

**Czech University of Life Science Prague**

**Faculty of Economics and Management**

**Department of Economics**



**Bachelor Thesis**

**Economics Evaluation of Pepper Production in Cambodia**

**Author: Sosathya Pok**

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## BACHELOR THESIS ASSIGNMENT

Sosathya Pok

Business Administration

Thesis title

**Economic evaluation of pepper production in Cambodia**

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### Objectives of thesis

There are two goals for this thesis.

1. To identify and evaluate Market chain of pepper production in Cambodia including selling price in local market, export and import
2. To study about factors affecting pepper production, get information about Harvest area in selected areas in Cambodia (Kampot province, Sihanouk province, and Kampong Cham province), and compare the data of production, harvest area, and price of that selected areas.

### Methodology

There are 2 methods which apply to my thesis.

1. Method of Regression analysis OLS
2. Nonlinear Regression analysis

## **The proposed extent of the thesis**

40 pages

## **Keywords**

Pepper production, Cambodia, Agriculture, Investment, Foreign trade, Economic evaluation

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## **Recommended information sources**

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St. James, Dorothy. The Scarlet Pepper. New York: Berkley Prime Crime, 2012. Print.

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## **The Bachelor Thesis Supervisor**

Ing. Petr Procházka, Ph.D., MSc

## **Supervising department**

Department of Economics

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**prof. Ing. Miroslav Svatoš, CSc.**

Head of department

Electronic approval: 26. 1. 2017

**Ing. Martin Pelikán, Ph.D.**

Dean

Prague on 14. 03. 2017

# **BACHELOR THESIS**

## **ASSIGNMENT**

**Sosathya Pok**

**Business Administration**

Thesis title

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### **Objective of thesis**

To evaluate and study about economics evaluation of pepper production in Cambodia from 2000 to 2011 in Cambodia, to get information about harvest area, and examine key factors that influence the economics of pepper production for the whole period.

### **Methodology**

For Literature review part, there are method to write it such as abstraction, synthesis, deduction and induction. For practical part, the following methods are basic statistic, regression of dissolution factors, quantitative, and qualitative.

### **Schedule for processing the thesis**

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01/2017 Practical part

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**Keywords**

Pepper Production, Economics evaluation, Cambodia, Agriculture, Investment, direct domestic Trade

**Recommendation sources**

Chandararot, Kang And Dannel Liv.Rural Development And Employment Opportunities in Cambodia 1<sup>st</sup> ed. Bangkok: ILO, 2013. Print. ISSN: 2227-4405

Kem, S., Chhim, C., Theng, V. And So, S. Policy Coherence in Agricultural And Rural Development 1<sup>st</sup> ed. Phnom Penh: CDRI, 2011. Print.

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Ros, Bansok, Phirun Nang, and Chhun Chhim. Agricultural Development And Climate Change. Phnom Penh: CDRI, 2011. Print.

## **Declaration**

My name is Sosathya Pok, and I hereby to guarantee and declare that I have written this bachelor thesis by my own and my words plus the sources that I have put above and at reference part.

In Prague, 09.03.2017

.....

Sosathya Pok

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I would like to thank to my family especially my mom who always supports and encourages me all the time to be a good person in family, school, and society.

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# **Economics Evaluation of Pepper Production in Cambodia**

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## **Ekonomická Analýza Produkce Pepř v Kambodže**



## **Summary**

Pepper is one of the king spices, and it is given name as 'Black Gold'. Black pepper (*Piper nigrum*) is known as family of Piperaceae. It is flowering vine, and it is being cultivated when it become fruits, which is famous to get it dry and used as a spices and seasoning. Pepper had been found in India, and it was used to cook since the prehistoric time at least 2000 years BCE. Peppercorn had become much valuable prized trade good. In the middle age, it had been transferred to Europe, the Middle East and North America. Since that time the pepper has become one of the biggest valued products around the world as we can name it 'Black Gold'. In Cambodia, pepper has been found in Kom port province in 19<sup>th</sup> century. Before that time, due to Chinese emissary Zhou Daguan who documented much about early Cambodian history including the delectable, pepper had been grown along mighty temple in this written document at the time.

This thesis is written and designed to fulfill two objectives. First objective is to identify and evaluate the economics of Pepper Production from 2000 to 2011 and to study about keywords factors why it becomes influenced to Cambodian economic during that period. The factors are price of pepper production, import the quantity of pepper, export the quantity of pepper, the total of both domestic and foreign investment in agriculture sector, and natural disaster. The first objective was evaluated by using regression linear model and regression analysis the method of ordinary least square. Beside the first objective, there is also second objective which define how influence on harvest areas, and total product change in the whole period 2000-2011. The method to analysis is difference from first objective. It is done by logarithm dissolution method.

## **Keywords**

Pepper Production, Economics evaluation, Cambodia, Agriculture, Investment, direct domestic Trade

## Abstrakt

Pepř je jedním z královských druhů přezdívaný jako 'Černé zlato'. Černý pepř (*piper nigrum*) pochází z rodiny Piperaceae. Je to kultivovaná kvetoucí réva jejíž plody se po sklizni suší a jsou celosvětově používány jako koření. Pepř se začal používat v Indii před více než 2000 lety př. n. l. a už v té době se využíval k vaření. S postupem času se z pepře stala poměrně draze ceněná komodita. Ve středověku byl pepř rozšířen do Evropy, Středního východu a Severní Ameriky. V tuto dobu si pepř získal oblibu po celém světě, jeho cena vzrostla a získal přezdívku 'Černé zlato'. V Kambodži byl pepř nalezen v 19. století v provincii Kom. Ale ještě před tímto objevem, byl pepř pěstován v některých Kambodžských chrámech díky čínskému misionáři Zhou Daguanovi, který zde také dokumentoval historii Kambodži.

Tato práce má za úkol splnit dva cíle. Prvním je identifikace a posouzení ekonomických aspektů produkce pepře v letech 2000 – 2011 a rozbor faktorů, které stály za tím, že produkce pepře ovlivnila ekonomii Kambodže. Mezi tyto faktory patří cena produkce pepře, dovoz a jeho objem, vývoz a jeho objem. Dále domácí i zahraniční investice do zemědělství a vliv přírodních katastrof. Tento první cíl je dosažen za použití regresního lineárního modelu a regresní analýzy metody nejmenších čtverců. Druhým cílem je určení dopadů faktorů na sklizně a jejich vývoj v letech 2000 – 2011. K tomu je použita analýza využívající rozdíl s prvním cílem – logaritmickou metodou.

**Klíčová slova:** produkce pepře, hodnocení ekonomie, Kambodža, zemědělství, investování, domácí trh

## **Abbreviations**

**AEC:** ASEAN Economic Community

**ASEAN:** Association of Southeast Asian Nations

**CDC:** Council for the Development of Cambodia

**CIB:** Cambodian Investment Board

**CMAC:** Cambodian Mine Action Centre

**CRDB:** Cambodian Rehabilitation and Development Board

**CSEZB:** Cambodian Special Economic Zone Board

**FAO:** Food and Agriculture Organization

**FDI:** Foreign Direct Investment

**GDP (PPP):** Gross Domestic Product (Purchasing Power Parity)

**PMIS:** Provincial/Municipal Investment Sub-Committee

**WB:** World Bank

**WTO:** World Trade Organization

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## **1. Introduction**

Pepper is one of the most famous species in the world. It was given name as black goal, and became king specie. It has come from a flowering vine in the family of Piperaceae, and mostly we cultivated for its fruit. After we cultivated, usually it is gotten dry and used as the spice and seasoning. In Cambodia, pepper has been found in 13<sup>th</sup> century next to Angkor wat temple (related to the diary of the Chinese explorer Tcheou Ta Kouan), but there was not much popular, and go back to the beginning of the Aceh war in Indonesia (1873-1908), the intensive of pepper production has been back. In 19<sup>th</sup> century it has been grown. In 21<sup>st</sup> century, it has been known as the agro-industry product which lives for long time in tropical area.

There are many reasons why this production is important to our live. First of all beside seasoning and cooking, we can also use it as the medicine or herb to cure some illnesses efficiently. More than 700 years ago in Cambodia has had tradition natural comparative pros in pepper cultivation.

About the climate, luckily Cambodia places in non-strong disaster or is caused by big natural disaster such as earthquake or tsunami. The climate condition performs well enough. Since 2008, Kom pot pepper commodity was opened, and in 2016, this small crop was labeled by European Union about the quality and productivity.

## **2. Objectives and Methodologies**

### **2.1. Objectives**

The first objection of this thesis is to study and evaluate economics of pepper production In Cambodia from 2000-2011for whole periods, and to set key factor to study about how influenced it is during that periods and to estimate the relationship whether it is strong or not among of pepper production and the key factors such as

- Price of pepper production
- Import quantity of pepper production
- Export quantity of pepper production
- Invest on pepper production (both domestic and foreign investment)
- Natural disaster

The second objective is to study about the harvest areas and yield on pepper production in Cambodia annually from 2000-2011. The evaluation of second objective is used another different method from the first objective.

### **Research questions**

- How strongly did the price of pepper production influence pepper in Cambodia in the whole period from 2000-2011 as total price of farmer to produce it?
- How much trade (both export and import) of Cambodian pepper influence it in Cambodia for the whole period from 2000-2011?
- How strong did natural disaster cause on the pepper production to cause its demand in the whole period from 2000-2011?
- How much influenced did harvest area and yield cause on pepper production annually for the whole period from 2000-2011?

