Czech University of Life Sciences Prague

Faculty of Economics and Management

Department of Economics

Bachelor Thesis

Fisheries Production in Vietnam

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CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Faculty of Economics and Management

BACHELOR THESIS ASSIGNMENT

Hoai Anh Vu

Economics and Management
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Thesis title

Fisheries Production in Vietnam

Objectives of thesis

The aim of the bachelor thesis is to define the main determinants of the production of fisheries in Vietnam and to evaluate its development in the future.

The aim will be fulfilled based on the partial aims. Then, several hypotheses will be defined and verified. Based on the results of and empirical analysis the final conclusions will be introduced.

Methodology

The bachelor thesis will cover both theoretical and empirical part. Theoretical part will contain theoretical background of the selected topic as well as the methodological framework. Scientific literature will be used to prepare the literature overview. The empirical analysis will be based on the time series analysis. Based on the empirical analysis the results will be presented and some recommendations will be suggested.

The proposed extent of the thesis

40-60

Keywords

Fisheries, production, Vietnam, regression analysis, time series.

Recommended information sources

ATHANASOPOULOS, G. – HYNDMAN, R J. *Foresasting : principles and practice.* [London]: Otexts, 2014. ISBN 9780987507105.

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Prague on 17. 03. 2020

Declaration

I declare that I have worked on my bachelor thesis titled "Fisheries Production in Vietnam" by myself and I have used only the sources mentioned at the end of the thesis. As the author of the bachelor thesis, I declare that the thesis does not break copyrights of any their person.

In Prague on March 18th, 2020 _____

Acknowledgement

I would like to take this honourable opportunity to show my thankful to all of the people who helped and supported me in writing this thesis.

First of all I would like to express my acknowledgement to my supervisor, Ing. Lenka Rumánková, Ph.D. for her unconditional help, providing materials, leading the subject Empirical research of Economics as well as her advices to leading my bachelor thesis achieve academic level of research.

Also, with my gratitude, I sincerely thanks to all the lecturers of Economic and Management faculty who have helped me during the time I studied at the university.

For senior students, Bachelor thesis is a honour project. I have made many efforts to implement the Thesis in the most complete way. However, I was just starting to get acquainted with scientific research, my knowledge is still limited and inexperienced. Therefore, I cannot avoid shortcomings for sure. Hence, I am looking forward to receiving valuable comments from all the teachers and colleagues to make the thesis more complete.

Lastly, I would like to wish to all the teachers in the Faculty of Economics and Management as well as teachers in University of Life Science in Prague full of health and faith to continue carrying out their noble mission of imparting knowledge to the next generations.

Fisheries Production in Vietnam

Abstract

Aquaculture industry plays a significant role in Vietnam economy. Production of fisheries in Vietnam has been growing extremely fast from 1990s, reaching the total of 7.7 thousand tons in the year 2018. However, many difficulties are surrounding the industry which affect to the production and the economy of the country. This bachelor thesis is aimed to define these difficulties influencing the fisheries production and to forecast the aquaculture industry in Vietnam in the future. The second aim is to evaluate fisheries production development based on indices and ratios. The main method used is Time series analysis by using base index, chain index, simple regression model, linear trend function, coefficient of determination and mean average percentage error method to find out the total production of fisheries in aquaculture and catch, total of fish and shrimps in aquaculture industry of Vietnam as well as export growth rate are all in growing trends but not as fast as in the past. Therefore, it is necessary to understand difficulties to bring out solutions to improve and become a booming industry in Vietnam.

Keywords: Fisheries, production, Vietnam, regression analysis, time series.

Produkce Rybolovu ve Vietnamu

Abstrakt

Odvětví akvakultury hraje ve vietnamské ekonomice významnou roli. Produkce rybolovu ve Vietnamu od 90. let velmi rychle rostla a v roce 2018 dosáhla celkem 7,7 tis. Tun. Avšak průmysl čelí mnoha problémům, které ovlivňují produkci a hospodářství země. Tato bakalářská práce je zaměřena na vymezení těchto obtíží ovlivňujících produkci rybolovu a na prognózu akvakulturního průmyslu ve Vietnamu v budoucnosti. Druhým cílem je zhodnotit vývoj produkce rybolovu na základě indexů a poměrů. Hlavní používanou metodou je analýza časových řad pomocí bazického indexu, řetězového indexu, jednoduchého regresního modelu, lineární trendové funkce, koeficientu determinace a hodnoty MAPE. V bakalářské práci je analyzována produkce rybolovu v akvakultuře a úlovku, produkce ryb a krevet v odvětví akvakultury ve Vietnamu i míra růstu vývozu vykazují rostoucí trend, růst je však pomalejší než v minulosti. Proto je nutné pochopit obtíže při navrhování řešení ke zlepšení a stát se prosperujícím odvětvím ve Vietnamu.

Klíčová slova: Rybolov, produkce, Vietnam, regresní analýza, časové řady.

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List of abbreviations

BI: Base Index
CI: Chain Index
DOC: Department of Commerce
EC: European Commission
ESS: European Social Survey
EU: European Union
FAO: Food and Agriculture Organization of the United Nations
GDP: Gross domestic product
GSO: General Statistics Office of Vietnam
IPCC: Intergovernmental Panel on Climate Change
IUU: Illegal, Unreported and Unregulated

KM: Kilometers
LDCs: Least Developed Countries
MA: Moving Average
MAPE: Mean Absolute Percentage Error
MLL: Million
SIDS: Small Islands Developing States
SVEs: Small and Vulnerable Economies
TSS: Total Sum of Squares
US: United States
USAID: United States Agency for International Development
USD: United States Dollar
VASEP: Vietnam Association of Seafood Exporters and Producers
VND: Viet Nam Dong

1 Introduction

Vietnam is considered to be a country with great potential for fisheries both freshwater and saltwater, so there are many favourable conditions to develop fishing and aquaculture to create an abundant supply of raw materials for seafood processing industry serving domestic demand and export. As a result, the seafood industry in general and seafood export in particular have become one of the most important sectors of the economy, bringing a large source of foreign currencies to the country and always on the list of valuable industries.

According to the Ministry of Agriculture and Rural Development, fishing production in the year 2018 reached 3.6 million tons (increased 6%), aquaculture production reached 4.16 million tons (increased 8.3%). The establishment turnover set a record of 9 billion USD, increasing by 8.4% compared to 2017.

However, Vietnam's seafood has not built a national brand for key products, so Vietnam's seafood products are highly dependent on market fluctuations, low profits and great competitive pressure. On the other hand, the impact of climate change and disease also causes the shortage of raw materials.

Among the major seafood export markets of Vietnam, the EU market plays a very important role. For many years this market (together with the US and Japan) is one of the three largest seafood export markets of Vietnam.

However, the world seafood export market is getting more and more new competitors as well as the competition between seafood exporting countries is increasing under the impact of the trend of trade liberalization. Meanwhile, the domestic fishery industry, despite its many progressive achievements, still reveals weaknesses that have not been overcome, at the same time, the outdated facilities do not meet the needs of the times. Besides, in recent years, there have been many problems raised with seafood export activities, which significantly affected the production and export capacity of aquatic products. Vietnam's seafood industry has been facing many disadvantages of the market. In addition, technical and commercial barriers, and provenance of fishing conditions are challenging for Vietnam's fisheries sector.

Therefore, the topic: "Fisheries Production in Vietnam" was selected for research.

2 Objectives and Methodology

2.1 Objectives

The main aim of the bachelor thesis is to define the main difficulities influencing the production of fisheries in Vietnam and to evaluate its development in the future.

To achive the main aim of the bachelor thesis, the thesis is divided into particial objectives:

1. To define Vietnam's strength in aquatic production
2. To clarify the main factors influencing fisheries product
3. To prognose the fisheries production in Vietnam
4. To examine export growth and solution to promote

The main hypothesis is that fisheries product is one of the strong point in Vietnam with the supports of natural conditions. Aquaculture products of Vietnam in the past 20 years has always grown and developed very well.

The secondary hypothesis is that the production of fishery products has increased quiet low over the past years due to the exhaustion of natural resources.

Not only that, since the European Commission (EC) fined IUU yellow card for Vietnamese seafood, the export volume to this market has started to show signs of slowdown, greatly affecting the export of fisheries production.

All of these hypotheses will be shown based on the information and data gathered from Food and Agriculture Organization of the United Nations, General Statistics Office of Vietnam and Vietnam Association of Seafood Exporters and Producers. Data will be used to forecast and examine for accuracy based on empirical analysis.

2.2 Methodology

2.2.1 Time series analysis

Analysis process based on Time series analysis with linear trend function to gathered the trend and the trend function in order to predict the future value based on the values of previous years.

"A time series is a collection of observation made sequentially through time. Example occurs in a variety of fields, ranging from economics to engineering, and

methods of analysing time series constitute an important area of statistics." (Chatfield, 2014)

In a simple way, the term "time series" consists the meaning of data storing and values that given for these time units. Time series analysis is a consitis of methods and processes working with components to achive goals. The main goals of time series analysis consists of:

- Describe the time series parameters characteristics then identify trend based on data
- Time series forecasting based on trend

Time series analysis involves examining past data and explaining its key characteristics. One of the simplest and most effective methods is to visually display the graph. Invisible characteristics in data tables often emerge through graphical illustrations. It is a common statistical tools in business, helps in decision – making process and provides a long or short term planning based on the value from present and in the pass. (Athanasopoulos, G. and Hyndman, R J., 2014)

In this bachelor thesis, quantitative forecasting will be applied based on the available of yearly numerical data of the government from the 1990s. Moreover, it is reasonable to use these data to predict since it has been sustanable grew and will continue develop in the future.

Components of time series

Time series data contains:

- Long term trend (T)

The trend demonstrate the long term tendency of the whole to increase or decrease during a period of time.

