

# VARIABILITY OF THE TOP 10 EXPORT FISH PRODUCTS IN THE PHILIPPINES

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## ABSTRACT

*The Philippines is among the top producing countries of fishery products in the world. Fishery products have significant contribution to the country's Gross Domestic Product (GDP). This paper analyzed the fractality of the volume of exports of the top 10 fishery exports from 1997-2012 using a surrogate measure of data roughness through fractal dimensions. Fractal dimensions as statistical quantities are forceful methods which are not easily influenced by extreme observations unlike other variance-based time series measures of any product. The results revealed that the top 10 fishery exports are moderately fragmented which ruggedness varies from 29 to 49%. The fractality of the data of each of the species of the fishery products is associated directly or indirectly with some factors. The roughness implies that there are years which have low volume of exports which eventually affect the contribution of the fishery industry to the national income. This calls for an awareness of the policy makers and government officials to be on guard for the succeeding years of international trade for the improvement of the fishery sector.*

**Keywords:** fish products, fish exports, fractal dimensions, fractal statistics

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## 1.0 Introduction

Exchange of goods among countries is one of the best economic activities of a nation for purposes of economic gains and political relationships. Classical theories of international trade suggest that a country will gain more on export than import, and a country should produce a product which has a comparative advantage. The Philippines has this comparative advantage because it is truly blessed with its bounty of fishery resources thriving the water bodies.

The Philippines ranked 11<sup>th</sup> in 2001 among the top fish producing countries in the world with a total production of 3.17 million metric tons of fish, crustaceans,

mollusks, and seaweeds (Lopez, 2006 in FAO, 2005). It is the second largest producer of seaweeds which contributed 7.4% of the world production. In the same year, fishery exports amounted to \$ US 458.8 Million (159,069 metric tons), compared to imports of only \$US 75.7 Million (BFAR, 2010). Over the years, the fisheries industry contributed positively to the gross domestic product of the country. However, the contribution of the sector to the National income varies annually where some years have low production and vice versa. The volume of production is largely dependent on some factors such as climate, number of fishers and government policies. Then,

volume of exports varies with the capacity of the country to produce.

The impact of the sector to the Philippine economy is usually analyzed in its annual volume and value of production and exports through the usual statistical techniques where the tabular and graphical presentation of data are popularly done to make the information more articulate. However, the ruggedness or fragmentation of the time series data of the top 10 fishery export products from 1997-2012 is best analyzed through fractal dimension. That is, the fractal dimension of the data set represents data roughness and is similar to the variance-based productivity measures but with the advantage of not being dependent on the existence of a mean (robustness against extreme observations).

**2.0 Basic Concepts in Fractal Statistics**

Fractal statistical analysis applies to conditions where the mean or first moment does not occur. It is also applicable to situations where smaller fluctuations overrule the larger ones. Padua (2012) recommended the use of a power law distribution which is similar to Pareto’s distribution as given:

$$1...f(x) = \frac{\lambda-1}{\theta} \left(\frac{x}{\theta}\right)^{-\lambda}, \lambda > 0, \theta > 0, x \geq \theta$$

where  $\lambda$  defined as the fractal dimension of X and  $\theta$  was the smallest (positive) value of the random variable.

The extreme likelihood estimator of  $\lambda$  is:

$$2... \tilde{\lambda} = 1 + \frac{1}{\log\left(\frac{x}{\theta}\right)}$$

so that each observation contributes to the fragmentation of the support X.

Padua (2013) demonstrated that the distribution of the maximum likelihood estimators obey an exponential type of distribution so that both the mean and variance of the fractal dimensions exist.

A device called fractal spectrum or  $\lambda(s)$  spectrum was suggested by Padua et al., (2013) to identify locations on the support X where high data roughness or fragmentation occur and where smoothness appear to dominate. The spectrum is defined as:

$$3.... \lambda(s) = 1 - \frac{\log(1-\alpha)}{\log\left(\frac{x}{\theta}\right)} = 1 - \frac{\log(1-\alpha)}{s}$$

where  $X_a$  is the  $a$ th percentile

$$\text{of } X \text{ and } s = \log\left(\frac{x}{\theta}\right)$$

Deviations from smoothness indicate the big variations of the cacao production in the Philippines from 1990-2012. A test for deviation from smoothness i.e.  $H_0:\lambda = 1$ , is suggested in the second paper of Padua (2012) and the reader is referred to the paper as provided in the list of references.