### **Hypothesis**

- Price of pepper production had a negative influence on pepper in the whole period from 2000-2011 in Cambodia
- Import of pepper production had a negative influence on pepper in the whole period from 2000-2011 in Cambodia
- Export of pepper production had a positive influence on pepper in the whole period from 2000-2011 in Cambodia
- Investment on the pepper production in agriculture sector had a positive influence in the whole period from 2000-2011 in Cambodia
- Natural disaster had a positive influence on pepper in the whole period from 2000-2011 in Cambodia

### **2.2. Methodologies**

In this thesis, Secondary data is used to fulfill hypothesis. Regression model analysis is used to fulfill the first objective and to find out how much influenced the key factors (price, import, export, and investment) together with the natural disaster which had caused on pepper production in the whole period of 2000-2011 as the following of secondary data:

- Pepper production in units of tones
- Price of pepper production in unit of USD per ton
- Import quantity of pepper production in unit of tones

- Export quantity of pepper production in unit of tones
- Investment in production (for both domestic and FDI) in unit of USD million
- Number of disaster in numerical occurrence

The second objection is to evaluate the harvest areas and yield that influence on the pepper production annually from 2000-2011 through the method of logarithm dissolution factor by using secondary data as the following:

- Harvest areas in unit of hectares
- Yield in unit of tons per hectare
- Pepper production in unit of tons

The method of logarithmic dissolution factors are described as following:

- $\Delta Q$  = change in pepper production
- $\Delta QY$  = change in pepper production influenced by change in yield
- $\Delta QH$  = change in pepper production influenced by in harvested area

$$\Delta Q = \Delta QY + \Delta QH$$

$$\Delta QH = (\Delta Q) * (\ln IH / \ln IQ)$$

$$\Delta QY = (\Delta Q) * (\ln IY / \ln IQ)$$

$$I = \text{Actual period} / \text{Base (last) period}$$

- I = Index between actual and base (last) period

Correlation matrix analysis is conducted to evaluate how strongly all the data (pepper production, price of pepper production, import and export quantity of pepper production, investment on agriculture sector, natural disaster, harvest area and yield) which have mentioned above correlated in the whole period from 2000-2011. All of the secondary data mentioned earlier for the analysis is rank from 2000-2011. We can find some data in 2012, but it is more convenient to use data from 2000-2011.



### **3. Theoretical section**

#### **Literature Review of Pepper crop report in 2015**

During this century, pepper is one of the most focused and the most produced crop. Not just only Cambodia produce this crop, but there are many countries that produce it such as Brazil, China, India, Indonesia, Vietnam, Thailand etc. The most produced countries are Brazil, India, and Indonesia. For the global consumption, 40-45% has been taken place in Asia.

#### **Price**

Base on NEDSPICE report about pepper production, since 2014 where issuing the report of pepper price, it has shown that the price of pepper production is still stable or volatility. Last decade of pepper price, the price of pepper is so much different, and there is probably an argument of pepper price volatility if compared to other agricultural commodities. However, for many reasons, the farm community has found out that there was little incentive to invest in pepper production and expand the areas which have been cultivated already according to the latest elaboration in this report. So supply cannot be able to keep up with this spur in demand. To deal with this problem, or in other word to bring out supply and demand become equal, piece of pepper production tends to be increased. That's why the price of global pepper production has been increasing faster. (Nedspice, 2015)

#### **Production**

Pepper production is a plant that is very sensitive to many conditions such as soil condition, climate condition (temperature and rainfall) during the life span of its. In this recent year, there was a research about effect on pepper production, and there are El Nino and El Nina effect. According to climatic studies, it has indicated that there is a fair chance of another El Nino which is going to impact on crops in Asia. Fortunately, there is no indication that pepper production in Asia has been affected yet until now. (Nedspice, 2015)

However, there are many reasons mentioned that why global pepper supply cannot be able to keep up with demand. According to this report, there is increasing in cost of input material at the farm level such as fertilizer, pesticides, labor cost, and water. There are also another problems like land availability, invest in new gardens but only yield return within 3 years, spread of disease because of minimal crop alternation, and usage quite high of fertilizers, etc. There are also other cases that cause on changing of pepper production. They are Urbanization and Demographic. A young generation hires employees who have lack

knowledge in agriculture sector. Old farmer changes to plant higher incentive crops. Due to this case, there is an affect of scarcity of spices. It also has negative effect on the environment. In general, life span of pepper production is pretty short. If this problem is still happening, the true yield is quite limited. (Nedspice, 2015) (Nedspice, 2014)

### **3.1. Overview of Cambodia**

Cambodia is a small country which is located in Southeast Asia. It is given name as Kingdom of Cambodia. The total landmass is 181 035 square km (90<sup>th</sup> in the world). By the northwest part is next to Thailand, by the east is next to Vietnam, by the northeast is next to Laos, and by the southwest is next to the Gulf of Thailand. The population is 15.33 million in 2014 (data world bank), and 90 percents are followed by Buddhism religion. The capital city is Phnom Penh. In 1953, the independence was given to Cambodia by French. The official name of this small country is Kingdom of Cambodia. The present king is Norodom Sihamoni who has been crowning as a king since 2004. (Data from World Bank)

Not just only located in Southeast Asia, the climate is also provided such great condition for agriculture by tropical area. It is followed by 2 seasons which are dry season from November to April, and rainy season from May to September. The hottest month is April, and the wettest month is July or either August. The official language is Cambodian (Khmer).

Follow by parliament system, Cambodia has election every 5 years which represents by 25 provinces and 123 seats and municipal. The latest national election took in July 2013. After the national election, there is a division one big province into two (Kompong Cham province was divided into Kompong cham and Tbong Kmom in 2014).

As a low income country, Cambodia depends on agriculture, tourism, garment, and agro-industry. Since 2004 Cambodia became the member of WTO (World Trade Organization) which sharing agricultural products to foreign countries. The estimate GDP is \$16.78 billion in 2014 (data from World Bank) while 2013 the GDP was 15.45 USD Billion. The GDP annual growth rate is 8.6% grow compare to the previous year. More than 60% of population is based on agriculture sector. (World Bank)

### **3.2. History of Pepper**

#### **3.2.1. Ancient time**

Pepper was found first in India since long time ago. It was found since prehistoric time. At least more than 2000 years BCE, it was used as specie for cooking by native Indian people,

and it was given name as Black Gold. It also appeared in Southeast Asia too because it is tropical plant. Back to J. Innes Miller note, he mentioned that pepper was grown in some place in southeast Asia like in southern part of Thailand and Malaysia, and it is the most important to use as medicine or seasoning or cooking. The main source comes from India. Peppercorn becomes one of the much-prized trades good. (The Spice trade of Roman Empire, 29 B.C. to A.D 641)

Since ancient history of black pepper, it has been confused to the long plant, and the dried fruit was closed to the Piper longum. The Romans made a research, and knew both of them and it often referred to each other as just Piper. But the truth is revealed till the new discovery of the new world and new century that pepper and chili pepper are totally different. Pepper is also long fruit, but there are lots of fruits, for chili pepper, it is also fruit but the appearance and the taste is different from pepper.

Before 16<sup>th</sup> century, pepper was grown in Java, Sunda, Sumatra, Madagascar, Malaysia, and everywhere in Southeast Asia include Cambodia too. In fact, since that time, pepper was just normal. No one studied or knew it that it was so useful for seasoning, cooking, or making medicine. The main area traded was China, and it was being used a lot in the locally areas. Back to Cambodia, pepper has been cultivated or grown for more than millennia especially in the Kom pot area for more than 1000 years.

Since the early of 4<sup>th</sup> century, both black and long pepper had appeared in Greece. It was one of the most valuable and expensive good that only rich families can afford it. By that time of the early Roman Empire, especially after Rome's conquest of Egypt in 30 BCE, near routine there was an open-ocean crossing of the Arabian Sea direct to southern India's Malabar Coast. Then there were more information about trading across the Indian Ocean has been passed down in the Periplus of the Erythraean Sea. Related to the Roman geographer Strabo, in the early Empire there were 120 ships annually which were sent a fleet to China, Southeast Asia, India, and back. The fleet timed its travel cross the Arabian Sea to take the predictable monsoon winds. Back from India, the ships needed to travel up the Red Sea.

There were much more interesting details about pepper. Likely it was known and widespread since 3<sup>rd</sup> century. Since that time it appeared in cookbook, includes how to use it in a majority of its recipes. According to Edward Gibbon wrote, in *The History of the Decline and Fall of the Roman Empire*, the pepper was one of the favorable ingredient, and it was one of the most expensive Roman cookery.

### **3.2.2. Postclassical Europe**

In the Europe, since when pepper was used, it was so expensive to buy, and sometime it was used as collateral often. In German, people used to say ‘pepperduur’ which mean in English Language ‘pepper expensive’ to express something which is extremely expensive. The taste of pepper was passed on to who would see Rome fall. After the fall of Rome, there was many countries took over in the middle legs of the spice trade, the first country is Persian and then the Arabs. By the end of Early Middle Ages, the central portion of its trade was controlled under the Islamic. Venice and Genoa were the largest monopolized trade by Italy. According to the Saint Aldhelm in 7<sup>th</sup> century, he had written a riddle related to pepper’s role in England:

- “I am black on the outside, clad in a wrinkled cover.
- Yet within I bear a burning marrow.
- I season delicacies, the banquets of kings, and the luxuries of the table, both the sauces and the tenderized meats of the kitchen.
- But you will find in me no quality of any worth, unless your bowels have been rattled by my gleaming marrow.” (*A riddle authored by Saint Aldhelm, a 7th-century Bishop of Sherborne*)

By reading this riddle through, everyone was realizing that the king of black gold is pepper. During the middle age the only trade of pepper was Italy, and it was monopoly trade. During the middle age, pepper was used to mix with meat then it was rotten. The smell and the taste were so amazing, but unfortunately there was no evidence to agree with this claim. Plus during that time the pepper was too expensive and only rich people could buy it.