It is sometimes misunderstood between the terms: increase/decrease and upward/downward. Although with its long term, smooth, general and average tendency charateristic, the trend not always shows the direction of increase or decrease throughout the given time data. In practice, the trend may increase, decrease or even stable in different sections of time. On the other hand, upward/downward or stable are used to describe the overall tendencies of movement.

The trend is linear when the set of data cluster form a straight line. Otherwise, it is non – linear trend.

- Seasonal variations (S)

  These rhythmic forces express short term periodic fluctuations in values, which operate in a regularly and periodically way.

- Cyclical variations (C)

  The variations in medium term changes caused by factors with repetitive cycle, which occurs in a longer time compare with seasonal variation but shorter than trend. It may has regular character but not periodic.

- Random or residual variation (R)

  The last component could be described as irregular variation. Thes fluctuations are unpredictable, uncontrollable and erratic

Then, a fundamental step for modeling and forecast procedure is to consider the type of given data exhibited from the time series graph.

Index numbers

Index number is a relative number that compares two levels of the same phenomenon. The two levels here are two scales of a phenomenon in two different periods, of which one is called the base or base period and the other is called the current period or the reporting period.

In this practical part of the thesis, index numbers are used to measure the changes in fishery production and export value with respect to time in order to analysis their charateristics. The main index numbers used in this bachelor thesis include:

- Base index: helps to understand and clarify changing percentages over time by selected the index number at the base stage for index calculation. In the base index calculation, one time period is set as the base year. That means all result for base index are the comparison with the base time period. If we have P_1 as the value of the year that we want to calculate the base index and P_0 as the value of the base year then base index can be calculated as the following formula: (Paul Newbold, William L. Carlson and Betty Thorne, 2010)

$$\text{Base index} = \frac{P_1}{P_0}.100$$

- Chain index: helps to understand changing percentages from year to year, which the value at any given period is related to a base in the previous period. Chain index is different from the base index, where the value of every period is related to one base value. It is called as chain index because it can be chained together by multiplying or dividing by 100, thus converting these into a series which helps created a chain from the first to the last time period. With P_{t+1} is the value of the time period *t* that need to calculate chain index and P_t is the value of the previous time period, the chain index is calculated as follow: (Allen, 2017)

$$\text{Chain index} = \frac{P_{t+1}}{P_t}.100$$

2.2.2 Time series forecasting

When working with forecasting part, it is necessary to know that "Trend" and "Forecast" are very close terms, but there are diffenreces.

As mentioned above, trend represents for past data. For example, by analyzing the production of fisheries, you can determine the production trend and understand how this industry has performed in the past and how it is performing.

On the other hand, forecast is related to the future. For example, by analyzing the production from the 1990s, we can only predict the industry production based on the trend in the pass data.

Simple linear regression model

The basic concept of this bachelor thesis is forecast the production of fisheries *y* assuming that it forms a linear relationship with time series *x.*

In the simple way, the regression model forms a linear relationship between dependent and independent variables:

$$y_t = \beta_0 + \beta_1 x_t + \varepsilon_t$$ (Athanasopoulos, G. & Hyndman, R J., 2014)

Where: y_t – dependent variable at time *t*

x_t – independent variable at time *t*

β_0 – intercept

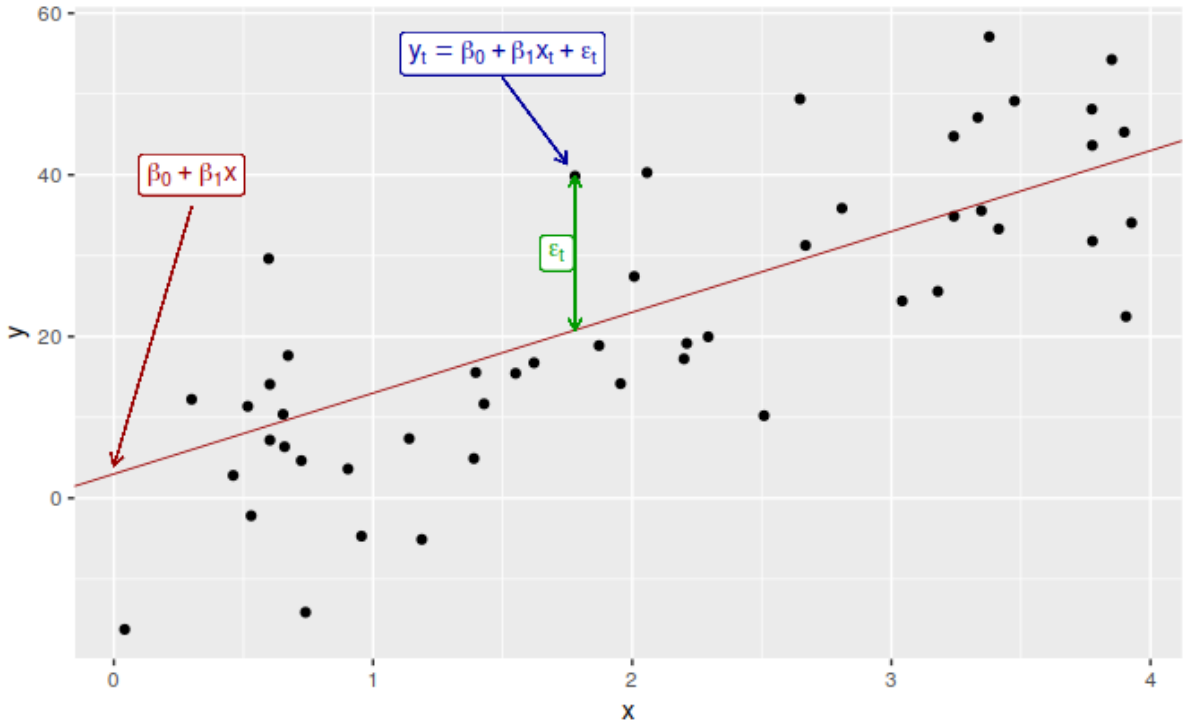
β_1 – slope

ε_t – error

When x = 0, the intercept β_0 represents the predicted value y. The slope β_1 shows the average predicted change in result of predicted value y from 1 unit change in x.

Figure 1. below simulates the linear regression model. Ofcourse the observation data will not lie on one straight line but are dispersed around it. Each observation y_t take part in explaining the model based on indepentdent valuables, intercepts and error. The term "error" here does not mean a mistake but deviation of the line model.

Figure 1. Simple linear regression model



Source: (Athanasopoulos, G. and Hyndman, R J., 2014)

Linear trend function

Linear trend function is an essential part of pronosing data.

The linear trend model (trend line model) is a special case of a simple regression model. (Nau, 2019)

The term "trend" is one of the components of Time Series. It describes a general direction in which something is changing. The trend is underlying long term increase or decrease behavior of the data.

As mentioned in *"The analysis of time series: An introduction"* that the simplest trend is the "linear trend + noise", which means for any observation at time t is a random variable X_t followed by:

$$X_t = \alpha + \beta t + \varepsilon_t \quad \text{(Chatfield, 2014)}$$

Where: α – intercept and β – slope are constants

and ε_t is a random error with zero mean.

Trend function helps describe the function increase or decrease. It would be easier as we consider the slope β of the trend function: If the slope is positive, the linear function will increase and if the slope is negative, it will decrease.

Coefficient of determination

The trend function can be used to forecast the following years. In this case, we must consider the coeffiecient of determination R^2. The coefficient of determination (or goodness of fit) measures the proportion of variation in the dependent variable explained by the predictors included in the model (Zhang, 2016). It is measured by least squares method concern a procedure to determine the best fit line to data and then predict the future according to the trend function.

$$R^2 = \frac{ESS}{TSS} \quad \text{(Zhang, 2016)}$$

The coefficient of determination is used to explain how reliable the predicted values will be and is ranged from 0 to 1. The closer the value to 1, the better the line fits the data.

Mean Absolute Percentage Error (MAPE) method

The Mean Absolute Percentage Error (MAPE), also known as Mean Absolute Percetage Deviation (MAPD) is a method used for evaluate the forecasting values in relation to the database. This is the most common way that shows forecasting error calculation. MAPE is calculated as:

$$MAPE = \frac{\sum_{t=k+1}^{n} \left| \left(\frac{e_t}{Y_t} \right) 100 \right|}{n-k} \quad \text{(David R. Anderson et al., 2010)}$$

The MAPE formula consists of M and APE parts. M stands for mean or average, which is the average of the APE across different periods of time.

3 Literature Review

Aquaculture is one of the most important industry in Vietnam. Owning a long coastline and an exclusive economic zone, Vietnam is always a potential country to develop the fishing production. It is true that this country owns a variety of fisheries products which are distributed based on differences in geographical features and climate.

