-based seaweed traders had been swooping down these past years on Asian countries like Indonesia, Malaysia, and the Philippines gobbling up all their seaweed production outputs by offering high buying prices, to the detriment of domestic manufacturers of carrageenan. Traditional markets in US and Europe have been beset by many problems over the years with some Philippine carrageenan exports blocked by these importing countries due to health and food safety concerns and increasing demand for stricter standards in labeling and certification. The seaweed or hydrocolloids industry in the Philippines continues to grow by 10 to 14 percent annually, with earnings of \$3 billion expected this year, national news agency PNA reported. China is identified as the emerging major buyer for raw material of the carrageenan industry.

However, there are still many uncertainties about the exact costs of production and the potential revenues. The market for seaweed products is diverse. Human consumption offers

highest values but there is currently only a small market demand for seaweeds (Van den Burg et al., 2016).

FAO (Undated) reported that various red and brown seaweeds are used to produce three hydrocolloids: agar, alginate and carrageenan. A hydrocolloid is a non-crystalline substance with very large molecules and which dissolves in water to give a thickened (viscous) solution. Alginate, agar and carrageenan are water-soluble carbohydrates that are used to thicken (increase the viscosity of) aqueous solutions, to form gels (jellies) of varying degrees of firmness, to form water-soluble films, and to stabilize some products, such as ice cream (they inhibit the formation of large ice crystals so that the ice cream can retain a smooth texture). Approximately 1 million tonnes of wet seaweed are harvested and extracted to produce the above three hydrocolloids. Total hydrocolloid production is about 55 000 tonnes, with a value of US\$ 585 million. Alginate production (US\$ 213 million) is by extraction from brown seaweeds, all of which are harvested from the wild; cultivation of brown seaweeds is too expensive to provide raw material for industrial uses. Agar production (US\$ 132 million) is principally from two types of red seaweed, one of which has been cultivated since the 1960-70s, but on a much larger scale since 1990, and this has allowed the expansion of the agar industry. Carrageenan production (US\$ 240 million) was originally dependent on wild seaweeds, especially Irish Moss, a small seaweed growing in cold waters, with a limited resource base. However, since the early 1970s the industry has expanded rapidly because of the availability of other carrageenan-containing seaweeds that have been successfully cultivated in warm-water countries with low labor costs. Seaweed meal, used an additive to animal feed is made from brown seaweeds that are collected, dried and milled. Approximately 50 000 tonnes of wet seaweed are harvested annually to yield 10 000 tonnes of seaweed meal, which is sold for US\$ 5 million. The high fibre content of the seaweed acts as a soil conditioner and assists moisture retention, while the mineral content is a useful fertilizer and source of trace elements. However, in the early twentieth century, a small industry dwindled with the advent of synthetic chemical fertilizers. Today, with the rising popularity of organic farming, there has been some revival of the industry, but not yet on a large scale. Cosmetic products, such as creams and lotions, sometimes show on their labels that the contents include "marine extract", "extract of alga", "seaweed extract" or similar. Alginate or carrageenan could improve the skin moisture retention properties of the product. Pastes of seaweed, made by cold grinding or freeze crushing, are used in thalassotherapy, where they are applied to the person's body and then warmed under infrared radiation. This treatment, in conjunction with seawater hydrotherapy, is said to provide relief for rheumatism and osteoporosis. There are potential uses for seaweed in wastewater treatment. Some seaweeds are able to absorb heavy metal ions such as zinc and cadmium from polluted water. The effluent water from fish farms usually contains high levels of waste that can cause problems to other aquatic life in adjacent waters. Seaweeds can often use much of this waste material as nutrient.

Pena (2009) found out that five years ago, over 100 carrageenan processors were already operating in the Philippines. There are more than 50 additional producers today. The carrageenan industry requires about 80,000 metric tons of dried seaweeds annually. The growing seaweed industry has benefited 160,000 coastal and island dwelling families and allied services farming of over 20,000 hectares. One quarter hectare planted with seaweed would produce 1,000 kg. per cropping within a 60-day cycle. Seaweed raw material could be applied to various food and non-food products and liquids, among others: jellies, ham, patties, sauce, juice, petfood, toothpaste, ice cream, beer, milk and chicken. Aside from economic benefits, seaweed is also a catalyst for ecological preservation since its biomass attracts various marine species that provides sanctuary and breeding ground for marine life while dramatically minimizing destructive fishing practices, Simbajon said. In Mindanao, seaweed farming thrives

The profitability ratio analysis of fresh dried seaweed and processed KD foliar fertilizer in Punta Biao, Cogon Digos City, Davao del Sur in the farmlands of Zamboanga, Cagayan, Cotabato, Butuan, Davao Region and General Santos.

Alin et al. (2015) found out after a 3 harvest cycle in seaweed in one year, an Internal Rate of Returns on Investment (ROI) at 101% have been registered. Studies on economics of seaweed farming in the Philippine indicated that the investment in seaweed farming are highly profitable. Padilla and Lampe (1989:8) stated the ROI for farms in Philippine in 1988 was 78% per annum, which according to the authors “way above the opportunity cost of capital”. No calculations were included. They were assuming away the opportunity cost at 15% (or seaweed priced at PhP4 per/kg) and concluded that seaweed production in the Philippines was still resilient. Another studies by Alih EM (1990) and Salayao et al (1991) reached similar conclusions for Tawi-Tawi islands and for Northeast Sorsogon respectively. Among the latest are Hurtado AQ (2013) and Hurtado AQ, et al (2014), both provided an overview on production, comparing costing as well as the productivity level of different farming techniques, diseases and effect of typhoons to the seaweed production. Only two of the previous studies highlighted the overall production of Palawan province. In a concise note, Mundo et al (2002) said that 20 municipalities in Palawan produced 138,950 m.t. seaweed in year 2000. They also mentioned that seaweed farming in Green Island was a seasonal activity. Pido et al (undated slides) noted that in year 2005, seaweed farming revenue increase the income of the communities in six barangays of Puerto Princesa.