**3.0 Research Design and Methods**

In this paper, the time series analysis of the top 10 fishery export products was considered. The data were taken from the website of the Bureau of Agricultural Statistics, Philippines.

One dimensional plot of every variable considered was constructed. The plot was then used as an input to a fractal software FRAK.OUT available as a freeware from the NET. The output is a fractal dimension for the data set. Thus, the fractal dimensions of the following were obtained; membership, assets, liabilities.

The deviation from smoothness:

$$4... d = (\lambda - 1) \times 100\%$$

is computed for each fractal dimension. The higher the percentage deviation is, the more varied the cooperatives' performance.

Finally, we attempt to locate the areas of high fractal dimensions (more varied performance) and relatively smoother areas by computing for the fractal spectra of each data set.

Graphical representations of the performance of the top 10 fishery export products considered were also shown

as a support to the discussion of fractality.

#### 4.0 Results and Discussions

Graphical Presentation of each of the top ten fishery exports products is shown in one-dimensional plots. This explains how the fishery export products induced ruggedness or fragmentation on the straight line interval. The roughness is also clearly shown in figs. 2, 4 and 6.

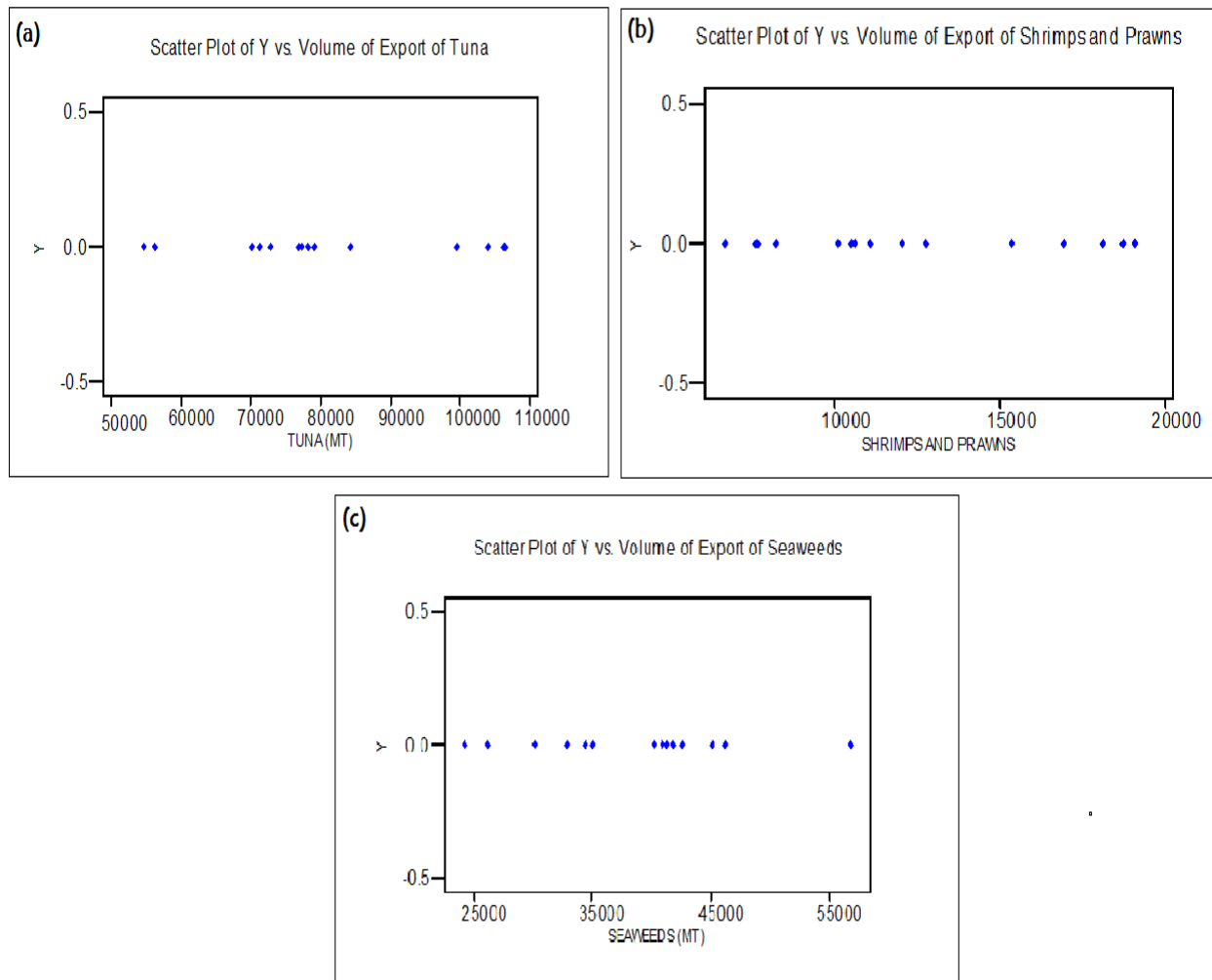


Figure 1. One-dimensional plot of volume of export of (a) tuna, (b) shrimps and prawns, and (c) seaweeds from 1997 to 2011