3.1 Potential and advantages

Vietnam is located in the Southeast Asia, stretching from latitude 8°27' North to 23°23' North with 1650km long in the north – south direction. The country has sea boundaries with Gulf of Tonkin, Gulf of Thailand and South China Sea. The mainland borders China, Laos and Cambodia. (Figure 2)

Figure 2. Vietnam administrative map

Source: (Nations Online, 2019)

3.1.1 Physical geography

Vietnam is located on the West coast of the East Sea – a large sea of the Pacific Ocean, specified by its S – shaped, covering an area about 331.2 thousands square kilometers (km), with a coastline of 3,444 km long (exclude islands). The north – to – south distance is about 1,650 km, the widest part of the mainland is about 600km long and the narrowest part is nearly 50 km wide. (Hays, 2014)

The internal waters and territorial waters are 226,000 square km wide, the exclusive economic zone is over 1 million square km with two main archipelagos (Hoang Sa and Truong Sa), more than 3000 islands, creating 12 bays and lagoons with a total area of 1,160 square km. (FAO, Fish marketing and credit in Vietnam, 2004)

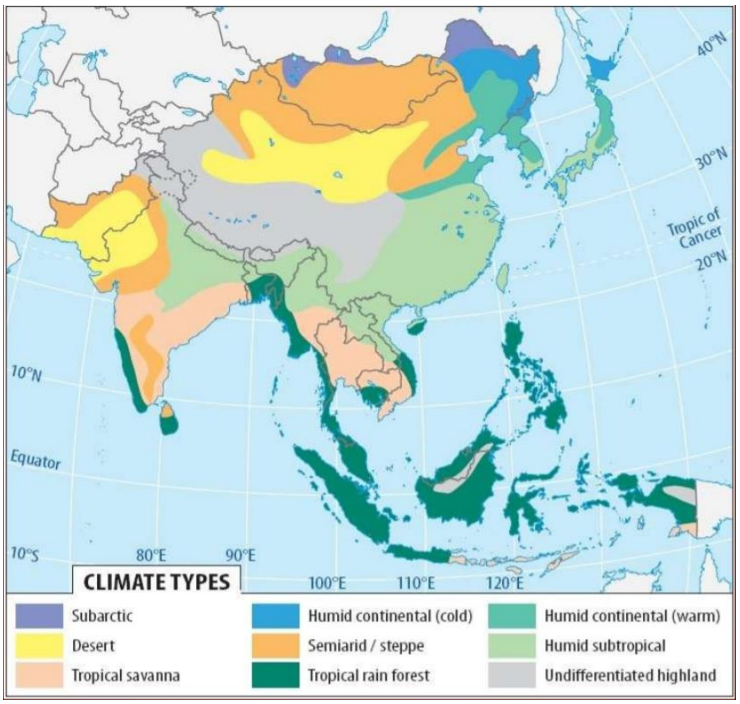
3.1.2 Climate condition

Vietnam has a geographical position where natural conditions are very favorable for aquatic species to gather, breed and develop. Although there are some differences between the three regions of North, Central and South, in general, the whole country has two distinct seasons: rainy season and dry season.

With the benefit that each region focuses on many different types of seafood, the seafood sources of the country become more and more diverse. (Aquaculture Vietnam, 2019)

Figure 3. shows that Vietnam has three main climate with North region, Central region and Southern region, which contributes to a diverse and abundant fisheries product.

Figure 3. Climate types



Source: Adapted from Rand MCNally's Classroom Atlas, 2003.

3.1.3 Human resources

Vietnam belongs to the most populous countries in the world. According to the results of the 2019 Population and Housing Census of General Statistics Office of Vietnam, about 70% of the population lives in rural areas, of which the coastal population has a higher growth rate than the national average of about 2.2%.

It can be said that the human resource is in abundant development with tens of millions of farming households and aquaculture and fishing. Over 4 million people live in tidal areas and about 1 million people live in lagoons in 28 coastal provinces and cities, creating a significant labor force in the fisheries sector. It is because of the rapid and continuous increase of the labor force that the abundant labor supply force makes labor prices much lower than that of the region and the world. In addition, Vietnamese people have a tradition of hard work, love of labor and most of the population is accustomed to living with rivers and water, so they are very experienced in seafaring.

However, this advantage until now is not well promoted because the educational level as well as professional level of this workforce is low. (GSO, 2019)

3.2 Status and trend of fisheries production

3.2.1 Geographic diversity

Vietnam has a dense system of rivers and long seaways, which is very convenient for developing fishing and aquaculture activities. Vietnam's seafood production has maintained continuous growth over the past 17 years. With the policy of promoting the development of the government, the aquaculture activities have made strong development steps, the output has continuously increased in the past years, significantly contributing to the growth of the total aquaculture production of the whole.

"The distribution of aquaculture systems typically vary as one moves from the north, through central to the south of Viet Nam". (FAO, 2019)

- Northern region: with the trend of freshwater fish, fish farming and cage fish farming in the sea.
- Central region: focus on intensive farming of black tiger shrimps and cage fish culture in the sea and lobster.
- The Southern region: owns a variety of husbandry types such as pond culture, fencing, cage culture for catfish and many other types such as snakehead, perch and giant freshwater shrimps that are intensively integrated with other types such as farming model combined fish – rice, shrimp and aquaculture model combined with mangroves.

Strength in aquatic products in Vietnam include catfish, shrimp, tilapia, along with a number of growing species such as shellfish and marine fish such as cobia, cod and grouper. Aquaculture is most thriving in the Mekong Delta provinces, accounting for 70% - 80% of the national catfish and shrimp production.

The following figure shows the aquatic production by six regions in Vietnam: Red River Delta, Northen Mountains and Midlands Area, Northen Central Area and Central Coast Area, Central Highlands, Southeast and Mekong River Delta. Aquatic products is classified based on Fish, Shrimps and Other express the strengs of each region.

Figure 4. Aquatic production by region 2015p (tons)

Region	Fish	Shrimp	Other	Total
Red River Delta	406,447	20,963	155,967	583,377
Nothern Mountains & Midlands Area	102,210	170	494	102,874
North Central Area & Central Coast Area	112,167	78,918	34,019	225,104
Central Highlands	32,555	7	59	32,621
Southeast	80,701	23,692	14,621	119,014
Mekong River Delta	1,788,517	504,483	157,275	2,450,275
Total	2,522,597	628,231	362,438	3,513,266
% of Total	**71.8%**	**17.9%**	**10.3%**	**100.0%**

Source: (Aquaculture Vietnam, 2019)

The Mekong River Delta ranks the first in both Fish and Shrimps productions. This area belong to the south of Vietnam, which has the promising potential of either fresh water aquaculture or fising.

Followed by the Red River Delta with the total amount production of almost 600,000 tons. Although aquaculture in Red river delta is clearly develop, however, it is not a key area due to the lack of water supply and drainage system.

3.2.2 Market trend

This part focus on the market demand of fishery products as well as the future protential of it.

Pangasius (Catfish)

Current market demand for pangasius is strong. Pangasius are raised popularly along the Mekong River. After joinning into globalization, catfish are now farmed in ponds with pellet feeds instead of raised in cages and pens in the past. (Duc, 2011)

In 2018, a remarkable growth was recorded. Pangasius farming area in 2018 reached 5,400 hectares (up 3.3% compared to 2017), production reached 1.42 million tons, up 8.4% compared to 2017. (VASEP, 2019) Pangasius now is the most important imported fish products not only in EU market but also in the US.

Shrimps

Since 2002, lots of shrimp farmers have transferred to whiteleg shrimp, especially since 2005 with different production systems ranging from large scale intensive, semi – intensive and extensive. (Duc, 2011)

Market demand for shrimps in the EU is high. Although financial crisis the EU demand remained strong, demand for shrimp products has increased during the past few years. In the near future, competition in the shrimp markets is expected to increase as EU trading and processing companies are able to source different shrimp species from a wider variety of countries. Therefore its value added potential is relatively high. (Arie Pieter van Duijn et al., 2012)

Tuna

For 10 years (2009 – 2018), tuna is one of the key export seafood products of Vietnam. Tuna export value more than tripled from USD 183 million to USD 653 million, up 256%. (VASEP, 2019)

From the end of 2012 to the present, tuna fishing with hand – fishing combined with light appeared facing many difficulties, the quality and value of tuna products decreased, and the loss of value and resources. Influence the prestige and brand of Vietnamese tuna, reducing competitiveness in export markets.

Enterprises have increasingly focused on increasing the value of products, processed tuna products such as tuna/fillets, canned tuna in oil, canned tuna, etc. have been boosted exports.

Clams, oysters and mussels

According to Arie Pieter van Duijn et al., 2012, In Vietnam oysters and mussels are only cultured, while clams are both cultured and captured.

Considered one of the most important wild resources from the East Sea of Vietnam, clamps is a high value mollusk kept and harvested in “culture based catching beds” in coastal of the country. Most of the captured clams are caught and concentrated in the Mekong Delta and the Red River Delta . Production of clams has increased steadily.

There are three species of oysters occur in the lagoons and along the shores of Vietnam. At the present, more than 90% of the commercial oyster production comes from farming, the remaining 10% is captured. Like the production of clams, the production of oysters has grown quickly in Vietnam.

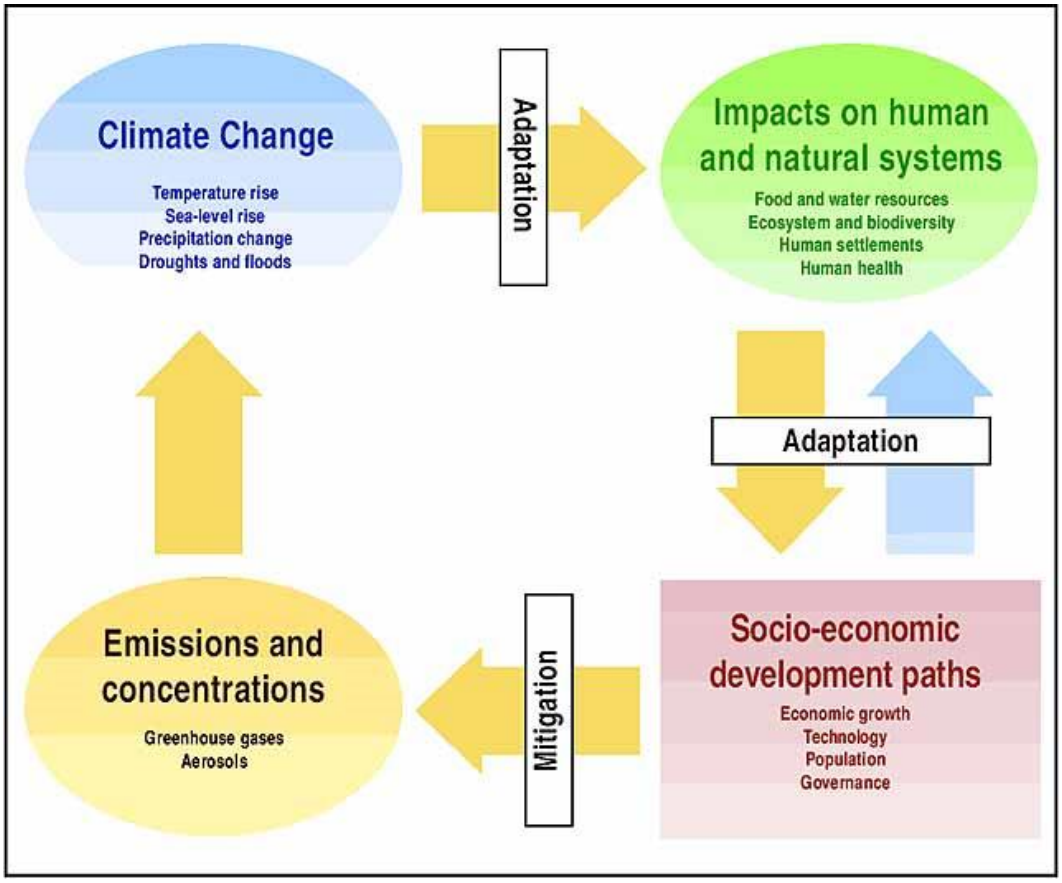
Mussels are farmed in small numbers in the North Central and the South Central regions of Vietnam.