Methodology

Research Locale

Punta Biao, Cogon is a part of Digos City. It is a 2nd class [city](#) and capital of the [province](#) of [Davao del Sur](#), [Philippines](#). According to the 2015 census, it has a population of 169,393 people. The city lies on the western shores of the [Davao Gulf](#) and southern foothills of [Mount Apo](#) on the island of [Mindanao](#), centrally located between the two major cities in [Mindanao](#), [Davao City](#) and [General Santos City](#). It is considered as part of [Metropolitan Davao](#).

Research Site Component

There were eight seaweed farm sites identified in the study. These are small areas and not contagious. The sites are owned by farmers who are beneficiaries of the Integrating Social Entrepreneurship through KD Foliar Fertilizer with Seaweed Farmer Organization (ISE KD) Project. Each farmers was provided with 47 kilos of seaweed propagules and other operating materials to start in the establishment of their farms.

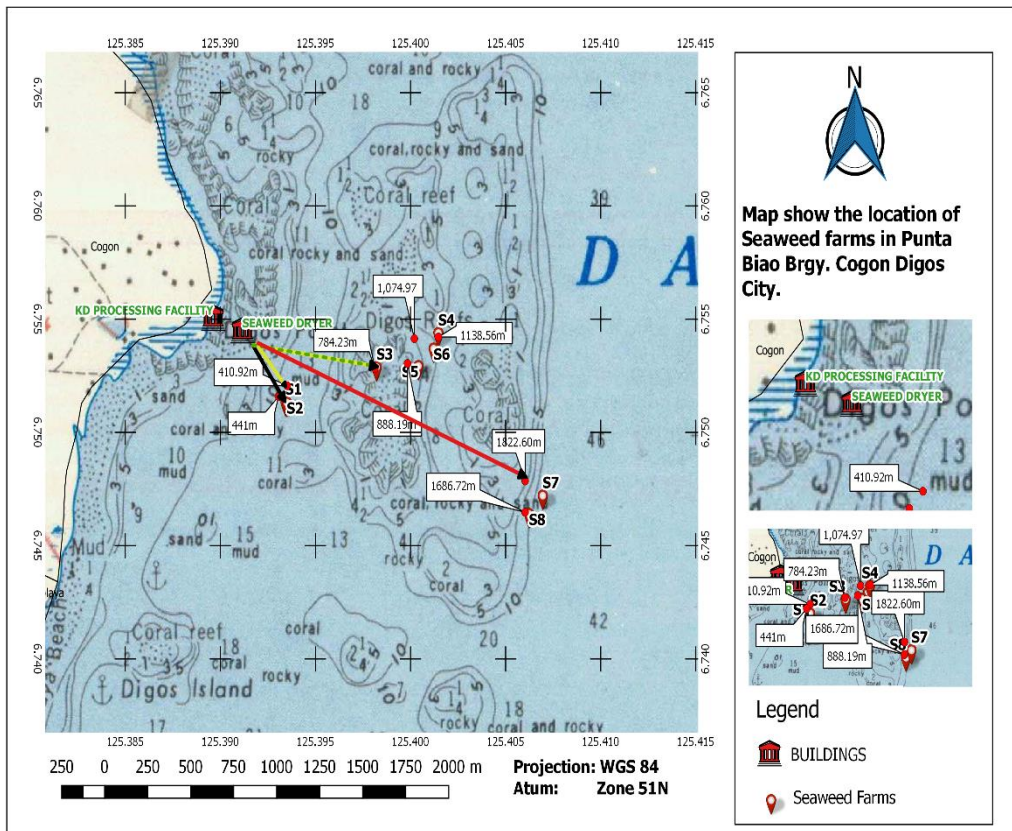
Research Design

The study used causal design. It is usually used in a business environment to quantify the effect that a change to its present operations towards its future production such as the volume of production, net profit sales, return on investment, net (loss) profit margin and break even analysis for Fresh, Dried and Processed KD Foliar Fertilizer, in Sitio Punta Biao Digos City Davao Del Sur.

Sampling Design and Technique

The researcher used the spatial sampling technique in determining the experimental sites, this sampling method and technique gives a new important point of view to economic analysis and already used in agricultural and environmental contexts, while they have never been exploited for establishment surveys. Furthermore, a comparison between methods which

select samples spread in the space and methods which are balanced on geographic coordinates (Espa, et.al 2014). There were eight farm sites identified from the study.



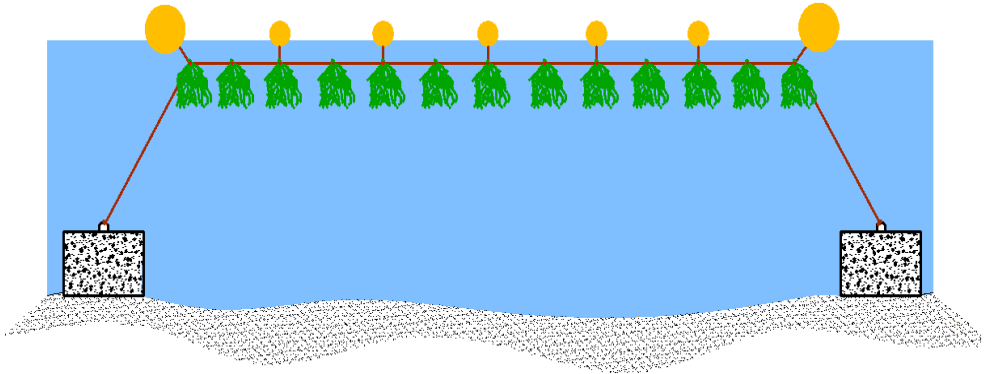
Preparation of the Seaweed Farm Sites

A suitable area for seaweed is the most difficult task encountered in the industry due to the very delicate nature of the plant. The following are some guides in the preparation of the seaweed farm sites.