Back to Roman Empire, especially in 30 BCE after roman’s conquest of Egypt, there were around 120 ships on a year traveled crossing an open-ocean of the Arabian Sea shipped direct to southern India’s Malabar Coast. Details of this trading cross the Indian Ocean have been gone down in the Periplus of the Erythraean Sea. Within this duration, the shipment of black pepper became shorter trade route than long pepper, and the price had changed too. According to the Roman cookbook ‘Apicius’ De re coquinaria, a 3<sup>rd</sup> century cookbook, and pepper has been included as the first major of the recipes. Edward Gibbon wrote, in the history of Roman Empire, pepper was the most favorable and the most expensive of out other spices. The taste of pepper was compared to its monetary value.

### **3.2.3. History of pepper in Cambodia**

According to history of Cambodia, pepper has been found more than 1000 years ago in Kom Pot religion. There is much more interesting part about pepper history in Cambodia. Related to the documentary of Zhou Daguan, pepper was grown since Angkor period next to the temple of Angkor. Pepper has been produced and cultivated for more than millennia. Since 19<sup>th</sup> century and early 20<sup>th</sup> century pepper had been moved to produce in Kampot Religion. Back to early 13<sup>th</sup> century, Chinese explorer Tcheou Ta Kouan had already described about pepper in Cambodia, and intensive pepper production returns back to the start of Aceh war in Indonesia (1873-1908). The sultan of Aceh who didn't want to give these valuable thing Dutch enemies destroyed and burned everything down pepper plantation in 1873-1874. (FarmLink Ltd Jerome Benezech CEO)

In 1930, related to the book 'Un empire colonial Français l'indochine', under the authod G. Maspero, it is mentioned that 'pepper is exported by crops so far. Almost all the pepper was consumed by France- 2100 tons in 1927; 2600 tons in 1928; came from Indochina, so far in April 1928 custom law allows to export unlimited to France. The French colony exports it even more than 3416 tons in average since 3 year, 4235 tons in 1927. This production almost disappeared from the Cochinchine religion where it was given to Hainan Chinese grower but unfortunately everything came from Cambodia. Pepper is always one of the most important industries in Kampot region. Its flavor and its pugnacity made him to become one of the most delicious peppers in the world, and its quality also becomes one of the best peppers in the world. Nowadays it is recommended by French chefs to use it as the spice in the kitchen. (FarmLink Ltd Jerome Benezech CEO)

### **3.3. Agriculture overview**

Pepper is one of the longest live plants, and it is climbing vine plant which is grown in tropical areas especially Cambodia, Thailand, Vietnam, China, and Malaysia. The raining level is about 2000-2500 ml per year. In Cambodia, pepper is well known as agro-industry which is really important for supporting financial in family and also for the whole country. Besides using it as seasoning and species, in Cambodia we can use it for curing some illness and using it as the ingredient to kill insects which is living in goods which produced by further. (Pepper Book from Minister of Agriculture, Forestry, and Fisheries)

### **3.3.1. Pepper production in agriculture**

#### **3.3.1.1. General detail about pepper production**

In Cambodia, pepper is grown in lowland area especially like in Kom Pot, Preah Sihanuk, Kompong Cham, Koh Kong, and the latest province is Rathanak Kiri where there are red lands full of soils for pepper production. The condition of climate is tropical area whereas the level of rain is about 2000-2500 ml per year or sometime it must be more than this. In Cambodia, pepper is the main agro-industry product which is given the most profitable for small family and the whole country. Since 19<sup>th</sup> century, pepper had been started to grow in Cambodia meanwhile in 1840 it was imported from Hai Nan province in China. Mostly in Cambodian, it is used as the spices and seasoning, and sometime it is also used as part of medicine and part of ingredient to kill insects such as insects which are living on clothes and feathers. In the small crop of pepper per 100g, there is much more nutrients. (Pepper Book from Minister of Agriculture, Forestry, and Fisheries)

<b>Principle</b>	<b>Nutrient Value</b>	<b>Percentage of RDA</b>
<b>Energy</b>	255 kal	13%
<b>Carbohydrates</b>	64.81 g	49%
<b>Protein</b>	10.95 g	19.5%
<b>Total fat</b>	3.26 g	11%
<b>Cholesterol</b>	0 mg	0%
<b>Dietary Fiber</b>	26.5 g	69%
<b>Vitamins</b>		
<b>Choline</b>	11.3 mg	2%
<b>Folic acid</b>	10 mcg	2.5%
<b>Niacin</b>	1.142 mg	7%
<b>Pyridoxine</b>	0.34 mg	26%
<b>Riboflavin</b>	0.24 mg	18%
<b>Thiamin</b>	0.109 mg	9%
<b>Vitamin A</b>	299 IU	10%
<b>Vitamin C</b>	21 mg	35%
<b>Vitamin E</b>	4.56 mg	30%
<b>Vitamin K</b>	163.7 mcg	136%
<b>Electrolytes</b>		

<b>Sodium</b>	44 mg	3%
<b>Potassium</b>	1259 mg	27%
<b>Minerals</b>		
<b>Calcium</b>	437 mg	44%
<b>Copper</b>	1.127 mg	122%
<b>Iron</b>	28.86 mg	360%
<b>Magnesium</b>	194 mg	48.5%
<b>Manganese</b>	5.625 mg	244.5%
<b>Phosphorous</b>	173 mg	25%
<b>Zinc</b>	1.42 mg	13%
<b>Phyto-nutrients</b>		
<b>Carotene-B</b>	156 mcg	--
<b>Carotene-A</b>	0 mcg	--
<b>Crypto-xanthin-B</b>	48 mcg	--
<b>Lutein-zeaxanthin</b>	205 mcg	--
<b>Lycopene</b>	6 mcg	--

Source: [http://www.nutrition-and-you.com/black\\_pepper.html](http://www.nutrition-and-you.com/black_pepper.html)

Main source: (USDA National Nutrient data base)

Pepper is the generational crop production and mostly it is become bigger and bigger base on the cutting the top part of the plant which is 18 months age above.

### **3.3.1.2. Growth**

In Cambodia, pepper is well grown in low land and places close to the sea part. The requirement is the lands with the good soils and most waters nearby like some provinces such as Kampot, Sihanuk, Kompong Cham, Mondulkiri, Koh Kong, and Takeo province. Before 1970 the total places to growth were 860 ha and the total produce was 2520 t in Kampot Sihanuk, Koh Kong, and Kompong Cham province. Now the growth's place is improve to some provinces such as Mondulkiri and Takeo province, and the whole total increases more than 1000 ha. So in the result right now the whole total include another parts in Cambodia are more than 5000 ha, and it is going to increase more and more if the pepper's market is well-cared and better than it used to be. (Pepper book from Ministry of Agriculture, Forestry, and Fisheries in Cambodia)

### **3.3.1.3. Type of Pepper**

Pepper production which is grown in Cambodia has divided in two types. The first type is LamPong which is originally from Indonesia. This type has big leaf which has very long line and the crops are little small. The second type is Kamchay which is unknown type and now there are so many researches on this type to find out where originally it is from and since when it is grown and known as the type of pepper. This type has small leaf which is short lines and big crops. Mostly we can find those two types become more popular in Cambodia to grow for business and family industry especially in Kampot Province. Nowadays, there are so many experiments on pepper production which are tested by the both Cambodian or foreign students and researchers to find out new type of peppers and study on the quality of this production. (Pepper book from Ministry of Agriculture, Forestry, and Fisheries in Cambodia)

### **3.3.2. Environment of pepper production**

Pepper is the type of plant which requires land with good soils, and it also needs land with sour taste. The level of pH is between 5.5 to 7. Not just only pH between 5.5-7, and it also need some chemistry such as nitrogen oxide between 1-1.5%. Pepper needs the lands which have deep layer, and they can absorb the water well to help growing this small plant especially the natural lands with natural chemistries and mines. The most suitable lands are clays with some sand or sandy lands with clay or the land which is given name as red paschal. Pepper can be produced at places which require temperature between 23-28 degree callus, and the humidity is between 81-82%. It does help the male flowers to have connection with female flowers and make another generation, plus it does help to make well-grown of pepper flowers. Pepper needs the quantity of rainy level between 2000-3000 ml per year regularly between 7-8 months. In this period, pepper does need water to be done and produce production of pepper. In other hand, the level of water must not be lower than 1800 ml per year due to the limitation of dry in pepper in the period between 4-5 months per year. In case if the level of water is less than 1800 ml per year, pepper is going to have big trouble problems such as the quality of the fruits are not so good, sometime it can be damaged and less delicious to make food and seasoning. Due to this level of water, pepper needs times to be well-done at the same time. Pepper plants are well-grown by looking at the height them between 850-1000 m compare to the level of the sea. Sometime we can notice the well-grown pepper by its fruits and the quality of its if we taste it. (Pepper book from Ministry of Agriculture, Forestry, and Fisheries in Cambodia)



### **3.3.3. Technical of growing Pepper production**

#### **3.3.3.1. Land Preparation**

One of the most important things to do and help pepper grows well is land. The requirement of land must have lot of soil. The type of land that it requires is clay with sandy type, and another type is sandy with clay. The pH of land is between 5.5-7 plus little bit sour. Before we grow the plants, first we do need to raise the land deeply from 30-40 cm. We do at least two or three times in this process because we want to make the land well resolution, and we need to clear all grasses and all small trashes from the land. After we are done with this process, it helps a lot for the farm to grow the pepper easily, protect all the insects that destroy the plants, and illnesses which are caused by bacteria of mushrooms. Second step, raising the land becomes smooth. After we are done with this process, it helps pepper to absorb water well. Especially in the dry season, it is much easy to water the plants. If we don't do this process well, the land becomes stuck. It is pretty hard for the plants to absorb the water, and sometime the land becomes harder and harder in the dry season. In the rainy season, it does help lot for the land as well. During this season when it is raining, the water is going to come through the end of the plants. Third step, we make the places for plants. First in this process, we need to make distant between the plants between 1-1.2 m. Second step, we need to subscribe the land little bit from 15-20 cm. Third steps, make the wood strips. It is 2 m. Then we put it deeply in the land. It helps the plants grow up straight. (Pepper book from Ministry of Agriculture, Forestry, and Fisheries in Cambodia)