3.3 Difficulties influencing fisheries product

3.3.1 The climate changes

Vietnam is the 27th country in the group of 33 countries in the world with the economy most vulnerable to the impact of climate change on fishing and aquaculture. (Edward H. Allison et al., 2009) The development of appropriate and effective solutions to adapt to climate change in the future depends on the full prediction of the outcome of management actions.

Figure 5. Climate change - an integrated framework



Source: (IPCC, 2001)

"The effects of climate change on fisheries will impact both at sectoral and national levels. Climate change will probably affect production volumes, species mix, as well as methods of fishing. This will have consequences on the livelihoods and earnings of fisher-folk and on other actors operating in the fisheries sector. Moreover, a decline of fisheries due to the overexploitation of resources and climate change

impacts may have wider negative implications at the national level affecting exports, employment, growth and GDP. The overall impact will vary from region to region and will be stronger where fisheries play relevant roles in the economy and the society, like in many LDCs, SVEs, and SIDS." (Graeme Macfadyen & Edward Allison, 2009)

Aquaculture plays an important role in Vietnam's economy, contributing 16% of GDP and is considered as a source of economic development, poverty reduction and food security. (FAO, World Aquaculture 2010, 2011)

In the diet of Vietnamese people, fresh fish and shrimps were second behind pork as the main source of protein, accounting for 14.6kg per capita per year (2011). (Needham, S. & Funge-Smith, 2014) In Vietnam, the labour in fishery sector is unknown as it is normally combined among aquaculuture activities. However, it is estimated more than 12 millopn households in the rural area of Vietnam take part in this sector, including fish farming, fish trading, etc. (FAO, Fish marketing and credit in Vietnam, 2004)

Table 1. Some impacts of climate change on Vietnam's seafood industry

Climate Stressors	Risks in water resources	Risks in Fisheries
• Increased temperatures • Increased frequency/intensity of extreme events • Sea level rise	• Increase in evaporation, reducing water availability • Significant decrease in groundwater table due to decrease in groundwater recharge during dry season • Destruction of water infrastructure • Saline intrusion into groundwater, reducing quality	• Altered physiology of fish (e.g., faster growth but more vulnerable to disease) • Shift in distribution and composition of species; migration to colder waters • Increased salinity, leading to fish mortality and migration • Loss of livelihoods; increased migration to urban centers

Source: information from USAID 2017, table by author.

3.3.2 Market barriers

On October 23rd 2017, the European Commission (EC) gave "yellow card" warning for IUU fishing of Vietnam and made official recommendations for Vietnam to implement to improve fisheries management. (Ojamaa, 2018)

In international terms, IUU means illegal, unreported and unregulated fishing. This regulation covers three standards with seafood imported into the EU.

The first is illegal fishing, which means fishing vessels fishing in illegal waters or banning fishing. Fishing vessels not licensed to fish or violating national and international fishing regulations are also included in the above group. Data from the FAO shows that illegal fishing costs the world about $ 23 billion a year.

Next, IUU stipulates that fishing activities should be reported to the authorities to comply with the provisions of domestic and international laws. The final factor requires fishing vessels to fly the flag of a particular country and not to overfish, fish or destroy the fisheries resources of an area.

It sounds unrealistic when consumers often only care about the quality and price of seafood when buying. Even so, the EU works closely with non – union countries to expand IUU's influence. According to policy makers, IUU helps legal fishermen can compete more fairly with illegal fishing vessels.

In addition, the EU believes that overfishing in one area may affect the ecosystem of other waters, thereby affecting the region's fisheries resources.

The issue of "yellow card" IUU increases the difficulty of market barriers to the EU market. With the largest market in the US, the issues of anti – dumping tax on shrimp and catfish, the catfish inspection program and the latest import fishery monitoring program are becoming a strength pressures for seafood export activities of Vietnam.

“According to the Ministry of Agriculture and Rural Development, after the EC “yellow card” warning for Vietnam's fishing, the political system and society, the fishing community and enterprises have made great efforts to implement the recommendations, however, the illegal fishing of fishing boats and fishermen of countries in the South China Sea region is still increasing. In 2018, there were 85 cases per 137 ships per 1,162 fishermen, up 28 cases per 46 ships per 379 fishermen compared to 2017. From the beginning of 2019 until now, the Vietnamese fishing

boats in violations of foreign waters has continued and been more complicated with 16 cases per 26 ships per 96 fishermen." (Thanh Nguyen & Huyen Trang, 2019)

As Consulate General of Vietnam in Houston – Texas's statistic that The EU is Vietnam's second largest seafood import market, bringing about 1.1 – 1.4 billion USD annually (period 2012 – 2016). This is also a market accounting for 19 – 22% of Vietnam's total seafood export value. However, since the country is fined the IUU yellow card for Vietnamese seafood, export to this market has begun to show signs of slowing down.

After two years of being warned by the EU for yellow cards due to failure to meet the provisions of IUU, Vietnam's seafood exports have been affected significantly. The seafood processing business community and state management agencies have tried to overcome weaknesses according to the recommendations of the EU, but regaining IUU green card still faces many difficulties. This is a judgment of the delegates at the 2 – year evaluation meeting to implement the program of seafood enterprises committed to fight against IUU fishing organized by Vietnam Association of Seafood Exporters and Producers (VASEP) in September 25th, Ho Chi Minh City.

3.4 Export of fisheries product

Vietnam's seafood export has made great progress in nearly 20 years. The export turnover of aquatic products from the low level of 550 million in 1995 (VASEP, 2019) has experienced strong growth over the years with an average growth rate of 15.93% per year. (Ojamaa, 2018) This growth process has made Vietnam always become one of the five largest seafood exporters in the world, playing a leading role in providing global seafood resources. (Shahbandeh, 2019)

From 1991 up to now: fishery export activities have really entered a new phase. In the process of renewing the self – management mechanism of the fishery sector "self – balancing, self – financing" and being allowed to freely export fishery products. This is paving the way for increasing seafood export. Export of aquatic products in the past years has grown in width and gradually in depth, creating a position in foreign markets. The fishery industry has grown from a small agricultural sector to an important and spearhead economic sector of the country. Beginning in 2000, Vietnam's seafood exports had a breakthrough growth thanks to the strong

development of aquaculture, especially catfish and brackish water shrimp farming (tiger shrimp and white leg shrimp). (Dung, 2003) Therefore, seafood exports have made great contributions, becoming a driving force for the development of the fisheries economy in particular and Vietnam's economic growth in general. Every year, seafood export has brought a great source of foreign currency to the country, from 550 million USD in 1995, by 2018 the figure was 8802 million USD. Thus, along with other exports, fishery exports have contributed greatly to creating capital for the industrialization and modernization that we are undertaking.

Fishery is one of the products that we have competitiveness, prospects for development, contributing to economic growth, export of foreign currencies, and at the same time contributing to economic restructuring for people's lives getting better and better. From a weak economic field in terms of material and technical facilities, the fisheries sector has risen up, making positive contributions to the process of building material and technical foundations, expanding the domestic and foreign markets.

In addition, due to the requirements of the world market and also due to fierce competition, the seafood production units always explore, improve the design and product quality to best meet the needs of market. Thereby contributing to better meet the needs of the domestic market, contributing to the GDP growth of the country.

Thus, with the advantage of being consistent with the first stage of the process of industrialization of the country, attracting a lot of labor, creating a large foreign currency revenue for the seafood exporting country has been and has been played a significant role in the system of key export products of Vietnam.