1. Purchased of propagules and other materials was done by ISE KD team, there were 47 kilos of planting materials distributed to each farmers together with those materials needed like , 90 meters ropes, Polytwine (half roll) softie twine (2.25 roll), bottle containers (1.25kg), Styrofoam etc.

2. Monoline farming was practiced by the farmers it was commonly employed in deeper water up to more than 15 meters deep which is subject to strong wave actions. Flat binders were the common lines used for attachment of propagules in the farm instead of polyethylene ropes as commonly used in floating long lines and other culture methods. This method is intensive farming, which could be equivalent to fixed off-bottom in the shallow waters, but in deeper areas and less space to expand for hanging or floating monolines.

The profitability ratio analysis of fresh dried seaweed and processed KD foliar fertilizer in
Punta Biao, Cogon Digos City, Davao del Sur



Fresh seaweed was harvested after 45 days after planting. This is a standard process to come up with good quality seaweed.

Dried Seaweed

After harvesting the enormous wet bulk of the seaweeds must be reduced by drying for 3-5 days into drying facility. Wet seaweed deteriorates fairly quickly. Moreover, when agar is to be produced, drying is essential because extracts of the seaweed don't have gel. Once properly dried, the weed can be stored for a number of years without appreciable loss of gel content.

KD Foliar Fertilizer

After harvesting, with a kilo of seaweed an improvise tank with a hose in a pre-direct sunlight was ready just to process the KD foliar fertilizer, a minimum of 3 days for this process.

Data Gathered

Data was gathered as to:

1. Net profit sales for fresh, dried, and dried plus KD foliar fertilizer, this data was computed using the *average total fixed cost minus the average gross income*.
2. Return on investment for fresh, dried, and dried plus KD foliar fertilizer, data was computed using the *average net income divided by the average production cost x 100*
3. Net Income (loss) Profit Margin for fresh, dried, and dried plus KD foliar fertilizer, data was computed using the production cost per unit minus the selling price per unit.
4. Break even analysis for fresh, dried, and dried plus KD foliar fertilizer, data was computed using *the average production cost divided by the selling price per unit*.

Data Gathering Procedure

This research study observed the following procedures enumerated below:

1. Formulated the structured questionnaire to suit the need for the study on the volume of production, net profit rate, return on investment, income (loss) and break even analysis for Fresh, Dried and Processed KD Foliar Fertilizer, in Sitio Punta Biao Digos City Davao Del Sur.
2. Requested a permit from the Graduate School Department through the Dean, Barangay and the respondents for the conduct of the study;
3. Administered the questionnaires to the respondents of the study in their respective residences or farms;

4. Collated and tabulated the data collected;
5. Subjected the data collected with statistical tools.
6. Presented the results in tabular form with narrative discussion.

Statistical Tools

Data was analyzed using quantitative methods such as frequency counts, percentage and regression analysis for the responses of the eight farm sites.

Statistical Formula:

Formula: $Rf = \frac{f}{n} \times 100$

Where:

Rf = is relative frequency

f = is the frequency (number of respondents of particular criteria)

n = is the total number of the sample size

Results and Discussion

Net Profit Sales

Table 1 presents the Net Profit Sales of fresh dried seaweeds and Dried Seaweeds plus processed KD foliar fertilizer.

The results indicates that among the products from seaweeds, it is the Dried Seaweeds plus processed KD foliar fertilizer showed highest net profit sales of ₱ 3,371.00 followed by Fresh seaweeds with a net profit sales of ₱523.33. The lowest sales were noticed in Dried Seaweeds with the amount sales of ₱ P 70.67.

These results implied that adding more value to your product will definitely increase your income, however maintaining the quality of the give additional earnings. This observation strengthened by Alivio (undated) that the effective mechanism on how to boost your income is by adding substantial value to your product.

Table 1. Net Profit Sales for Fresh ,Dried Seaweed and KD Foliar Fertilizer, In Sitio Punta Biao Digos City Davao Del Sur.

	Fresh Seaweeds	Dried Seaweeds	Dried plus KD Foliar
Ave. Gross Sales	P 2,530.00	₱2,450.00	₱7,500.00
Ave. Fixed Cost	P 2,006.67	₱2,379.33	₱4,129.00
Net Profit (loss) Rate	P 523.33	P 70.67	P 3,371

Table 2 displays the Return on Investment (ROI) of the three products from seaweeds. Results disclosed that dried plus processed KD Foliar Fertilizer demonstrated positive ROI with of 81.6 % it means high ROI investment's gains compare favourably to its cost (Pearce,2015) thus, Dry (2009) believed that putting more value in the product will recognized in generating higher profits. While, the lowest ROI was documented in Fresh with 26.06 % and dried seaweed with a negative 32.6 % respectively, this means that adding value to a product plays an

The profitability ratio analysis of fresh dried seaweed and processed KD foliar fertilizer in Punta Biao, Cogon Digos City, Davao del Sur important role in gaining a positive ROI. Ottawa (1995), agreed that operation that consistently does not meet sales and profit expectations through innovation generally sees their investments outperform market averages.

Table 2. Return on Investment Fresh, Dried Seaweed and Dried Seaweed Plus KD Foliar Fertilizer, In Sitio Punta Biao Digos City Davao Del Sur.