#### **3.3.3.2. Crops' chosen Technical**

Before growing, we need to choose pepper' crops which are one year old. It must be healthy, good quality, and guarantee by the labor. Mostly farmers usually take the pepper' crop which has small roots, and all the roots must be strong and healthy. The roots are between 40-50 cm. The distant between each root is 10 cm. After they take the roots from the pepper, they must put it into the land and plant it immediately. They cannot keep them more than 2 or 3 hours because the roots are going to be weak, unhealthy, and they cannot grow well to give the best quality of crop. (Pepper book from Ministry of Agriculture, Forestry, and Fisheries in Cambodia)

#### **3.3.3.3. Growth's Technical**

Generally, the best month to grow the pepper is either in July or August, but most farmers prefer to grow in July because there are light rains. Before putting crops into land, the first

step we need to take the crops and put them into the water and keep about 1 to 2 hours because this process allows the crop to produce the small roots well. Then we prepare the place to grow them. Size of each place should be 0.4\*0.4\*0.5 m. The second step, we put the two long stick woods. The distant between each sticks should be 2m or little bit further. For 1 ha, we can make 2500 sticks. After that we put the pepper' crops into the land about 2-3 cm. Then we cover the sticks by the leaf to protect the sunlight. Three or four months later, we can notice that the pepper plants start to grow. For the wood, we need to choose the quality of wood and strong. (Pepper book from Ministry of Agriculture, Forestry, and Fisheries in Cambodia)

#### **3.3.3.4. Caring Technical**

There are not so many difficult steps to take care the pepper. It just need to be cleaned and water them properly, but in order to make it clean we have steps. First we do need to clean the grasses once there are too many. It is the biggest problem to make pepper grown weak and low quality. We need to clean the grasses two or three times in dry season, and in rainy season we need to clean them at least five times or more. Then we need to add addition land to plants at least two times per year because there is more energy for plants, and there are more nutrients for the plants to absorb. Another main reason for this is to help the plants grow much stronger and healthier especially the top of plants. (Pepper book from Ministry of Agriculture, Forestry, and Fisheries in Cambodia)

#### **3.3.4. Composing the pepper**

One of another the most important step is to compose. This step allows the pepper stay strong and makes the pepper grow up well. It is not so difficult to do this. We just take out some flowers and make the pepper stick together with the woods. In Cambodia, we water pepper from the end of rainy season which is in November until begin of this season again next year. Every 15 days we water extra the plants 200-300 m cube in one ha, and we water each plants every 2 or 3 day. Another step to make the pepper grow well is to redo the land 2 or 3 times per year. Most farmers do this step first time on the beginning of the rainy season and another time at the end of rainy season. This process helps the land soft, and it is easier for the roots to absorb the water and the nutrients of the land are always there. It always keeps the humidity of the land well. (Pepper book from Ministry of Agriculture, Forestry, and Fisheries in Cambodia)

### **3.3.5. Harvest period**

Generally, pepper always gives their product to harvest after three years grown. These harvests amounts always change years by years depend on the age of the pepper. Basically between 3-8 years, the pepper gives products between 15-20 tones per 1 ha or the dry pepper between 2-4 tones per 1 ha. From the age of 12-15 or more, the result of harvest is decreasing from 20-25 kg per 1 ha. The crops are always harvested the crops which are well-done, and then they are been dry under the sunlight in dry season, or they are been dry by machine during rainy season. (Pepper book from Ministry of Agriculture, Forestry, and Fisheries in Cambodia)

### **3.4. Overview of Climate in Cambodia**

Cambodia is located in Southeast Asia. Especially it is well-known that is located in Indochina. The climate is tropical monsoon, so it is divided into two seasons which are dry and rainy seasons. The dry season start from November till April. The rainy season starts from May till October. During the dry season, the temperature is between 27-35 degrees Celsius, but except in April which is the hottest month, the temperature can increase from 30 to 40 degrees Celsius. During the rainy season the temperature is between 25-32 degrees Celsius. From May till July the humidity is between 65-75%, and from August till October the humidity is between 80-90%. Due to climate changes, evaporation always changes too. Generally, the evaporation is located in range between 2000-2200 mm. The highest evaporation rate occurs in March or April. Sometime it is between these two months. The lowest evaporation rate is in September at point 120-150 mm. (Ros, B., Nang, P. and Chhim, C. Agricultural development and climate change)

#### **3.4.1. Natural disasters**

##### **3.4.1.1. Flood**

Related to this disaster, most countries around the world always face it. As same as in Cambodia, There are two big water resources in Cambodia Mekong and Tonle Sap Lake whereas the most incredible view and one of the most fishes place in the world. During the dry season, the water comes from Tonle Sap Lake to Mekong River, and during the rainy season, the water comes from Mekong River to Tonle Sap Lake. Once there are so many rainfalls, there is existed flood. Like for exam, in 2009, during the typhoon called Ketsana, the cause of total damage was 132 million USD, and 14 provinces have been affected.

### 3.4.1.2. Drought

Each year during the dry season in Cambodia, there is existed drought. As the high temperature in the world increases days by days, the more droughts happen in this small country too. According to the research of ministry of environment in Cambodia, from 1960-2015 the average of temperature has been increased every year from 0.8-1.4 degrees of Celsius. During the rainy season, the estimate of the average of temperature rate per decade has been increased from 0.13-0.16 degrees of Celsius whereas in the dry season the rate has been increased from 0.2-0.23 degrees of Celsius per decade. Drought is one of the most important problems in Cambodia which government must keep eyes on it because it is affected to agriculture all around country, and the longer drought causes, the damage in agriculture sector is increased.

**Table 1 Events and Results of disaster in Cambodia**

Year	Event	Detail about event
2000	Flood	2 floods, Mekong and flash flood. First Mekong flood from July till 25 <sup>th</sup> September. Second flash flood from 11 <sup>th</sup> till 15 <sup>th</sup> October. The result: 5,158 villages, 883 communes, 131 districts, and 21 provinces were affected. Total physical damage for both events was 150 million USD
2001	Flood	2 floods again like last year, Mekong and flash flood. First flash flood two times in rainy season. One was from July till August and one was in October. Second Mekong flood was from 13 <sup>th</sup> to 15 <sup>th</sup> august. 2 floods affected 595 communes, 84 districts, and 14 provinces. Total physical was 20 million USD for both floods.
2001	Drought	9 provinces were affected from September till December and 530,844 people or 132,711 families were affected. 53,987 ha of seedling and transplanted rice field were damaged, and the total physical was more than 16 million USD for this event.
2002	Drought	420 communes, 79 districts, and 10 provinces were affected for 8 months from January to August. 62,702 ha of rice crop were destroyed, and according to statistic from the NCDM, 2,047,340 people or 442,419 families were affected. The cost was more than 21.5 million USD.

2002	Flood	Mekong flood was from 6 <sup>th</sup> March till 9 <sup>th</sup> April. 89 communes, 38 districts, 6 provinces were affected, and 1,470,000 people were affected. 29 people were death, and total physical was 14 million USD.
2004	Drought	Almost all provinces in Cambodia were affected. In agriculture, 418,293 ha of rice crop were affected, and 247,393 ha of rice crop were damaged. The estimated cost was 55.3 million USD, and 500,000 families or 1,500,000 people were affected.
2005	Flash Flood	3 provinces were affected. 1300 ha of rice and 200 of variety crops were destroyed. 9 pagodas, 30 schools, 1700 houses were flooded. 4 people were death, 3500 animals were moved to the safe place. 137 people were injured and 2500 families were affected.
2005	Drought	2 months from June to July. 304 communes, 79 districts, and 12 provinces were affected.
2006	Flood	2 floods, flash and Mekong flood from 29 <sup>th</sup> August till November. First, flash flood started from 29 <sup>th</sup> August with heavy rains and strong winds. 11 provinces were affected plus the capital city of Cambodia. 6 People reported to die. 252 houses have been flooded and 12 were washed away. 6000 families were affected. 532 families moved to safe places. 56,691 ha of rice crop were affected, and 10678 ha of rice were destroyed. 813 ha of variety crops, road 70,234 m, and agricultural hydraulics system 39 places were damaged. Second, Mekong flood occurred on November. 2 provinces were affected. A person was death. 11 lines of road, 18978 ha of rice crop, and 2 places of agricultural system were affected. 2103 ha of rice and 193 ha of variety crops were damaged. 71,870 families in 42 districts and 13 provinces were affected by both floods.
2006	Tropical cyclone	12 provinces and Phnom Penh city were hit by storm. 642 houses were destroyed, 549 houses were collapsed. 11 People were death, and 57 people were injured.
2006	Drought	13 provinces and 77713 of rice crop were affected. 7540 ha of rice crop were destroyed.