4 Analysis of fisheries production in Vietnam

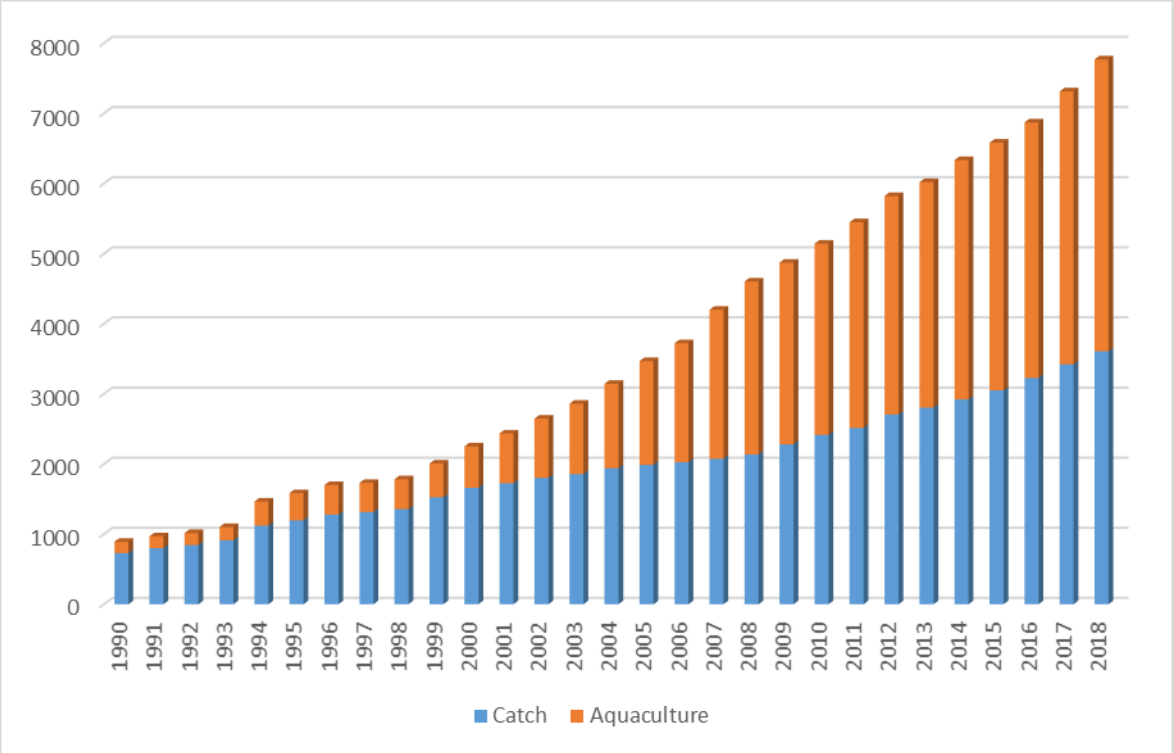
4.1 Analysis of fisheries production development

4.1.1 Assumption

With a coastline of 3,444 km in length, it is not a surprise that fishery plays a significant role in the source of food and income industry. Vietnam's sea with quite high biodiversity, is also the place of origin and dispersion of many groups of tropical marine animals in the Indian – Pacific region with about 11,000 species of species discovered. With the advantages of natural conditions and climate, Vietnam's seafood production has maintained a continuous growth over the past 17 years with an average increase of 9.07% per year.

The graph below show the production of Catch and Aquaculture production from the 1990s to 2018.

Figure 6. Production of Aquaculture and Fishing of Vietnam (Thousand tons)



Source: General Statistics Office of Vietnam. Graph by author.

In Figure 6., the blue columns show the fisheries production of Catch and the orange columns show the fisheries production of Aquaculture.

Overall, the production of fishery grew fastly and developed well.

The production of Catch grew slowly but substainable through time. It can be explained due to the depletion of natural resources and the level of fishing activities has not improved, the output of fishing activities has increased quite low over the years, with an increase in 6.42% on average per year.

Meanwhile, the Aquaculture production grew rapidly with outstanding change. Vietnam's key aquaculture sectors include pangasius, shrimp, tilapia and increasingly also bivalves and marine fishes such as cobia, seabass and grouper. (Ojamaa, 2018) Also, thanks to the government's policy of promoting development, aquaculture has made strong development steps, the output has continuously increased over the years, an average of 12.77% per year, which make a significant contribution to the growth of the country's total aquatic product output.

4.1.2 Fisheries production

Fishery is a very advantageous industry in Vietnam because of the long coastline along the length of the country, the fishery resources are plentiful and diverse so it is very convenient for exploitation (catching) and aquaculture.

To evaluate the development of fisheries production in Vietnam, we first obtain the total of catch and aquaculture production in the 1990s until 2018 in Vietnam. The base index and chain index also are calculated in the table. The data is collected from 1990 to 2018 through General Statistics Office of Vietnam.

Table 2. Development of Catch and Aquaculture production in Vietnam 1990 - 2018 (Thousand Tons)

Production (Thous.tons)	Catch	BI	CI	Aquaculture	BI	CI
1990	728.5	1.0000		162.1	1.0000	
1991	801.1	1.0997	1.0997	168.1	1.0370	1.0370
1992	843.1	1.1573	1.0524	172.9	1.0666	1.0286
1993	911.9	1.2518	1.0816	188.1	1.1604	1.0879
1994	1,120.9	1.5386	1.2292	344.1	2.1228	1.8293

1995	1,195.3	1.6408	1.0664	389.1	2.4004	1.1308
1996	1,278.0	1.7543	1.0692	423	2.6095	1.0871
1997	1,315.8	1.8062	1.0296	414.6	2.5577	0.9801
1998	1,357.0	1.8627	1.0313	425	2.6218	1.0251
1999	1,526.0	2.0947	1.1245	480.8	2.9661	1.1313
2000	1,660.9	2.2799	1.0884	590	3.6397	1.2271
2001	1,724.8	2.3676	1.0385	710.3	4.3819	1.2039
2002	1,802.6	2.4744	1.0451	845.3	5.2147	1.1901
2003	1,856.1	2.5478	1.0297	1,003.7	6.1919	1.1874
2004	1,940.0	2.6630	1.0452	1,203.2	7.4226	1.1988
2005	1,987.9	2.7288	1.0247	1,478.9	9.1234	1.2291
2006	2,026.6	2.7819	1.0195	1,695.0	10.4565	1.1461
2007	2,074.5	2.8476	1.0236	2,124.6	13.1067	1.2535
2008	2,136.4	2.9326	1.0298	2,465.6	15.2104	1.1605
2009	2,280.5	3.1304	1.0674	2,589.8	15.9766	1.0504
2010	2,414.4	3.3142	1.0587	2,728.3	16.8310	1.0535
2011	2,514.3	3.4513	1.0414	2,933.1	18.0944	1.0751
2012	2,705.4	3.7137	1.0760	3,115.3	19.2184	1.0621
2013	2,803.8	3.8487	1.0364	3,215.9	19.8390	1.0323
2014	2,920.4	4.0088	1.0416	3,412.8	21.0537	1.0612
2015	3,049.9	4.1865	1.0443	3,532.2	21.7903	1.0350
2016	3,226.1	4.4284	1.0578	3,644.6	22.4837	1.0318
2017	3,420.5	4.6953	1.0603	3,892.9	24.0154	1.0681
2018	3,606.7	4.9509	1.0544	4,161.8	25.6743	1.0691

Source: Data from General Statistics Office of Vietnam. Table and calculated by author.

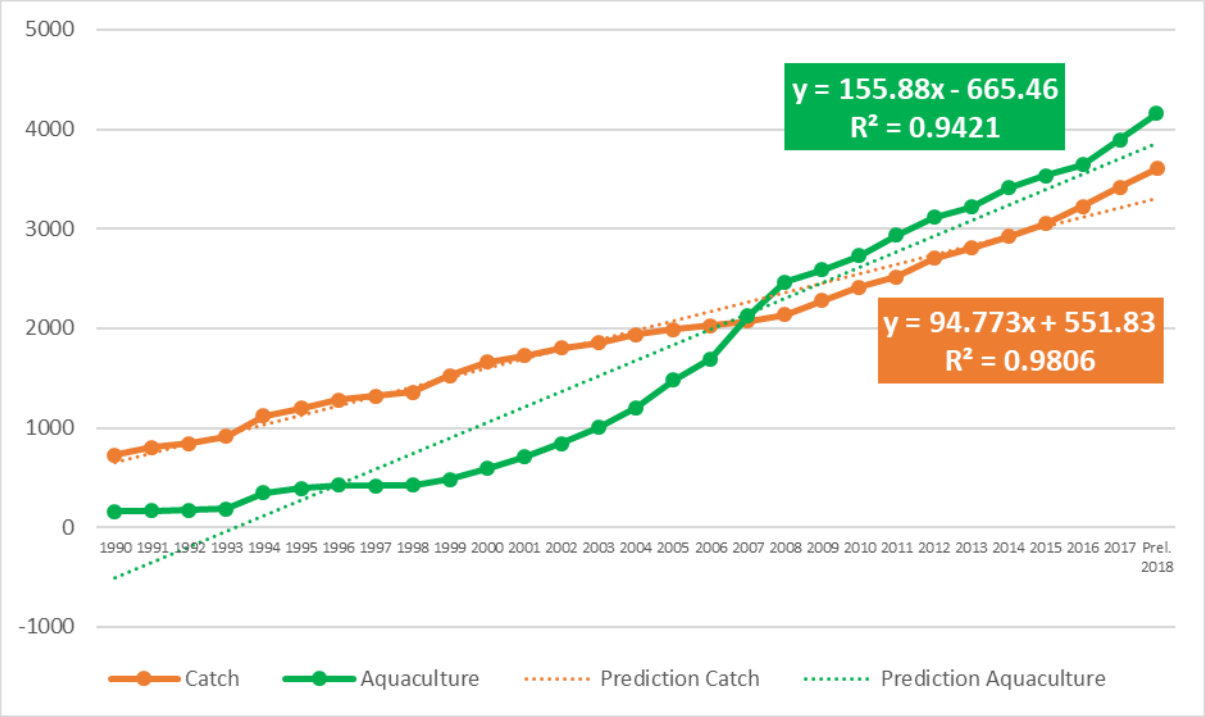
BI – Base Index CI – Chain Index

In table 2. the first column is from the years 1990 to 2018 and the second vertical column is the total catch production in Vietnam. Following by two vertical column which are the base index and chain index of the total catch production. Overall, the developing of catch production have risen significantly so far and they are likely to continue increasing in the future. In the beginning, the total catch production has the chain index of 1.0997. There was a rise sharply in 1994 (around 200 thousand tons)

compare to the growth rate of catch production. During the period of 4 years from 1990 to 1994, the production increases from 782.5 thousand tons to 1120.9 thousand tons and the growth rate in this period is 43.24%. From 1994 to 1998, production grew slightly and the went up in 1999, which is around 170 thousand tons compare to year 1998 (from 1357 thousand tons to 1526 thousand tons). Throughout the period, the fishing production went up slowly but stalely with the highlights production change significantly in the year 1994, 1999 and 2012. Its highest production reaches 3,606.7 thousand tons in 2018 with its annual growth rate in 18 years is 14.11% (from the year 1990 to the year 2018). Although the production steady climbed through year, the chain index still decrease from 1.0997 to 1.0544 compared to the beginning of the period. This leads to the fact that although production has increased year by year, but this rate began to decrease.