	Fresh Seaweeds	Dried Seaweeds	Dried plus KD Foliar
Ave. Net income	₱523.33	-₱776.33	₱3,371.00
Average Production Cost	₱2,006.67	₱2,379.33	₱4,129.00
ROI	26.06 %	-32.6%	81.6%

Net Income (loss) Profit Margin

Table 3 represents the Net Income (loss) Profit Margin for Fresh Seaweed & Dried Seaweed, and Dried seaweed Plus Processed KD Foliar Fertilizer. Results showed that among the three seaweed products only the Dried Seaweed Plus Processed KD Foliar Fertilizer gained a highest net income profit margin of P 10.13 meaning the product was gaining more with each unit it produces while both fresh and dried seaweed exhibited lowest net profit margin of P 2.04 and P 1.01 respectively, it means that the product needs to reduce costs and eliminate unusual expenses to achieve higher profit margin.

A net loss means your expenses exceed towards your revenue. According to Norton et. Al (undated), that usually a negative profit margin occurs in first cycle of operation because fixed cost exists that's why it can't generate insufficient sales to cover the costs .A product can sustain as long as it has cash reserves or other sources of capital. To succeed, a company must ultimately grow its sales or reduce its expenses so that it produces net income and a positive profit margin (Porter, 2007).

Table 3. Net Income (Loss) Profit Margin Fresh, Dried Seaweed plus Processed KD Foliar Fertilizer, In Sitio Punta Biao Digos City Davao Del Sur.

	Fresh Seaweeds	Dried Seaweeds	KD Foliar
Ave. production cost	P 2,006.67	₱2,379.33	P 4,129.0
Ave. Volume produced	252 kg	70kg	101L
Selling price per kilo/L	P 10.00	P35.00	P 50.00
Production cost per kilo/Liter	P 7.96	P 33.99	P 40.88
Net Income/loss Profit Margin	P 2.04	P 1.01	P 10.13

Break Even analysis

Break Even Analysis for Fresh, Dried Seaweed and Dried Seaweed plus KD Foliar Fertilizer is shown in Table 4. Results disclosed that to arrive at breakeven value, at the current price, each product should produce number of kilos or liters as shown below. For instance in Fresh Seaweed should produce more than 200.67 kilos to break even the cost of P 2,006.67 at the prevailing price of P10.0 per kilos. It implies that in excess of computed breakeven quantity; the business may generate income/revenue.

For Dried Seaweeds it requires 67.9 kilos times the selling price per kilo is P35.0 to break even the cost of P 2,379.33 while KD Foliar Fertilizer should produce 55.05 liters to breakeven the amount of P 4,129.00. This means that if your break-even point is lower than

your expected revenues, you'll need to decide whether certain aspects of your plan can be changed to create an achievable break-even point. Thus, a technique for analyzing how revenue, expenses and profit vary with changes in sales volume (Martin, 2012).

Table 4. Break Even Analysis for Fresh, Dried and Processed KD Foliar Fertilizer, In Sitio Punta Biao Digos City Davao Del Sur.

	Fresh Seaweeds	Dried Seaweeds	KD Foliar
Average Production cost	P 2,006.67	₱2,379.33	P 4,129.00
Selling price per unit	10.0	P 35.0	P 75.0
BE Quantity	200.67 kilos	67.9 Kilos	55.05 Liters

Seaweed Production Models

Fresh Seaweed Production Model

Figure below show the fresh seaweed production models. The estimated profit model is based on the fresh seaweed production model of $\hat{y} = 10x - 2,006.67$. This means that planter/s of seaweed should produce 200 kilos of seaweed to obtain a break – even. Producing more than 200.67 kilos of seaweed, profit came in. The model is significant for the estimation of the profits.

Results in consonance with Alhabeeb (2012) that to be profitable, it is important to know what your break-even point is and it will dictate how profitable your product.

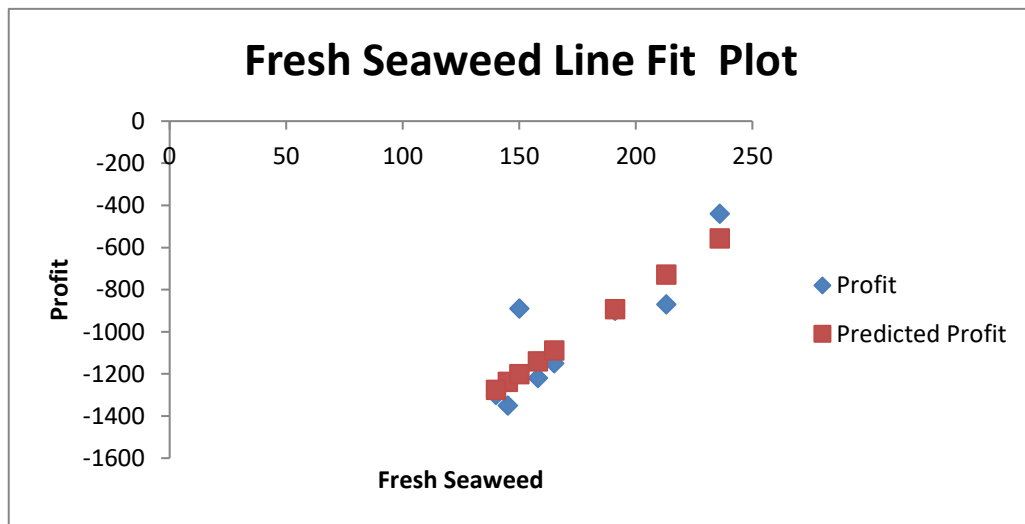


Figure 1. Fresh Seaweed Production Model from Fresh Seaweed, in Sitio Punta Biao, Digos City Davao Del Sur.

Dried Seaweed production Model

The estimated profit model for dried seaweed production is shown in figure 2. A regression model of $\hat{y} = 35x - 2,379.33$. This model shows that break-even is obtained if 67.9 kilograms of dried seaweed were produced.