2007	Drought	2 provinces and 20,936 ha of transplanted rice field were affected. 5653 of transplanted rice field were destroyed.
2007	Flash flood	8 provinces were affected for 4 months from May to August. 5 people were death. 16108 families, 21,050 ha of rice crop, and 21,211 ha of transplanted rice field were affected. 16,241 ha of rice crop and 2,545 ha of transplanted rice field were destroyed.
2008	Tropical cyclone	10 deaths and 23 injured were reported. 585 houses were totally destroyed while 835 houses were affected.
2008	Drought	9 provinces were affected from June to August. 81,550 ha of seedling and transplanted rice field were affected, and 602 ha of seedling and 1,171 ha of transplanted rice field were damaged.
2008	Flash Flood	8 communes, 4 districts, and 2 provinces were affected from 9 <sup>th</sup> till 23 <sup>rd</sup> September. 19,776 ha of rice crop were affected while 18,907 ha of rice crop were destroyed.
2009	Tropical cyclone	More than 7 days Cambodia was hit by Typhoon Ketsana. 336 communes, 73 districts, and 14 provinces were affected. 43 people were death while another 67 injured. 218 houses were destroyed while 804 houses and 83,542 household of the 342,522 people were affected. 53,325 ha of rice crop, 1,217 ha of seedling and 3,026 ha of variety crop were damaged. Road 167 lines, national and provincial roads 166.73 km, agricultural hydraulics system 102 places, 1,696 wells, 6,693 toilets, and 1,169 flooded schools were damaged and caused by this cyclone. Total estimate was 131,996,415 USD.
2009	Drought	13 provinces were affected for 2 months from July to August. 57,965 ha of seedling and transplanted rice field were affected. 833 ha of seedling and 1,788 ha of transplanted rice field reported to be destroyed.
2009	Flash Flood	8 provinces were affected for 7 days from 4 <sup>th</sup> to 10 <sup>th</sup> September. 6,711 ha of rice crop, 17 ha of seedling and 18 ha of diversified crop, 30 houses were totally destroyed. 13 people were death. Agricultural hydraulics 3 places, dam 4 places, bridge 1 place for 50 m, and 15,729 families were affected.
2010	Drought	8 provinces, 9,927 ha of rice crop and other crops were affected. 266

		ha of rice crop and 5,415 ha of other crops were destroyed.
2010	Tropical cyclone	16 provinces were affected. 7 people were death while another 74 injured. 794 houses were affected while others 226 houses were totally damaged. The school with 24 classrooms, other 6 houses, 1 health center, and rubber 1,876 trees were destroyed.
2010	Flash Flood	Just 4 days with heavy rain and wind cross the border flood from neighboring country affected 64 districts, 280 communes, 14 provinces. 18,154 households by food shortage, 6,301 families were affected. 6 people were death, and another 7 injured. 33,356 houses, 76,168 ha of transplanted rice field affected, and 272 schools were affected. 86 houses, 15,704 ha of rice crop, and 6,942 ha of subsidiary crop were destroyed. The total cost was 70 million USD.
2011	Flood	In 2 weeks, 61 people were killed.
2013	Tropical cyclone	At least, more than 36 people were reported to be death while this cyclone name Typhoon Usagi. This heavy monsoon rain came from Vietnam.
2013	Flood	At least 10 provinces were affected since the third week of September at northwest part and alone the Mekong river in central part. 30 people were confirmed to be death, and at least 16 children were killed.
2014	Local storm	Heavy rain plus storm affected 8 provinces. At least 4 people were killed, and more than hundred houses were damaged.
2014	Flood	7 provinces were hit by this flood along the Mekong river and tonle sap lake while reporter said that 8 people had been killed.

Source: <http://www.glidenumber.net/glide/public/search/search.jsp>

### **3.4.2. Government policy on climate change**

As the result above from 2000 till 2014 about natural disaster, in 2013 the royal government of Cambodia has published Cambodia climate change strategic plan from 2014-2023. This project was prepared and worked together by the national climate change committee of Ministry of Environment, private sectors, national and non-governmental organization, and development partner. There are three main goals:

- Reducing vulnerability to climate change impacts of people, in particular the most vulnerable and critical system (natural and societal)
- Shifting towards a green development path by promoting development in reducing carbon and technologies
- Set a promotion of public awareness and participation in climate response actions.

To achieve this goal, the national climate change committee has created and put 8 strategic objectives as follows:

- Promote climate resilience through improving food, water, energy, and security
- Reduce vulnerability of sectors, regions, gender, and health climate change impact
- Ensure climate resilience of critical ecosystems (Tonle sap lake, Mekong river, coastal ecosystems, highland etc.) biodiversity protected areas and cultural heritage sites
- Promote about reducing carbon, planning, and technologies to give a support to sustainable development of the country
- Improve capacities, knowledge, and awareness for climate change responses
- Promote adaptive social protection and participatory approaches in reducing loss and damage
- Strengthen institutions and coordination frameworks for national climate change responses and
- Strengthen more on collaboration and participation need to be active in regional and global climate change processes

Due to those strategies above, there are three main term to fulfill (immediate term, medium term, and long term).

- In the immediate term (2013-2014): in this term, focusing on improving of this committee, preparation the financial arrangement for doing this strategies, creating the national monitoring and evaluation frameworks and indicator, and developing plan for upcoming next term and action plan by line ministries. (Rural Government of Cambodia, Cambodia Climate Change Strategic Plan 2014-2023)
- In the medium term (2014-2018): during this term, there are many works will continue to support the implementation of the previous term. Finding fund to cover these activities is part of this term too. There are the Adaptation Fund and



Green climate fund, research and knowledge management, capacity development, mainstreaming of climate change across sectors at different level, operation of M&E and data management systems, and launching some high priority project in key sectors indentified in the climate change action plans. (Rural Government of Cambodia, Cambodia Climate Change Strategic Plan 2014-2023)

- In the long term (2019-2023): in this term, the focus will be on the research and leaning. There is main objective will be scale up success cases and continue to mainstream climate change into national and sub-national program. During this term, there needs much financial support, that's why from the previous term 1 and 2, the government try to find funds and money from the tax to support and take responsibility to this project. (Rural Government of Cambodia, Cambodia Climate Change Strategic Plan 2014-2023)

The government has taken care about the climate change and natural disaster in Cambodia plus as the member of UNFCCC (United Nations Framework Convention on Climate Change). Recently, the government has cared about how to grow more trees and motivate all citizens to care about all the activities relate to green places, wildlife and forests. (Rural Government of Cambodia, Cambodia Climate Change Strategic Plan 2014-2023)

### **3.5. Pepper Production**

Not just only in Cambodia, pepper is one of the well-known around the world. It is one of the most amazing spices and seasoning to make food delicious. To be involved with this part of the world, most farmers and pepper associations in Cambodia have been taking care of this production to sell into local and international market. Nowadays pepper production become more and more popular. There are 4 main different types of Cambodian pepper production. They are Green, Black, Red, and White pepper. The most used is black and green pepper. It is given name as the king of spice by the Cambodian chef, and long time ago it was known that the most expensive spice for royal family and rich family. In 2016, Kampot pepper was labeled from European Union to take care original product. This is one of the most meaningful to Cambodian farmers and the whole country. It kind of encouraging them to grow more natural pepper, give them support to sell their product into worldwide, and they can make really good money in their agricultural business. This is the positive news for Cambodia in the future to have the best pepper product and go to the international market like neighboring countries.

According to the table below, the pepper production from 2000-2013 was not growing much different. In this production, the farmers have been put all of their effort and worked really hard to give this result. Technically, the performance of this production in Cambodia was still low. From 2000-2004 there was increasing in this production, but after that time the quantity of harvest area came up and down year by years. This result was also affected by the natural disaster, but luckily there were not big disasters hit. The main grown area of pepper production is in Kampot province where is near to the sea, so when the disaster comes, it does affect this production plus there was lacking of quality in planting. Comparing the harvest area in 2013, there was lower than in 2008. About the production quantity, there were decreasing or increasing depend on year by year. There were not much different. The most production of quantity was in 2008, and the lowest production of quantity was in 2000. It was such improving of pepper production in Cambodia since government finished civil war in 1998.

Pepper production could not have process well if there weren't included technology and government policies. Plus the climate condition and disaster events in each year made this type of production still increased pretty low. All the Cambodian farmers who produced this product have been taking care and put all effort to produce more quantity in this production.

**Table 2 Pepper Production**

Year	Harvest areas in unit (ha)	Yields in unit (t/ha)	Production Quantity in unit tons
2000	325	6.77	2200
2001	350	6.57	2300
2002	357	6.52	2329
2003	369	6.51	2400
2004	374	6.47	2418
2005	400	6.25	2500
2006	384	6.43	2469
2007	382	6.45	2463
2008	380	6.46	2458
2009	379	6.47	2454
2010	378	6.48	2449
2011	377	6.49	2444
2012	375	6.4	2400
2013	381	6.53	2491