The fifth column is the production of aquaculture fisheries with two following vertical column show base index and chain index. From 1990 to 1996, the aquaculture production grew slowly from 162.1 thousand tons to 423 thousand tons. The grow rate in this period is calculated 160.95%. But from 1996 to 1997, there was a slight fall of total aquaculture to 414.6 thousand tons. From 1998 to 2008, with a very rapid rise of the production from 425 thousand tons to 2465.6 thousand tons, the grow rate is 480.1% and marked a peek in 2008. This is a great success of the fisheries industry due to the transformation of production structure as well as investment structure. The structure of commodity items and export aquatic product processing facilities also changes in the direction of diversification associated with market requirements. After growing rapidly, the production yearly until 2018 has been climbed remarkably and more sharply with the grow rate in the period 2008 – 2018 is 68.79%. Many seafood processing establishments for export have been newly built in raw material production areas such as Ca Mau and An Giang, attracting tens of thousands of agricultural laborers, contributing to the redistribution of labor in rural areas. The Government encourages all economic sectors to exploit all potential in terms of capital and experience, on the other hand, concentrates the budget and preferential credit capital for the fisheries sector.

Figure 7. Graph for development of fisheries production in catch and aquaculture, 1990 - 2018.



Source: General Statistics Office of Vietnam. Graph by author.

The graph used to display the total production trend in fishing and aquaculture production and also predict their trends in the future. The orange dotted line is the fisheries catch production trend function (in thousand tons) with the coefficient of determination R^2 is 0.9806. This figure shows the trend function is 98.06% reliable. On the other hand, the green dotted line shows the trend function of fisheries aquaculture production (in thousand tons) with the coefficient of determination R^2 is 0.9421. This also leads to the fact that this trend line is assumed with 94.21% reliable.

With these trustworthy numbers of R^2, it is clearly that trend function can be used to forecast for the following three years.

Total catch fisheries production (thousand tons)

Equation: y = 94.773x + 551.83

- When x = 30 (year 2019)

  y_{30} = 94.773 * 30 + 551.83

  y_{30} = 3395.02 (thousand tons)

In the 30th year (2019), the predicted value for the catch production of fisheries is 3395.02 thousand tons.

- When x = 31 (year 2020)

  y_{31} = 94.773 * 31 + 551.83

  y_{31} = 3489.8 (thousand tons)

In the 31st year (2020), the predicted value for the catch production of fisheries is 3489.8 thousand tons.

- When x = 32 (year 2021)

  y_{32} = 94.773 * 32 + 551.83

  y_{32} = 3584.56 (thousand tons)

In the 32nd year (2021), the predicted value for the catch production of fisheries is 3584.56 thousand tons.

Total aquaculture fisheries production (thousand tons)

Equation: y = 155.88x – 665.46

- When x = 30 (year 2019)

  y_{30} = 155.88 * 30 – 665.46

  y_{30} = 4010.94 (thousand tons)

In the 30th year (2019), the predicted value for the aquaculture production of fisheries is 4010.94 thousand tons.

- When x = 31 (year 2020)

  y_{31} = 155.88 * 31 – 665.46

  y_{31} = 4166.82 (thousand tons)

In the 31st year (2020), the predicted value for the aquaculture production of fisheries is 4166.82 thousand tons.

- When x = 32 (year 2021)

  y_{32} = 155.88 * 32 – 665.46

  y_{32} = 4322.7 (thousand tons)

In the 32nd year (2021), the predicted value for the aquaculture production of fisheries is 4322.7 thousand tons.

Using MAPE method to evaluate the quality of forecasting values, we have the calculation as follow:

Table 3. MAPE calculation of fisheries production forecasting

	Production (thousand tons)		3 MA		|ERROR|		|%ERROR|	
Year	Catch	Aquaculture	Catch	Aquaculture	Catch	Aquaculture	Catch	Aquaculture
2016	3,226.1	3,644.6						
2017	3,420.5	3,892.9						
2018	3,606.7	4,161.8						
2019	3395.02	4010.94	3,417.77	3,899.77	22.75	111.17	0.67	2.77
2020	3489.8	4166.82	3,474.07	4,021.88	15.73	144.94	0.45	3.48
2021	3584.56	4322.7	3,497.17	4,113.19	87.39	209.51	2.44	4.85
						MAPE (%)	1.19	3.70

Source: calculated by author.

Table 3. is the calculation of MAPE method to evaluate the forecasting production values. The first column shows the year from 2016 to 2021, followed by two vertical columns are catch and aquaculture production. The value of these in year 2016, 2017, 2018 are from the data from Table 2. and the value of production in year 2019, 2020, 2021 belonged to the pronose part. The fourth and fifth column of the table demonstate three moving average of each year.. The sixth and seventh column display these absolute value of error between 3 MA and the pronose productions. Two last column illustate the percentage of error. The MAPE results are highlighted are 1.19% and 3.70%, which shows that the error measured are low.

Fish and Shrimps production

The main production in the aquaculture are fish and shrimps which are showed in the table below with the prediction.

Table 4. Development of Fish and Shrimps production in Vietnam 1990 – 2018 (Thousand Tons)

Production (Thous. tons)	Fish	BI	CI	Shrimps	BI	CI
1990	129.3	1.0000		32.7	1.0000	
1991	132.3	1.0232	1.0232	35.8	1.0948	1.0948
1992	135.5	1.0480	1.0242	37.4	1.1437	1.0447
1993	139.7	1.0804	1.0310	39.4	1.2049	1.0535
1994	178.4	1.3797	1.2770	44.7	1.3670	1.1345
1995	209.1	1.6172	1.1721	55.3	1.6911	1.2371
1996	256	1.9799	1.2243	49.7	1.5199	0.8987
1997	279.3	2.1601	1.0910	49.3	1.5076	0.9920
1998	285.6	2.2088	1.0226	54.9	1.6789	1.1136
1999	336	2.5986	1.1765	57.5	1.7584	1.0474
2000	391.1	3.0247	1.1640	93.5	2.8593	1.6261
2001	421	3.2560	1.0765	154.9	4.7370	1.6567
2002	486.4	3.7618	1.1553	186.2	5.6942	1.2021
2003	604.2	4.6729	1.2422	237.9	7.2752	1.2777
2004	761.5	5.8894	1.2603	281.8	8.6177	1.1845
2005	971.2	7.5112	1.2754	327.2	10.0061	1.1611
2006	1,157.10	8.9490	1.1914	354.5	10.8410	1.0834
2007	1,530.30	11.8353	1.3225	384.5	11.7584	1.0846
2008	1,863.30	14.4107	1.2176	388.4	11.8777	1.0101
2009	1,962.60	15.1787	1.0533	419.4	12.8257	1.0798
2010	2,101.60	16.2537	1.0708	449.7	13.7523	1.0722
2011	2,255.60	17.4447	1.0733	478.7	14.6391	1.0645
2012	2,402.20	18.5785	1.0650	473.9	14.4924	0.9900
2013	2,351.60	18.1872	0.9789	560.5	17.1407	1.1827
2014	2,458.70	19.0155	1.0455	615.2	18.8135	1.0976
2015	2,536.80	19.6195	1.0318	634.8	19.4128	1.0319
2016	2,585.90	19.9992	1.0194	656.4	20.0734	1.0340
2017	2,734.80	21.1508	1.0576	747.3	22.8532	1.1385

2018	2,918.70	22.5731	1.0672	809.7	24.7615	1.0835

Source: Data from General Statistics Office of Vietnam. Table and calculated by author.

BI – Base Index CI – Chain Index

Table 4. shows the development of Fish and Shrimps aquaculture production in Vietnam. The first column shows the year from 1990 to 2018, followed by the second column with the production of fish each year which is recorded by the General Statistic of Vietnam. The next two column are the base index and chain index of the fish production.

At the first half of the period, the production of fish remained steady. There were just slightly change in the first four years (129.3 thousand tons to 139.7 thousand tons). From the year 1994 to 2001, the production started to grow, slowly but more markedly compare to the period mentioned above. A dramatic jump appeared from 2002 to 2008 when the fish production increased sharply from 486.4 thousand tons to 1863.30 thousand tons. The grow rate is this period is calculated as 283%. It continuously grew in the next four years but then hit a low in 2013. This could be explained by the low price of raw pangasius fish around 21,000 VND[1] per kg while the price of feed and input costs increased. (FAO, 2013) Moreover, in 2012, consumers in main import markets such as EU, USA, China, Saudi Arabia, Egypt, etc. reduced spending due to the difficult economic situation. From 2014 to 2018, the production of fish went up again with the growth rate is only 18.7% (from 2458.70 thousand tons to 2918.70 thousand tons). There was a small decline in 2016 due to environmental incidents in the North Central coastal provinces by Formosa Company put waste into the sea which causing fishermen in these provinces to stop fishing for many months, affecting fishing in the country. (Trang, 2017)