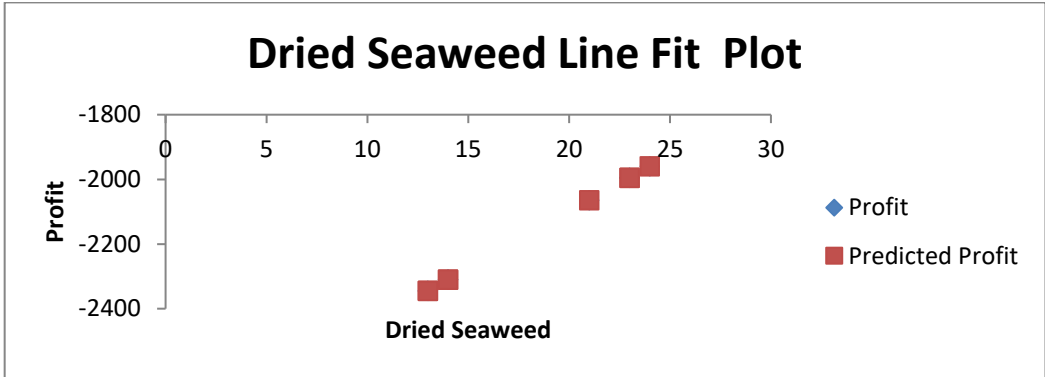
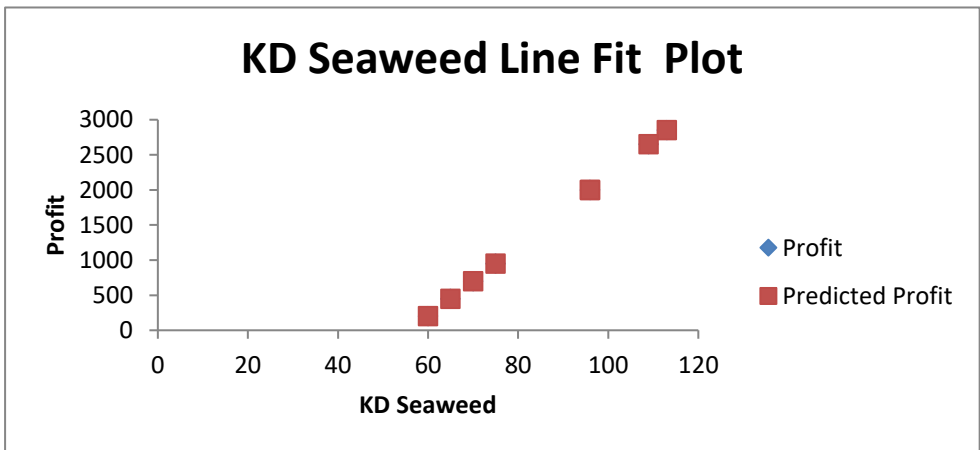


Figure 2. Dried Seaweed Production Models from Fresh Seaweed, in Sitio Punta Biao, Digos City Davao Del Sur.

Dried Seaweed plus KD Foliar Fertilizer Production Model

Dried seaweed plus KD Foliar Fertilizer Production Model from Fresh Seaweed is reflected in Figure 3. The third model is the estimated profit for KD profit model of $\hat{y} = 50x - 2800$. This model means that KD production of approximately 55.05 liters result a break-even of the product. Thus, KD production should be more than 55 liters to increased profitability. Avercamp (2014) believed that in every increase in the production cost without a corresponding increase in selling prices will cause the profit margin to shrink. With fewer profit margins, it will take more sales in order to cover the production cost. Of course, a decrease in selling price will also increase the break-even point. Lim (20170) testified that you have to measure and that calculates the margin of safety by comparing the amount of profits or units that must be sold to production costs associated with making the sales.



KD Foliar Fertilizer Line Fit Plot

Figure 3. KD Foliar Fertilizer Production Model from Fresh Seaweed, in Sitio Punta Biao, Digos City Davao Del Sur.

Summary, Conclusion And Recommendations

Summary

This study was conducted to determine the profitability ratio of fresh, dried and processed KD foliar fertilizer specifically to determine the net profit sales, return on investment, income (loss) profit margin and break even analysis for Fresh, Dried and Processed KD Foliar Fertilizer, in Sitio Punta Biao Digos City Davao Del Sur. There were 8 identified seaweed farm sites under this study. The study was conducted last December 2017 up to February 2018 using descriptive research method. Spatial sampling was employed in the selection of the samples. Data were gathered using survey questionnaire and analysed using regression analysis. These seaweed farm sites are beneficiaries of the Integrating Social Entrepreneurship through KD Foliar Fertilizer with Seaweed Farmer Organization (ISE-KD) Project where each farmer was given 47 kilos of planting propagules, 90 meters length of ropes and other operating materials.

The results indicate that the highest net profit sales of P 3,371 can be obtained from selling seaweeds as dried plus the KD foliar fertilizer.

Moreover, as to return on investment (ROI), dried plus processed into KD Foliar Fertilizer demonstrated positive ROI with the highest ROI of 81.6%.

As to income (loss), dried seaweed plus processed KD foliar fertilizer gained a highest net income profit margin with P 10.13.