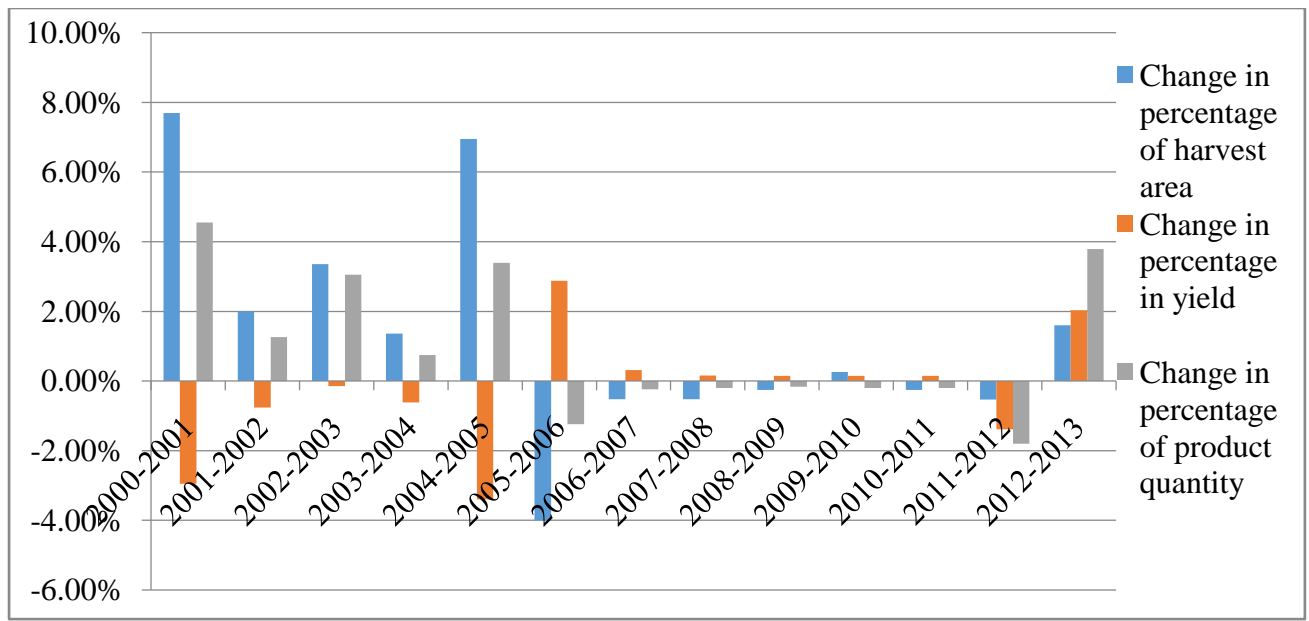
Source: <http://faostat.fao.org/site/567/DesktopDefault.aspx?PageID=567#ancor>

**Table 3 Change in percentage of pepper production**

Year	Change in percentage of harvest area	Change in percentage of yield	Change in percentage of product quantity
2000-2001	7.69%	-2.95%	4.55%
2001-2002	2%	-0.76%	1.26%
2002-2003	3.36%	-0.15%	3.05%
2003-2004	1.36%	-0.61%	0.75%
2004-2005	6.95%	-3.40%	3.39%
2005-2006	-4%	2.88%	-1.24%
2006-2007	-0.52%	0.31%	-0.24%
2007-2008	-0.52%	0.16%	-0.2%
2008-2009	-0.26%	0.15%	-0.16%
2009-2010	0.26%	0.15%	-0.2%
2010-2011	-0.26%	0.15%	-0.2%
2011-2012	-0.53%	-1.39%	-1.8%
2012-2013	1.6%	2.03%	3.79%

Source: own processing from table 2

**Graph 1 Change in percentage of pepper production**



Source: own processing from table 3

As the graph above, the change in percentage of pepper production in harvest area, yield, and product quantity seems to be up and down depending on the year. Change in harvest areas from 2000-2004, there were positive impacts, while from 2005 till 2009, there were negative impacts. Meanwhile in 2010, it became positive once again in harvest areas by 0.26% after than it was drop to negative. But in 2011 it was increasing by 1.6%.

However, there are not always bad lucks happen in pepper production in Cambodia. After facing all the bad events caused by natural disasters, in year 2012-2013, the change in percentage of pepper production became almost closed to each other. This is because of affording of the Cambodian farmers plus associations of pepper production. It has been shown the bright and positive result in the future for pepper production.

### **3.6. Price of pepper production**

One of the most motivation Cambodian farmers to product the best quality of pepper production is price. Cambodian farmers need to have revenue back for them to make their families live happily, pay bills, and give salary to employers. On the other hand, price is not always up and up or down and down. It depends on many facts of the production such as quality, how many tons that the Cambodian farmers can product, local market and needs, and the international market and need. In fact, price of pepper production is pretty good except 2002-2005. In 2005, the price of pepper production was too low comparing to other year. That was because of the bad event which was caused by the nature. In 2006, the price started to increase. Even in 2008, there was worldwide economics' crisis, the price of pepper was increasing, and it was still taken care by association and farmers. Until 2011, the price of pepper production has been increasing. This is the good result to motivate more to Cambodian farmers. Plus it was labeled by European to Kampot pepper, and there is going to have a hope for the price and more markets for this king of spices. (Parikh, T. And Sothear, K. Cambodia Daily EU Protection To Help Curb Fake Kampot pepper)

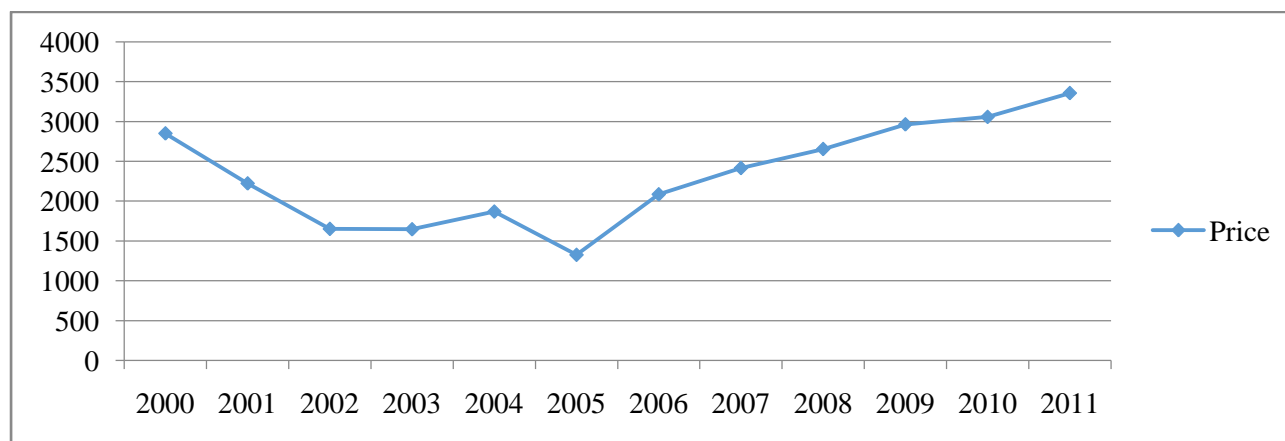
**Table 4 Price of pepper production**

Year	Price of pepper production (USD/ton)
2000	2851.4
2001	2223.3
2002	1652.1
2003	1647.2
2004	1869.4
2005	1326.3
2006	2086.2
2007	2416.1
2008	2655.1
2009	2965
2010	3058.3
2011	3357.7

Source: <http://faostat.fao.org/site/703/DesktopDefault.aspx?PageID=703#ancor>

<https://knoema.com/FAOPS2013Sep/price-statistics-2013?country=1000990-niger&item=1001550-pepper-piper-spp>

**Graph 2 Price of pepper production (USD/tons)**



Source: Own procession from table 4

**Table 5 Change in percentage of price**

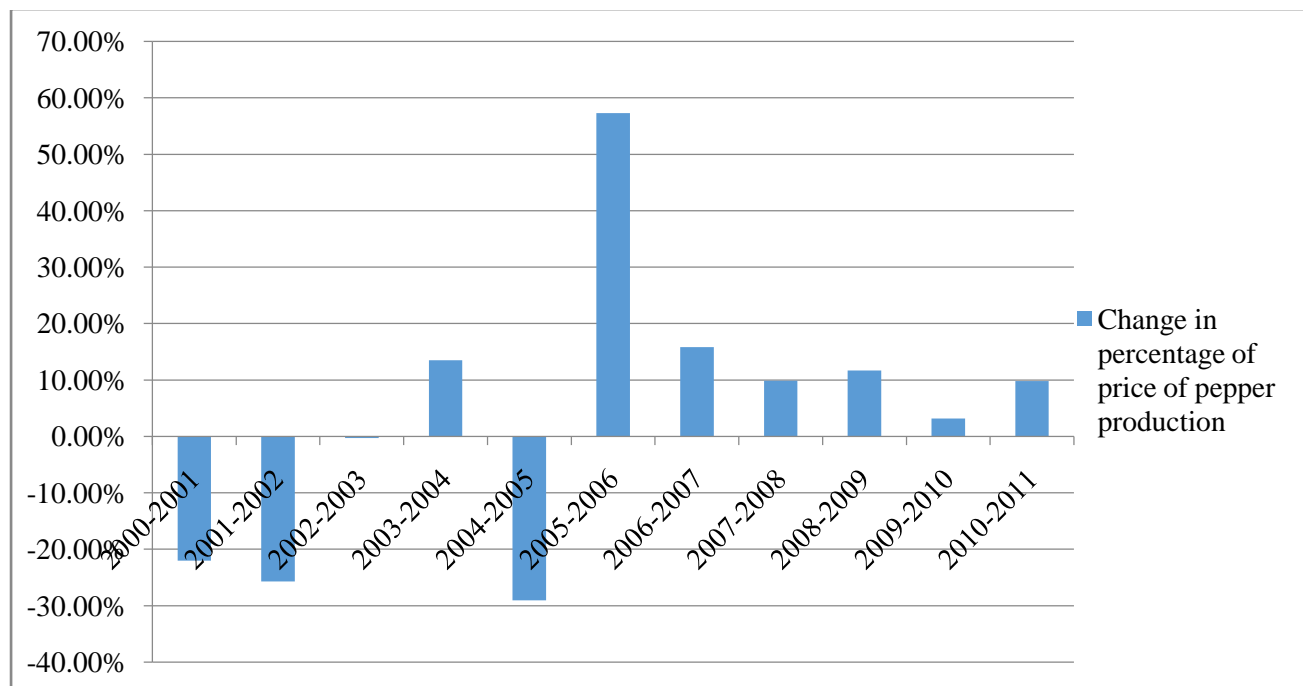
Year	Change in percentage of price of pepper
2000-2001	-22.03
2001-2002	-25.69
2002-2003	-0.30
2003-2004	13.49
2004-2005	-29.05
2005-2006	57.29
2006-2007	15.81
2007-2008	9.89
2008-2009	11.67
2009-2010	3.15
2010-2011	9.79

Source: Own processing from table 4

As it showed in table 5, there was a negative history in period 2000-2003. Those years, the price was bad until the period 2003-2004. At that time, the price increased to positive. Then in 2004-2005 the price became negative again. That was a shocking period for Cambodian farmers who produced pepper. However in 2005-2006, the level of percentage had been increased exceed 50% at the level of 57.29%, and this was a hope and light for that production. During that year, this was the big hit and motivation after the negativity has gone. Later on after that year, the new evolution of pepper production has come. The price has been increased year by year from 2006 till 2011. Starting from 57.29% in 2006, then 15.81% in 2007, and then 9.89% in 2008, and continue up and down until 9.79% in 2011 (see in table 5). This was a nice result. Even in 2008 due to economic crisis, the price of pepper didn't turn to negative. This was the big positive for this production in the future to move on.