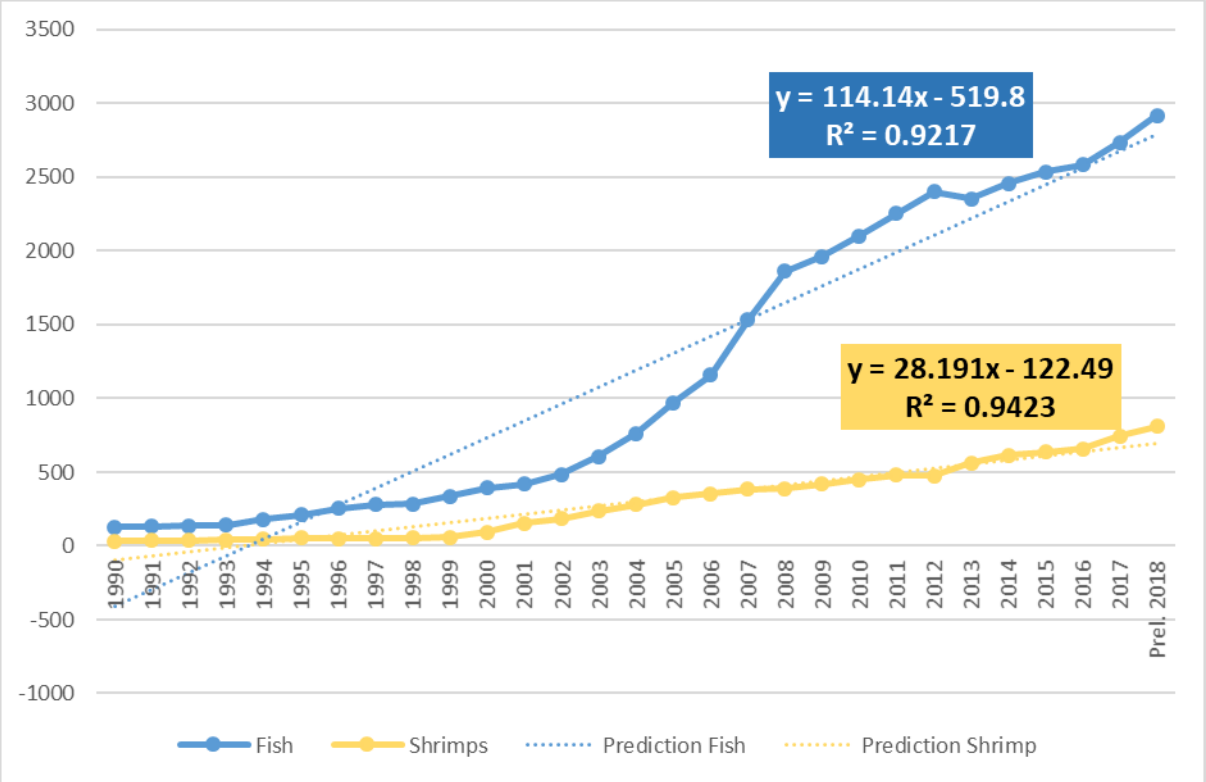
The fifth column shows the production of shrimps aquaculture through year, following by its base index and chain index.

Throughout the period, shrimps production grew slowly but surely. There was no suddenly peak and low points in the period. From the year 1997 to 2000, the production of shrimps went down a little bit with the lowest point in 1999 (57.5 thousand tons). In 2012, the shrimps went down again (473.9 thousand tons) due to

[1] Viet Nam Dong – currency of Vietnam. 1,000 VND = 1 CZK.

early mortality syndrome and the lack of adequate bank loan. (FAO, 2013) According to the Ministry of Agriculture and Rural Development, in 2012, there were 30 provinces and cities raising shrimp with 657,500 hectares, producing 476,400 tons. Compared to 2011, the shrimp farming area increased by 0.2%, but the yield decreased by 3.9% due to disease.

Figure 8. Graph for development of Fish and Shrimps production in aquaculture



Source: General Statistics Office of Vietnam. Graph by author.

The two paragraphs above described the production of fish and shrimps through years as well as the development trend. The blue dotted line is the fish trend function with the coefficient of determination R^2 is 0.9217. This means that the figure shows the trend function is 92.17% reliable. On the other hand, the yellow dotted line shows the trend function of shrimps productions based on given data. The coefficient of determination R^2 of this trend line is 0.9423 so this figure shows the trend function is 94.23% reliable.

With these trustworthy numbers of R^2, it is clearly that trend function can be used to forecast for the following three years.

Total fish production (thousand tons)

Equation: y = 114.14x – 519.8

- When x = 30 (year 2019)

  y_{30} = 114.14 * 30 – 519.8

  y_{30} = 2904.4 (thousand tons)

In the 30th year (2019), the predicted value for the fish production is 2904.4 thousand tons.

- When x = 31 (year 2020)

  y_{31} = 114.14 * 31 – 519.8

  y_{31} = 3018.54 (thousand tons)

In the 31st year (2020), the predicted value for the fish production is 3018.54 thousand tons.

- When x = 32 (year 2021)

  y_{32} = 114.14 * 32 – 519.8

  y_{32} = 3132.68 (thousand tons)

In the 32nd year (2021), the predicted value for the fish production is 3132.68 thousand tons.

Total shrimps production (thousand tons)

Equation: y = 28.191x – 122.49

- When x = 30 (year 2019)

  y_{30} = 28.191 * 30 – 122.49

  y_{30} = 723.24 (thousand tons)

In the 30th year (2019), the predicted value for the shrimp production is 723.24 thousand tons.

- When x = 31 (year 2020)

  y_{31} = 28.191 * 31 – 122.49

  y_{31} = 751.43 (thousand tons)

In the 31st year (2020), the predicted value for the catch production of fisheries is 751.43 thousand tons.

- When x = 32 (year 2021)

  y_{32} = 28.191 * 32 – 122.49

  y_{32} = 779.62 (thousand tons)

In the 32nd year (2021), the predicted value for the catch production of fisheries is 779.62 thousand tons.

Using MAPE method to evaluate the quality of forecasting values, we have the calculation as follow:

Table 5. MAPE calculation of Fish and Shrimps production forecasting

	Production		3 MA		|ERROR|		|%ERROR|	
Year	Fish	Shrimps	Fish	Shrimps	Fish	Shrimps	Fish	Shrimps
2016	2,585.90	656.4						
2017	2,734.80	747.3						
2018	2,918.70	809.7						
2019	2904.4	723.24	2,746.47	737.80	158	14.56	5.44	2.01
2020	3018.54	751.43	2,852.63	760.08	166	8.65	5.5	1.15
2021	3132.68	779.62	2,947.21	761.46	185	18.16	5.92	2.33
						MAPE (%)	5.62	1.83

Source: calculated by author.

Table 5. is the MAPE calculation to evaluate the forecasting Fish and Shrimps. The first column shows the year from 2016 to 2021, followed by two vertical columns are Fish and Shrimps production. The value of these in year 2016, 2017, 2018 are from the data from Table 4. and the value of production in year 2019, 2020, 2021 are took from the forecasting part. The fourth and fifth column of the table demonstate three moving average of each year. The sixth and seventh column show these absolute value of error between 3 MA and the pronose productions. Two last column display the percentage of error. The MAPE results are highlighted are 5.62% and 1.83%, which shows that the error measured are low.

4.2 Export growth

Vietnam is considered to be a country with huge potential for both freshwater and saltwater fisheries, so there are many favorable conditions to develop fishing and aquaculture to create an abundant supply of raw materials for seafood processing industry serving domestic demand and export. As a result, seafood export has become one of the most important export sectors of the economy, bringing a great source of foreign currency to the country and always on the list of top export – value industries of Vietnam. The export value of this industry contributes significantly to the total export turnover of the whole country in particular and the country's economic growth in general. The three main seafood export markets of Vietnam are the EU, the US and Japan, which is led by the EU market. (Dung, 2003)

Growth rate or rate of increase is one of the most common indicators to rate the progress of fisheries export activity. It is a relative indicator reflecting the increasing or decreasing rhythm of the phenomenon over time and is expressed as the number of times or the percentage. The growth rate is calculated by comparing the absolute increase between the two periods with the level of the period selected as the comparison base. It is calculated as below:

$$\text{Growth rate (\%)} = \frac{\text{Present value} - \text{Past value}}{\text{Past value}} . 100$$

To evaluate the export growth of fisheries production in Vietnam, we obtain the export value from 2004 until 2018 in Vietnam. The data is collected by Vietnam Customs and Vietnam Association of Seafood Exporters and Producers.

Table 6. Export value and Growth rate of Fisheries production in Vietnam, 1995 - 2018

	Export value (US$ mll.)	**Growth (%)**
1995	550	
1996	670	21.82
1997	760	13.43
1998	817	7.50
1999	971	18.85

2000	1478	52.21
2001	1777	20.23
2002	2093	17.78
2003	2240	7.02
2004	2401	7.21
2005	2739	14.08
2006	3348	22.23
2007	3763	12.40
2008	4509	19.82
2009	4251	-5.72
2010	5034	18.42
2011	6118	21.53
2012	6134	0.26
2013	6899	12.47
2014	7922	14.83
2015	6677	-15.72
2016	7053	5.63
2017	8316	17.91
2018	8802	5.84

Source: Data from VASEP. Table and calculated by author.