Furthermore, as to break even analysis Fresh Seaweed should produce more than 200.67 kilos to break even the cost of P 2,006.67 at the prevailing price of P10.0 per kilos while dried seaweeds is at 67.9 kilos times P35.0 per kilo to break even the cost of 2,379.33 furthermore KD Foliar Fertilizer to break even it should produce 55.05 liters just to break even the amount of P 4,129.00

Conclusion

Based from the results of the study, the researcher concluded that:

- 1.) The study settled that dried seaweeds plus processed KD foliar fertilizer showed the highest net profit sales of ₱ 3,371 because farmers find ways to boost their income by adding substantial value in the product.
- 2.) KD Foliar Fertilizer confirmed positive ROI of 81.6% this denotes that a positive ROI means that investment gains compare favourably to investment costs.
- 3.) Highest Net Income noted in Dried seaweed Plus Processed KD Foliar Fertilizer with an acceptable profit margin of P 10.13. This result signifies that income can suffice the farmers production cost.
- 4.) Fresh Seaweed should produce more than 200.67 kilos to break even the cost of P 2,006.67 at the prevailing price of P10.0 per kilos Dried Seaweeds is 67.9 kilos times P35.0 to break even the cost of P 2,379.33 while KD Foliar Fertilizer should produce 55.05 liters to breakeven the amount of P 4,129.00 It implies that in excess of computed breakeven quantity; the business may generate income/revenue.

The profitability ratio analysis of fresh dried seaweed and processed KD foliar fertilizer in
Punta Biao, Cogon Digos City, Davao del Sur

Recommendation

After thorough analysis, the researcher would like to recommend the following:

1. The researcher would highly recommend the dried plus KD foliar fertilizer as the main income generating product.
2. Seaweed farmers should perform best farming practices in order to minimize the loss of production.
3. Location with a good water movement or where there is a rapid water turnover, but not heavy enough to damage the farm should highly recommend.
4. Area should be sheltered from very strong wave action, current and winds and if possible choose areas where seaweed is safe. However, the absence of fish cages is highly considered.
5. Increased the number of planting materials to come up with huge volume of production.
6. Researcher also would like to recommend relevant trainings for farmers, specifically on financial aspect like simple bookkeeping, cash flow and inflows and etc.

Annex A. Income Cash Flow of Fresh Seaweed in Sitio Punta Biao, Digos City Davao Del Sur.

INCOME STATEMENT and CASH FLOWS					
Fresh Seaweed					
SPECIFICS	Cycle			Average	
	1st	2nd	3rd		
Revenues					
Revenue/Income Beginning		₱ 161.00	₱ 676.00		
180kg /284.4kg/291.6kg x 10 pesos	₱ 1,830.00	₱ 2,844.00	₱ 2,916.00	₱ 7,590.00	₱ 2,530.00
Gross Sales		₱ 2,683.00	₱ 3,592.00		
Less : Production Expenses					
Direct labor					
Labor cost @ 200/day (4)	₱ 800.00	₱ 800.00	₱ 800.00		
Materials					
Planting Materials (47kg@15pesos)	₱ 407.00	₱ 407.00	₱ 407.00		
Ropes					
# 16 bundle rope	₱ 102.00	₱ 102.00	₱ 102.00		
# 36 rope	₱ 135.00	₱ 135.00	₱ 135.00		
Polytwine	₱ 51.00	₱ 55.00	₱ 60.00		
Softie twine	₱ 186.00	₱ 190.00	₱ 194.00		
Bottle containers	₱ 15.00	₱ 15.00	₱ 15.00		
Styro Foam)	₱ 67.00	₱ 67.00	₱ 67.00		
Sack	₱ 28.00	₱ 36.00	₱ 42.00		
Contingency	₱ 200.00	₱ 200.00	₱ 200.00		
GRAND TOTAL EXPENSES	₱ 1,991.00	₱ 2,007.00	₱ 2,022.00	₱ 6,020.00	₱ 2,006.67
NET INCOME(LOSS)	-₱ 161.00	₱ 676.00	₱ 1,570.00		₱ 523.33

Annex B. Income Cash Flow of Dried Seaweed in Sitio Punta Biao,
Digos City Davao Del Sur.

INCOME STATEMENT and CASH FLOWS					
Dried Seaweed					
Income Statement					
SPECIFICS	Cycle			Average	
	1st	2nd	3rd		
Revenues					
Revenue/Income Beginning		-₱ 1,740.00	-₱ 801.00		
180 kg					
18 kg/94.8/ 97.2 x 35 pesos	₱ 630.00	₱ 3,318.00	₱ 3,402.00	₱ 7,350.00	₱ 2,450.00
Gross Sales		₱ 1,578.00	₱ 2,601.00		
Less : Production Expenses					
Direct labor					
Labor cost @ 200/day (7)	₱ 1,200.00	₱ 1,200.00	₱ 1,200.00		
Materials					
Planting Materials (47kg)	₱ 407.00	₱ 407.00	₱ 407.00		
# 16 bundle rope	₱ 102.00	₱ 102.00	₱ 102.00		
# 36 rope	₱ 135.00	₱ 135.00	₱ 135.00		
Polytwine	₱ 51.00	₱ 55.00	₱ 60.00		
Softie twine	₱ 186.00	₱ 190.00	₱ 194.00		
Bottle containers	₱ 15.00	₱ 15.00	₱ 15.00		
Styro Foam	₱ 67.00	₱ 67.00	₱ 67.00		
1 large Sack	₱ 7.00	₱ 8.00	₱ 9.00		
Contingency	₱ 200.00	₱ 200.00	₱ 200.00		
GRAND TOTAL EXPENSES	₱ 2,370.00	₱ 2,379.00	₱ 2,389.00	₱ 7,138.00	₱ 2,379.33
NET INCOME(LOSS)	-₱ 1,740.00	-₱ 801.00	₱ 212.00	-₱ 2,329.00	-₱ 776.33

The profitability ratio analysis of fresh dried seaweed and processed KD foliar fertilizer in
Punta Biao, Cogon Digos City, Davao del Sur

Annex C. Income Cash Flow of Dried Plus Processed KD Foliar
Fertilizer in Sitio Punta Biao, Digos City Davao Del Sur.