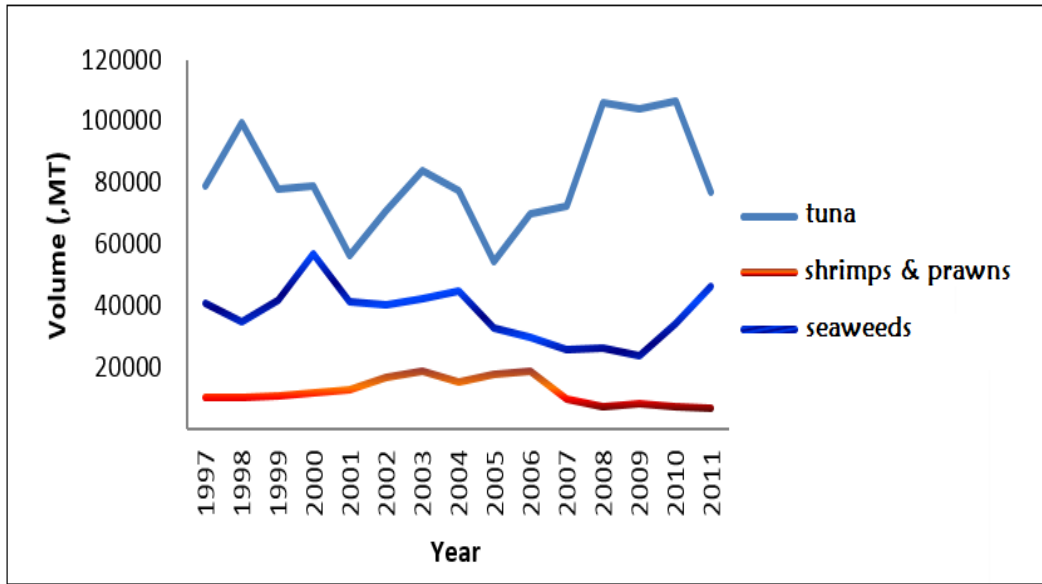


Figure 2. Volume of the top three fishery export products

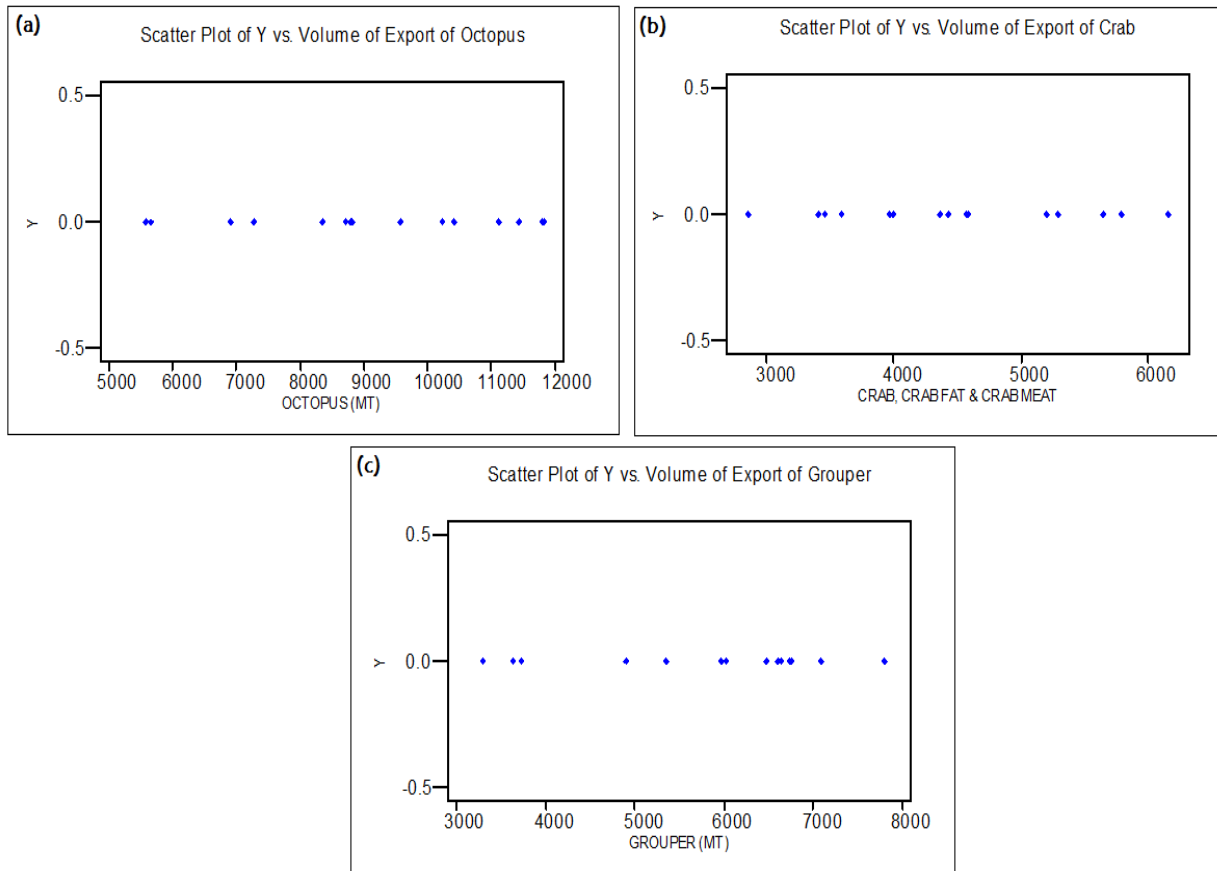


Figure 3. One-dimensional plot of volume of export of (a) octopus, (b) crabs, crab fat & crab meat, and (c) grouper from 1997 to 2011

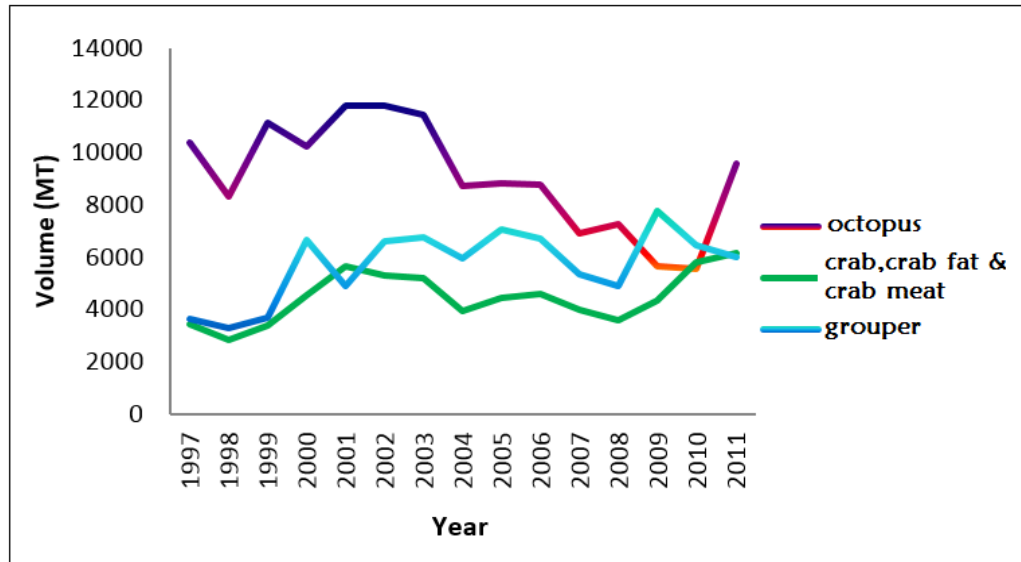


Figure 4. Volume of octopus, crab, crab fat and meat, and grouper as fishery export products