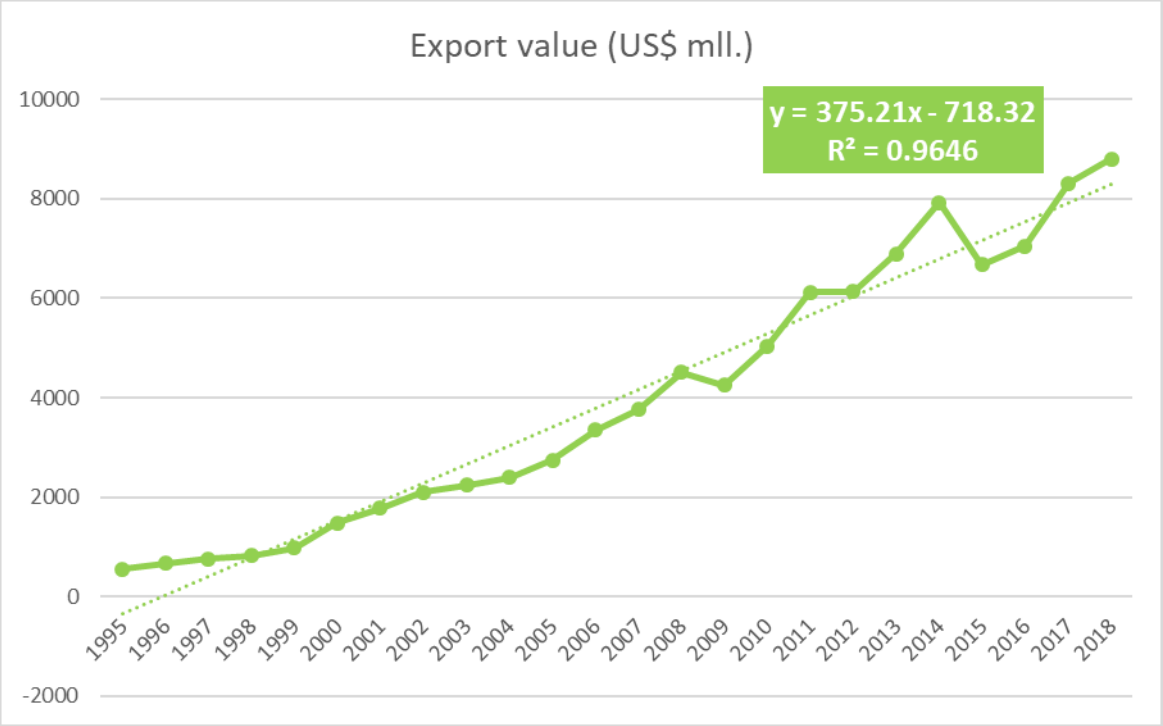
Result for Growth rate computation

The exported value is collected from VASEP and the Growth rate is calculated to evaluate the development of fisheries production in Vietnam to international markets. The result of Growth rate computation is given in the third column of Table 6. The overall results show that the growth rate is increasing year over year from 1995 to 2008 and became fluctuate since 2008 until now. There was a markable result in 2000, recorded as 52.21% compared to 2009. This was more than double in the export production, from 971 million US dollar to 1478 million US dollar. This could be explained that since the mid 1990s, the industry has focused on innovating methods of quality control and product safety, approaching and gradually meeting the highest demands in this area of large markets and from these right solutions so in the last years of the 20th century and the beginning of the 21st century, the fishery

industry has gained its important. (Ministry of Agriculture and Rural development - Directorate of Fisheries, 2019) After increased smoothly, there was a quick fall in the value recorded in 2009. The main reason for this decline was given by VASEP due to the financial crisis and the world economic downturn, so the difficulties in credit, exchange rate, and consumer demand had a strong impact on seafood trade in 2009. Especially, the traditional markets of Vietnamese seafood are EU, USA, and Japan, which are likely to reduce the most, about 15 – 20%. Many importers were subject to credit tightening by the banks, which made it impossible to pay for new orders. In particular, the two key products of Vietnam's seafood industry, which are shrimp and pangasius fish were worst affected. Since 2019, the growth rate became fluctuated. It peaked in 2014 and 2018 with 7922 million US dollar and 8802 million US dollar. On the other hand, it reached a low point in 2015 with 6677 million US dollar. The export value of three key products as of mid-November 2015 including shrimp, pangasius and tuna decreased compared to the same period in 2014, leading to a total reduction of 15.72% compared to the same period of the previous year. In the largest seafood import markets of Vietnam such as the US, Japan and the EU, fluctuations in the USD, Yen[2] and Euro have had significant impacts on export activities of seafood enterprises. (World Fishing and Aquaculture, 2016) However, the biggest difficulty in exporting seafood in 2015 is the technical and trade barriers introduced by importing countries. Accordingly, the anti – dumping tax on pangasius in the US market has caused difficulties for fish farmers and Vietnamese pangasius exporting enterprises. In 2015, the US Department of Commerce (DOC) twice imposed anti-dumping duty on frozen pangasius fish products imported from Vietnam. (VNA, 2017)

[2] Yen – currency of Japan.

Figure 9. Export value and Growth rate of Fisheries production of Vietnam, 1995 - 2018



Source: Data from VASEP. Graph by author.

The paragraph above describes the export of fisheries production yearly and its development trend. The green line shows the export value in million US dollar and the dotted line is the export trend function with the coefficient of determination R^2 is 0.9646. This means that the figure shows the trend function is 96.46% reliable.

With 96.46% reliable, it is clearly that trend function can be used to forecast for the following three years.

Export value (million US$)

Equation: y = 375.21x – 718.32

- When x = 25 (year 2019)

  y_{25} = 375.21 * 25 – 718.32

  y_{25} = 8661.93 (million US$)

  In the 25th year (2019), the predicted export value of fisheries is 8661.93 million US$.

- When x = 26 (year 2020)

y_{26} = 375.21 * 26 – 718.32

y_{26} = 9037.14 (million US$)

In the 26th year (2020), the predicted export value of fisheries is 9037.14 million US$.

- When x = 27 (year 2021)

  y_{27} = 375.21 * 27 – 718.32

  y_{27} = 9412.35 (million US$)

  In the 27th year (2021), the predicted export value of fisheries is 9412.35 million US$.

5 Discussion

Based on the result from the previous chapter, the production of fisheries in Vietnam is growing fast and the export growth is also increasing due to the development of Vietnam market to the world.

Vietnam has become one of the countries with leading seafood products in the world. Total production and export value are still rising every year, showing that fisheries play a significant role in the economics of the country. In 2018, the total seafood production reached 7.7 million tons and exports reached over 8 billion USD.

Forecast in the area of production of catch and aquaculture fishery production, production of fish and prawn aquaculture as well as export value are all have increase trend in the year of 2019, 2020 and 2021.

In the past, Vietnam increased its seafood exports by increasing its catch. However, with the current trend, Vietnam needs to focus on developing aquaculture due to the adverse effect of climate. At the same time, enhancing processing and creating products with high added value, especially with shrimp and pangasius products, which are Vietnamese products with strengths to overcome EU regulations's expect. On the other hand, world shrimp demand is increasing. Meanwhile, Vietnam has a lot of potential for developing shrimp farming and processing for export, but Vietnam's shrimp market share in large markets is very modest.

However, besides the achieved results, the fishery industry still has many limitations and challenges, such as the scale of the fishery industry is not commensurate with the country's potential; investment in obsolete fishery infrastructure systems remains inadequate; the organization of aquaculture production is not effective, etc.

After the EC warned the "yellow card" to Vietnam, the Government had many directions to implement solutions to end the violations of Vietnamese fishing vessels and fishermen. However, the situation of illegal fishing has not yet ended.

In the coming period, in order for Vietnam's fisheries industry to develop sustainably, it is necessary to develop Vietnam's fishery industry into a commodity – producing, branded and highly – competitive goods industry on the world market. It is important to conduct necessary studies, based on the scientific basis of aquatic resources, marine products, the exploitation capacity of existing boats, the socio –

economic situation of each sea area to determine the occupation structure for each reasonably.

In particular, first of all, continue to focus on restructuring the fisheries industry on the basis of fully assessing the needs of the domestic market and the world. On the basis of restructuring the fisheries sector, the Ministry of Agriculture and Rural Development and the Ministry of Natural Resources and Environment should coordinate with the concerned ministries and localities to focus on reviewing, adjusting, supplementing and making new plans under the Planning Law. Specifically conversion to on – shore jobs such as salt and brackish aquaculture, aquatic product processing and tourism and fishing services; conversion to an environmentally friendly fishing profession and introducing tuna fishing.

At the same time, specific construction of priority projects and tasks to mobilize capital sources for development investment.

Not only that, we should dentify specific policies and measures to reduce the number of coastal fishing vessels as well as developing new careers, solving employment problems in coastal localities. Apply FAO's "Responsible fishing" guide to the specific situation of the whole strip. This consists of:

- Applying measures to protect aquatic resources, establishing conservation areas and stipulating areas where fishing is prohibited.
- Prohibit and limit the adverse effects of harmful fishing gears, destructive fishing methods.
- Establishing specific measures to manage and protect the marine environment.

6 Conclusion

This bachelor thesis analyzed fishery production development of Vietnam in the period from 1990 to 2018. A review of theoretical literature related to the topic has presented. Analysis of fishery production shows that climate changes and market barriers has been influenced to the production as well as the export growth of the industry.

Vietnam is a country with rich and diverse fishery resources. The seafood industry in Vietnam develops on the basis of the favor of nature as Vietnam is located in the humid monsoon tropical region with abundant natural aquatic resources, with three sides bordering the sea and continental shelf. The large area is very convenient for aquaculture and moreover, there is an abundant labor force eager to learn and work hard.

The fisheries industry, after more than 20 years of operation since its inception, has gone through many ups and downs, many stages along with the guidelines of each development period of the country, and gradually proved its position in economic restructuring and social stability. Fishery is a key industry which contributes to the country's total GDP thanks to exports.

However, with the current situation of fisheries production as analyzed in this bachelor thesis, the fishery industry faces many difficulties. This makes the fisheries industry grow but does not correspond to the advantages that it has. The first is that this resource is in danger of exhaustion due to environmental impacts. Therefore, protection of aquatic resources is an issue for leaders and management. Also, the European "yellow card" for Vietnamese fisheries is considered a necessary impetus to drastically transform fisheries to develop sustainably and responsibly.

Method used in this bachelor thesis is based on time – series analysis, which are mainly based on base index, chain index and time series forecasting, which consist of simple linear regression, linear trend funtion and coefficient of determination. Base index shows the development of fishery production based on the year 1990. Chain index illustrated the changes compared to the previous year. Using linear trend function as a case of simple linear regression model is a way to describe the development of the production as well as artificial way of prediction in the future.

Therefore this analytical study of fishery development in Vietnam has helped understanding the current status of industry as well as forecasting of the production and based on that, right measures and models should be taken to contribute to the development of the fisheries industry in our country.

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