INCOME STATEMENT and CASH FLOWS					
Dried Seaweed/KD Foliar Fertilizer					
Income Statement					
SPECIFICS	Cycle			Average	
	1st	2nd	3rd		
Revenues					
Revenue/Income Beginning		₱ 968.00	₱ 5,170.00		
18kg/ 94.8kg/97.2x 35 pesos	₱ 630.00	₱ 3,318.00	₱ 3,402.00	₱ 7,350.00	₱ 2,450.00
86liters/101liters/116liters/ x 50 pesos	₱ 4,300.00	₱ 5,050.00	₱ 5,800.00	₱ 15,150.00	₱ 5,050.00
Gross Sales	₱ 4,930.00	₱ 9,336.00	₱ 14,372.00		₱ 7,500.00
Less : Production Expenses					
Direct labor					
Labor cost @ 200/day (12)	₱ 2,400.00	₱ 2,400.00	₱ 2,400.00		
Materials					
Planting Materials (47kg)	₱ 407.00	₱ 407.00	₱ 407.00		
# 16 rope	₱ 102.00	₱ 102.00	₱ 102.00		
# 36 rope	₱ 135.00	₱ 135.00	₱ 135.00		
Polytwine	₱ 51.00	₱ 55.00	₱ 60.00		
Softie twine	₱ 186.00	₱ 190.00	₱ 194.00		
Bottle containers	₱ 15.00	₱ 15.00	₱ 15.00		
Styro Foam)	₱ 67.00	₱ 67.00	₱ 67.00		
1 large Sack	₱ 7.00	₱ 7.00	₱ 7.00		
Bottle Containers	₱ 392.00	₱ 588.00	₱ 672.00		
Contingency	₱ 200.00	₱ 200.00	₱ 200.00		
GRAND TOTAL EXPENSES	₱ 3,962.00	₱ 4,166.00	₱ 4,259.00	₱ 12,387.00	₱ 4,129.00
NET INCOME(LOSS)	₱ 968.00	₱ 5,170.00	₱ 10,113.00		₱ 3,371.00

Literature Cited

FUSILERO, K. 2014. Project to boost seaweed production to be implemented. Mindanao Times. December 3, 2014.

ROMERO, J. B. 2002. Seaweed farming in the Sulu archipelago.
<https://repository.seafdec.org.ph>

ALIH, E. M. 1990. Economics of Seaweed (Euchema) Farming in Tawi-Tawi Islands in the Philippines, in Hirano R. Hanyu, I. (eds.) The Second Fisheries Forum, Asian Fisheries Society, Manila, Philippines.

ALIN, J. M., D. RAZALI, D. ERANZA, A. BAHRON and R. MAHMUD. 2015. Profit and Loss Analysis of Euchema Seaweed Farming in Green Island, Palawan, Philippines. Faculty of Business, Economics and Accountancy, Universiti Malaysia Sabah. Doi:10.5901/mjss.2015.v6n5s5p125

BIXLER, H. J. and H. PORSE. 2011. A decade of change in the seaweed hydrocolloids industry. J Appl Phycol (2011) 23: 321. doi:10.1007/s10811-010-9529-3

BRANCH, G. M., J. MAY, B. ROBERTS, E. RUSSELL and B. M. CLARK. 2010. Case studies on the socio-economic characteristics and lifestyles of subsistence and informal fishers in South Africa. <http://dx.doi.org/10.2989/025776102784528457>

BRAUN, D. M. 2016. Booming Seaweed Farming Exposes Producers and Environment to Risks, Experts Warn National Geographic Society. Ocean Views September 3, 2016. <http://voices.nationalgeographic.com>.

CHOPIN, T., A. H. BUSCHMANN, C. HALLING, M. TROELL, N. KAUTSKY, A. NEORI, G. P. KRAEMER, J. A. ZERTUCHE-GONZÁLEZ, C. YARISH, and C. NEEFUS. 2001. Integrating Seaweeds Into Marine Aquaculture Systems: A Key Toward Sustainability. DOI: 10.1046/j.1529-8817.2001.01137.x

CRAIGIE, J. S. 2011. Seaweed extract stimuli in plant science and agriculture. J Appl Phycol. 2011;23:321–335. doi: 10.1007/s10811-010-9560-4.

EHRHART, F, E. METTLER, T. BÖSE, M. M. WEBER and J. A. VÁSQUEZ. 2013. Biocompatible coating of encapsulated cells using ionotropic gelation. PLoS ONE. 2013;8(9):e73498. doi: 10.1371/journal.pone.0073498.

Food and Agriculture Organization (FAO). 2013. Fisheries and Aquaculture Information and Statistics Service – 18/12/2013

Food and Agriculture Organization (FAO). Undated. Introduction To Commercial Seaweeds - FAO. <http://www.fao.org>.

FUSILERO, K. 2014. Project to boost seaweed production to be implemented. Mindanao Times. December 3, 2014.

The profitability ratio analysis of fresh dried seaweed and processed KD foliar fertilizer in
Punta Biao, Cogon Digos City, Davao del Sur

HAYASHI, L., A. Q. HURTADO, F. E. MSUYA, G. B. LHONNEUR and A. T. CRITCHLEY. n. d. A Review of Kappaphycus Farming: Prospects and Constraints/

HILL, N. A. O., J. M. ROWCLIFFE, H. J. KOLDEWEYE and J. MILNER-GULLAND. 2012. The Interaction between Seaweed Farming as an Alternative Occupation and Fisher Numbers in the Central Philippines. *Conservation Biology*. Volume 26, Issue 2. April 2012. Pages 324–334. DOI: 10.1111/j.1523-1739.2011.01796.x

HURTADO, A. Q. 2013. Social and economic dimensions of carrageenan seaweed farming in the Philippines, in: Valderrama D.Cai,J., Hishamunda N., Ridler, N (eds.) Social and economic dimensions of carrageenan seaweed farming, Fisheries and Aquaculture Technical Paper no. 580, Rome, FAO.