**Graph 3 Change in price of pepper production**



Source: Own processing from table 5

### **3.7. Trade**

On 30.04.1999 Cambodia has become the member of ASEAN (Association of Southeast Asia). As one of the members of this association, Cambodia has a big chance to export and import the local products to other countries. Beside ASEAN, Cambodia is also the member of WTO.

Agriculture is one of the most important sectors in Cambodia. To develop this country, without agriculture, there is no economics at all. Rice is the biggest sector in agriculture. Beside the rice, there are many crops and plants such as sugar cane, maize, pepper etc. In this moment, Cambodian pepper has developed. It might not one of the most famous products to export like rice, but Cambodian farmers have had a chance to produce it for Cambodian markets and saved some small amount of its to export to Europe or other countries. Generally between 2000 to 2011, the Cambodian pepper production trade was up and down. Especially the export of quantity of pepper from 2000-2003 was zero meanwhile the import quantity of pepper in 2001 was a ton (see in table 6). After that in 2003, the export of quantity of pepper had been increasing to 52 tons, and then it was increasing and decreasing until 2011 whereas the best year of export and also import (see in table 6). In 2000, there was no export quantity of pepper, but at the same time the export value of pepper was 1000USD. After that in 2001 there was an import of pepper to Cambodia meanwhile the export was zero until 2002. Start from 2003, the pepper production has had market to export more than import until 2011,

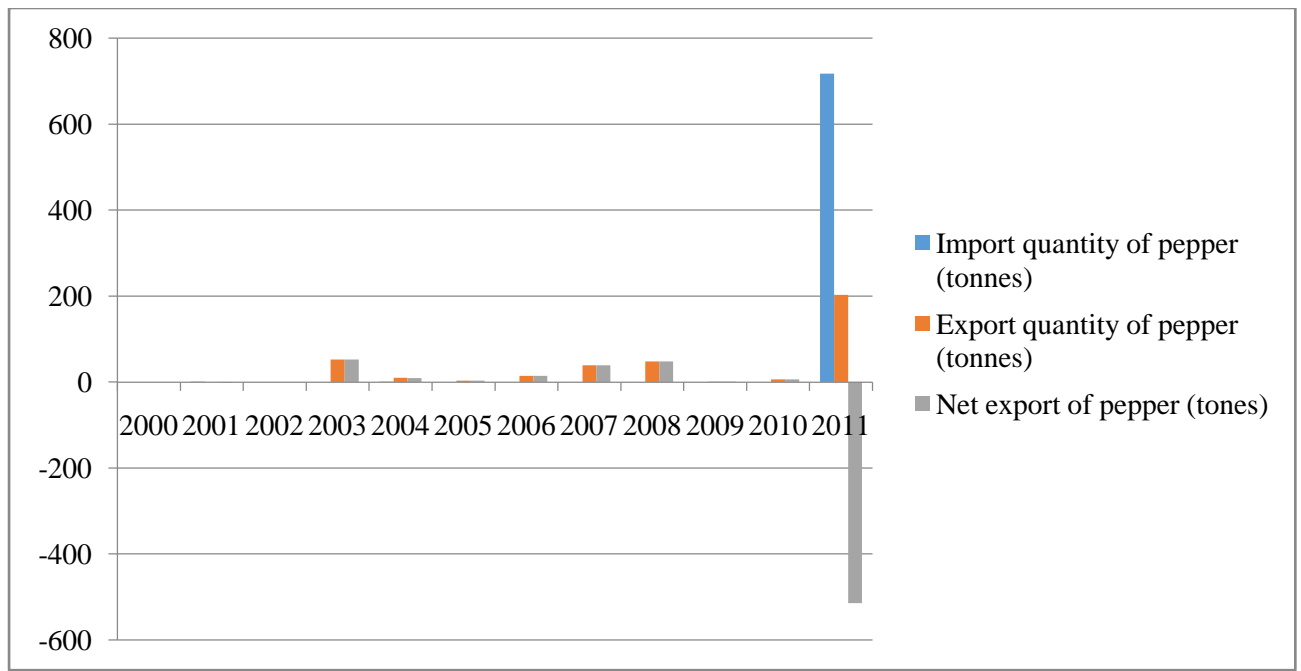
there was a big change because import quantity was more than export quantity while the export value was more than import value (see in table 6).

**Table 6 Trade of pepper production**

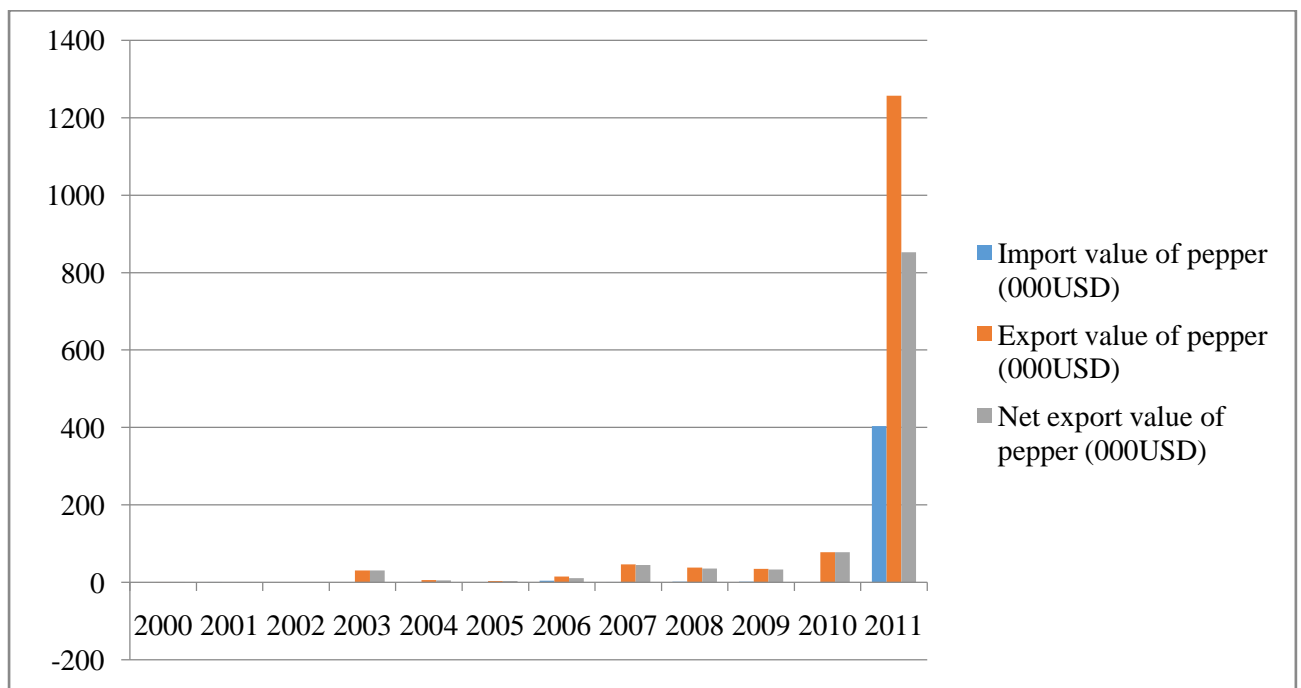
Year	Import quantity of pepper (tons)	Export quantity of pepper (tons)	Net export of pepper (tones)	Import value of pepper (000USD)	Export value of pepper (000USD)	Net export value of pepper (000USD)
2000	0	0	0	0	1	1
2001	1	0	-1	1	0	-1
2002	0	0	0	0	0	0
2003	0	52	52	0	31	31
2004	1	10	9	1	6	5
2005	0	3	3	0	3	3
2006	0	14	14	4	15	11
2007	0	39	39	1	46	45
2008	0	48	48	2	38	36
2009	0	1	1	2	35	33
2010	0	6	6	0	78	78
2011	717	203	-514	404	1257	853

Source: <http://faostat.fao.org/site/535/DesktopDefault.aspx?PageID=535#ancor>

**Figure 1 Trade in quantity of pepper production**



**Figure 2 Trade in value of pepper production**



Source: Figure 1 and 2 own processing from table 6

Between 2000-2011, the trade of pepper production hasn't changed too much until 2011. The import of pepper production has moved from zero to one and then move downward to zero