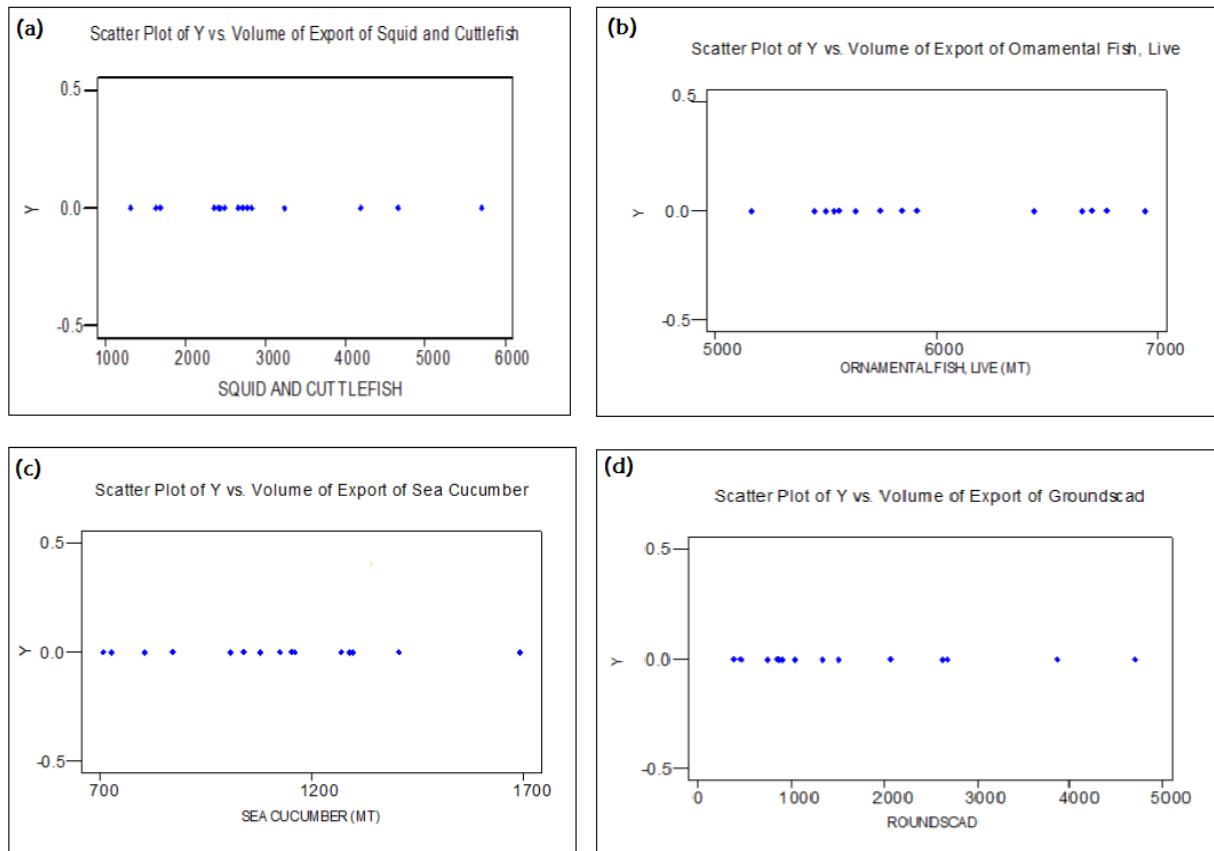


Figure 5. One-dimensional plot of volume of export of (a) squid and cuttlefish, (b) ornamental fish, (c) sea cucumber and (d) roundscad from 1997 to 2011