HURTADO, A. Q., GERUNG, G.S., YASIR, S., AND CRITCHLEY, A.T. 2014. Cultivation of Tropical red Seaweeds in the BIMP-EAGA region, *Journal of Applied Phycology*, Vol.26, no.2, pp.707-718.

JANG, S. S., Y. SHIRAI, M. UCHIDA, and M. WAKISAKA. Undated. Production of mono sugar from acid hydrolysis of seaweed

JENSEN, A. Undated. Present and future needs for algae and algal products

MCHUGH, D. J. 2003. A guide to the seaweed industry. FAO Fisheries Technical paper, No 441: 105 p

MUNDO, R. DIC. DEL, CABUNGCAL, R. M., and FONTANILLA, Z. T. 2002. Status of Kappaphycus and Caulerpa Farming in Palawan. In A.Q.Hurtado, N.G.Guanzon.,T.R. de Castro-Mallare,& M.R.J. Luhan (eds.) Proceedings of the National Seaweed Planning Workshop held on August 2-3,2001,SEAFDEC Aquaculture Department, Tigbauan, Iloilo.

NEORI, A. 2008. Essential role of seaweed cultivation in integrated multi-trophic aquaculture farms for global expansion of mariculture: an analysis. *J. Appl Phycol* (2008) 20: 567. doi:10.1007/s10811-007-9206-3

NEORI, A. T. CHOPIN, M. TROELL, A. H. BUSCHMANN, G. P. KRAEMER, C. HALLING, M. SHPIGEL, and C. YARISH. 2003. Integrated aquaculture: rationale, evolution and state of the art emphasizing seaweed biofiltration in modern mariculture. <http://dx.doi.org/10.1016/j.aquaculture.2003.11.015>

NORAMBUENA, R. Undated. Recent trends of seaweed production in Chile.

PENA, A. A. 2009. Huge China demand boosts prospects for RP seaweeds . Seaweed Farming is Profitable. <http://www.entrepreneur.com.ph>

PADILLA, J. E. and H. C. LAMPE. 1989. The economics of seaweed farming in the Philippines, *NAGA, the ICLARM Quarterly* 12(3), pp.3-5.

PIDO, M. D. C. A. ARMEDILLA, F. A. PONTILLAS AND E. DC PONCE DE LEON (undated). Socio-Economic Upliftment of Selected Seaweed Farming Communities in Puerto Princessa City, Palawan: Problems and Prospects, Center for Strategic Policy and Governance, Palawan State University.

REBOURS, C., E. MARINHO-SORIANO, J. A. ZERTUCHE-GONZÁLEZ, L. HAYASHI, J. A. VÁSQUEZ, P. KRADOLFER, G. SORIANO, R. UGARTE, MA. H. ABREU, I. BAY-LARSEN, G. HOVELSRUD, R. RØDVEN and D. ROBLEDO. 2014. Seaweeds: an opportunity for wealth and sustainable livelihood for coastal communities. *J Appl Phycol.* 2014; 26(5): 1939–1951. doi: 10.1007/s10811-014-0304-8.

ROMERO, J. B. 2002. Seaweed farming in the Sulu archipelago. <https://repository.seafdec.org.ph>

SALAYAO, N. D., R. N., TAGARINO AND C. G. KIRK, III. 1991. Seaweed Farming in the Philippines: Its Prospects in Northeast Sorsogon. Available: http://thedrkick.com/CGK320writings/Weed_Aisa.pdf. Access date: June 18, 2010

SAMONTE-TAN, G. P. B. , A. T. WHITE, M. TERCERO, J. DIVIVA, E. TABARA and C. CABALLES. 2007. Economic Valuation of Coastal and Marine Resources: Bohol Marine Triangle. <http://dx.doi.org/10.1080/08920750601169634>

SIEVANEN, L., B. CRAWFORD, R. POLLNAC and C. LOWE. 2005. Weeding through assumptions of livelihood approaches in ICM: Seaweed farming in the Philippines and Indonesia. <http://dx.doi.org/10.1016/j.ocecoaman.2005.04.015>

TROELL, M., A. JOYCE, T. CHOPIN, A. NEORI, A. H. BUSCHMANN, and J. FANG. 2009. Ecological engineering in aquaculture — Potential for integrated multi-trophic aquaculture (IMTA) in marine offshore systems. <http://dx.doi.org/10.1016/j.aquaculture.2009.09.010>

TROELL, M., D. ROBERTSON-ANDERSSON, R.J. ANDERSON, J.J. BOLTON, G. MANEVELDT, C. HALLING and T. PROBYN. 2006. Abalone farming in South Africa: An overview with perspectives on kelp resources, abalone feed, potential for on-farm seaweed production and socio-economic importance. <http://dx.doi.org/10.1016/j.aquaculture.2006.02.066>

VAN DER WAL, H., B. L.H.M. SPERBER, B. HOUWELING-TAN, R. R.C. BAKKER, W. BRANDENBURG and A. M. LÓPEZ-CONTRERAS. 2012. Production of acetone, butanol, and ethanol from biomass of the green seaweed *Ulva lactuca*. <http://dx.doi.org/10.1016/j.biortech.2012.10.094>

VAN DEN BURG, S. W. K., A. VAN DUJN, H. BARTELINGS, M. M. VAN KRIMPEN and M. POELMAN. 2016. The economic feasibility of seaweed production in the North Sea. Pages 235-252 <http://dx.doi.org/10.1080/13657305.2016.1177859>.

ZIMMERMANN, H., ZIMMERMANN, D., and REUSS, R. 2005. Towards a medically approved technology for alginate-based microcapsules allowing long-term immune isolated transplantation. *J Mater Sci Mater Med.* 2005;16:491–501. doi: 10.1007/s10856-005-0523-2.