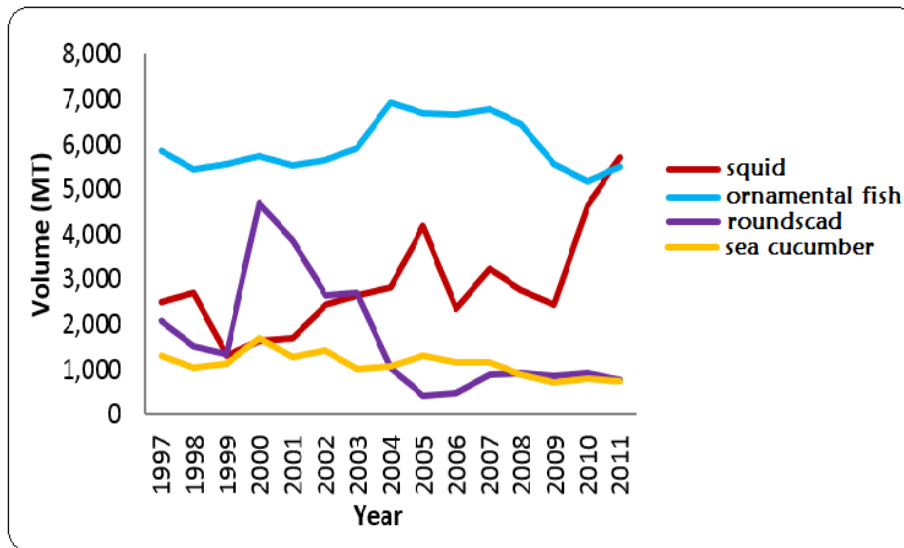


Figure 6. Volume of exports of squid, ornamental fish, roundscad and sea cucumber

Table 1. Fractal dimension and deviation statistics for the top ten fish export products

Rank in Export	Indicators	Fractal Dimension	Deviation Stat (%)
1	Tuna	1.4677	46.77
2	Shrimps and Prawns	1.3333	33.33
3	Seaweeds	1.3531	35.31
4	Octopus	1.4321	43.21
5	Crab, Crab Fat and Crab Meat	1.2989	29.89
6	Grouper, Live	1.4331	43.31
7	Squid and Cuttlefish	1.4789	47.89
8	Ornamental fish Live	1.4928	49.28
9	Roundscad	1.3763	37.63
10	Sea Cucumber Dried	1.3674	36.74

Table 1, on the other hand, displays the fractal dimensions of the one-dimensional plots (induced roughness) as well as the deviation statistics (percentage departure from a smooth straight line).

The one-dimensional plots of the volume of the top ten fishery exports show the visual representation of the enormity of fishery industry in the Philippines. Tuna as the number one fishery export in the country has fragmented volume of exports (1.4677) for 15 years since 1997. The extent of

roughness (variability = 46.77%) implies that there were severe fluctuations of the volume of production in the country coupled with the fluctuations of demand from the rest of the world. Lowest volume of exports (Figure 2) was experienced in 2001 and 2005 as a result of seasonality of the produce. The significant drop of the production in 2010 was a result of the fishing ban policy.

On the other hand, shrimps and prawns, and seaweeds are 13.44% and 11.46% smoother than the Tuna, respectively. However, their variability of

33.33% and 35.31% points out the trade flux of these two fishery products. The downward trend of the prawn industry were usually caused by low stocking brought about by changes in temperature, salinity of water, low survival rate and reduction of area because of financial constraints (BAS, 2012).

For the seaweeds, the drop of the production in 2000 to 2009 could be due to the unfavorable weather conditions combined with strong winds and rough seas, scarcity of good planting materials and the attack of “ice-ice” disease. However, its growth in export since 2009 was also the result of the increase in production due to strong research and development. But in the succeeding years, significant fluctuations in the production and volume of exports of this specie can be expected due to climate change.

The crabs fishery had the lowest fractality of 1.2989 which indicates that its export volumes for 15 years had no extremities of high and low production and demand. Its increase in export from 2008 signifies high demand of the product in the world market coupled with the increase in production in some of the crab producing regions in the Philippines. But no significant increase in the production can be expected in the years to come because few provinces, particularly Pampanga which is the top producer of mud crab, recorded a 3.12 percent reduction in the production due to poor quality of crablets and low salinity of water resulting from heavy rains during the previous quarters. The same problems were encountered in Sorsogon where there was a 27.84% output reduction (BAS, 2012). The situation implies that climate change would significantly

affect the production of mud crab.

The octopus, grouper, squid and cuttlefish and ornamental fish have a fractal dimensions of 1.4321, 1.4331, 1.4789 and 1.492, respectively. The data revealed that there were also severe fluctuations of the exports with 43 to 49 percent variations. There were cases that the demand for these products in the world market was extremely low brought about by the changes in the tastes and preferences of the consuming public. On the other hand, these species are mostly dependent on coral reefs ecosystem. Thus, abnormal temperatures due to climate change can easily affect the corals as evidenced by a coral bleaching.

## 5.0 Conclusion

The top 10 fishery exports are moderately fragmented which ruggedness varies from 29 to 49%. The fractality of the data of each of the species are due to some factors. The roughness implies that there are years which have low volume of exports which eventually affect the contribution of the fishery to the national income. This calls for an awareness for the policy makers and government officials to be on guard for the succeeding years of international trade. Since the products are climate sensitive, any occurrence in the abnormalities of climate can affect the local production and exportation.

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