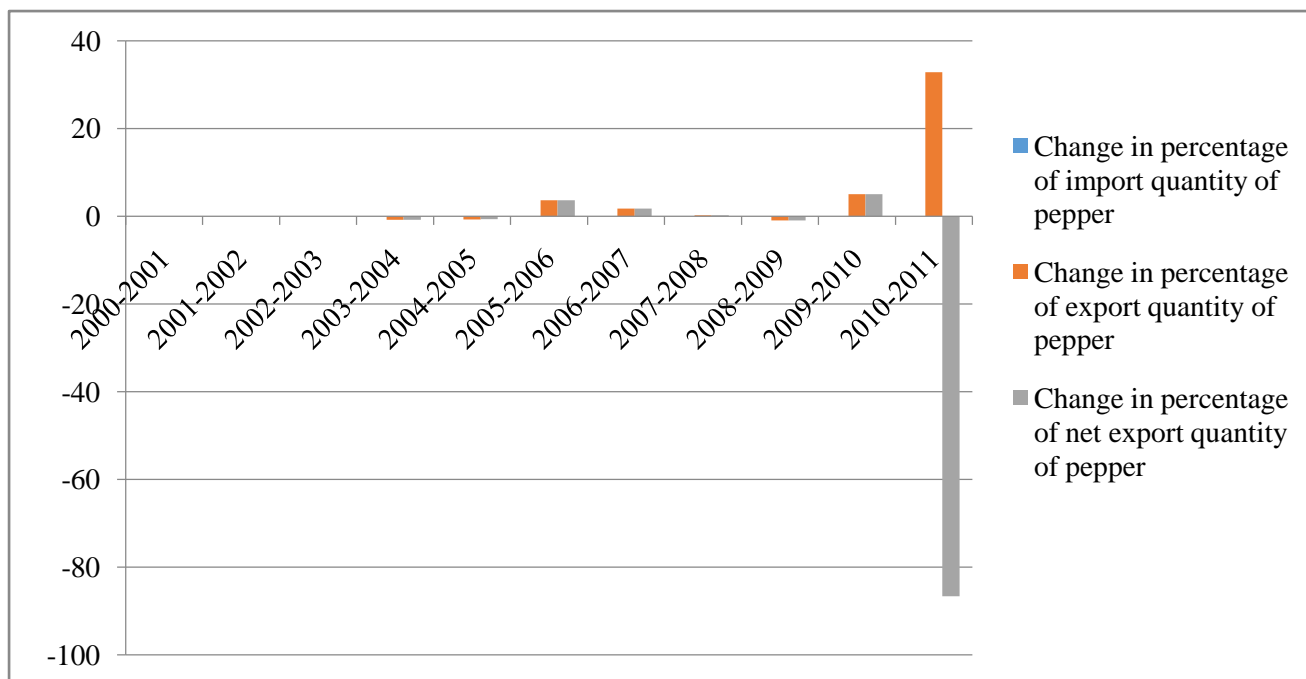
again for two years and then moved upward to one once again and then move downward to zero for six years until 2011, the import has move upward fast to 717 (see in figure 1). This change has made the next export of pepper production more positivity than negativity. Moreover in 2011 the net export of quantity of pepper production became negative (see in figure 1). However, the trade value of pepper production has moved slowly as same as the trade quantity of pepper production. Just from 2000-2011 the import value of pepper changed pretty slowly from zero to one and then zero again until 2011 whereas the year of big change in this production. The import value had moved to 404000USD. For the export value of pepper, the price has moved oppositely from the import value. Start from 1000USD in 2000, the export value was downward to zero for two years because of there was no pepper remained to export. Then in 2003, there was a big change in history of export from previous year. The export value was 31000 USD (see in figure 2). Then it dropped up and down until 2011 whereas the big change again pepper production. The export value was 1257000 USD (see in figure 2).

**Table 7 Change in percentage of trade of pepper production**

Year	Change in percentage of import quantity of pepper	Change in percentage of export quantity of pepper	Change in percentage of net export quantity of pepper	Change in percentage of import value of pepper	Change in percentage of export value of pepper	Change in percentage of net export value of pepper
2000-2001	NA	NA	NA	NA	0%	-200%
2001-2002	NA	NA	0	0%	NA	0%
2002-2003	NA	NA	NA	NA	NA	NA
2003-2004	NA	-80.77%	-82.69%	NA	-80.65%	-83.87%
2004-2005	NA	-70%	-66.67%	0%	-50%	-40%
2005-2006	NA	366.67%	366.67%	NA	400%	266.67%
2006-2007	NA	178.57%	178.57%	-75%	200.67%	309.09%
2007-2008	NA	23.08%	23.08%	100%	-17.39%	-20%
2008-2009	NA	-97.92%	-97.92%	0%	-7.89%	-8.33%
2009-2010	NA	500%	500%	0%	122.86%	136.36%
2010-2011	NA	3283.33%	-8666.67%	NA	1511.54%	993.59%

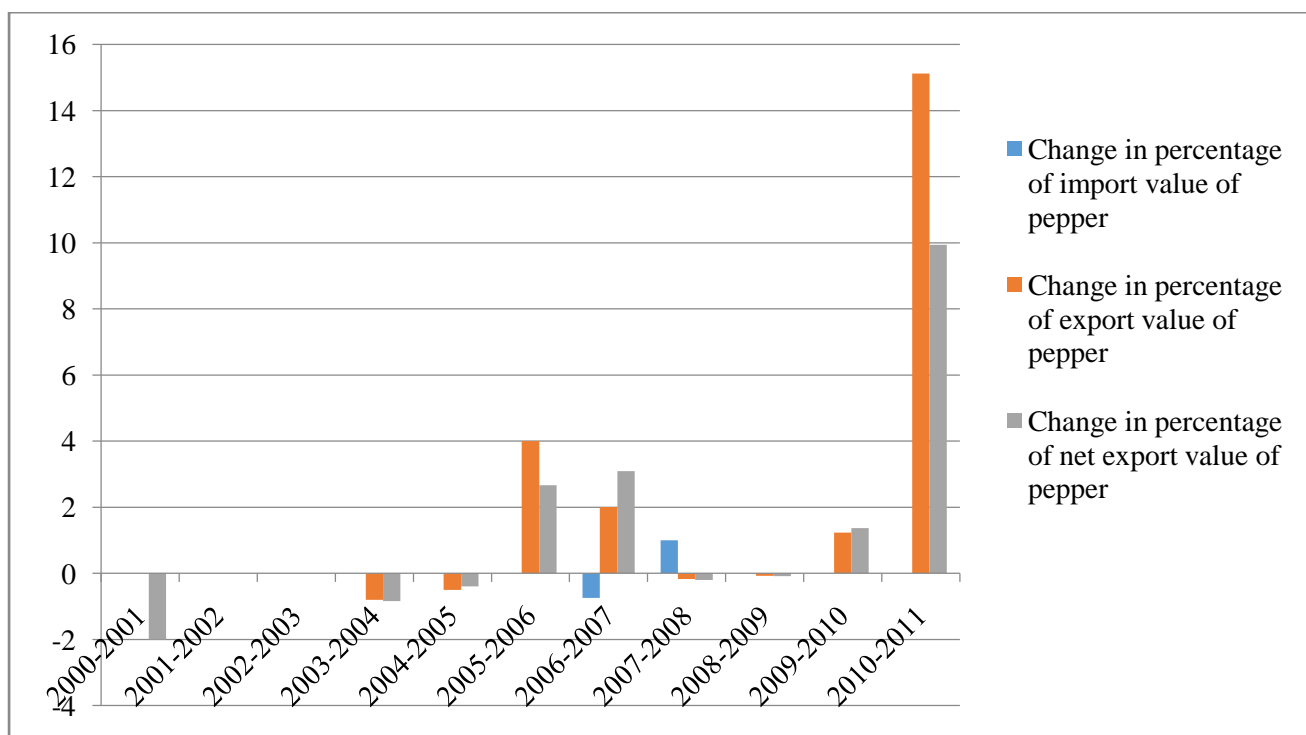
Source: Own processing from table 6

**Graph 4 Change in percentage of trade of pepper production in quantity**



Source: Own processing from table 7

**Graph 5 Change in percentage of trade of pepper production in value**



Source; Own processing from table 7

As noted in graph 4, there is no change in import of quantity at all. All the factors in import were equal to zero or non-exist. For the export of quantity part, there were positive, and

negative, and some years there were non-exist too. Just only eleven years, the change rate has changed very strongly. From 2000-2003, there were no-exist result for the changed of export (See in graph 4). Start from 2003-2005 the change has come downward to negative, and then it started to moved widely to positively at the level of 366.67% (see in graph 4). After the big change in 2005, the level of export rate has come downward, but it was still on the positively. In 2008-2009, the change has become negative once again at the level of -97.92% (see in graph 4). After that year until 2011, there was a big change rate once again at the level of 3283.33%. This result has influence the change of net export from 2000-2011. Because the pepper wasn't imported to anywhere till 2011, the result of change in percentage of net export was incredible. In 2011, the percentage of net export of quantity was -8666.67% (see in graph 4). This result caused by the big import of pepper during that year more than export (see in table 7).

The change of percentage of trade of pepper in value is very dramatically. As the noted in graph 5, the change of import wasn't strongly. There were many non-exists and zero like the import of pepper in quantity, but the export was different. The export of value became the strongest in 2011 as same as the net export of trade of pepper in value. The level of rate of export was 1511.64% while the net export in value was 993.59% (see in graph 5).

### **3.8. Domestic investment and FDI in agriculture sector**

Before the first election happened in Cambodia, there were many civil wars in this small country. Then in 1993, there was a first election which was controlled by UN. Then Cambodia became the democratic country. Since that time, there was a new chapter to attract foreign investment from Western countries. Just one year later, there was much different in this small developing country. Cambodia created new departments, changed the policies, and made low taxes for foreign investments and competitors etc. One year later, the revolution of this small country has been forward. In 2003, there were changes of law on investment in purpose to get more attraction from foreign investment and foreign capital.

In 2004, Cambodia has become the member of WTO. There were more opportunities and great impact to gain more and more attraction from foreign investment. By this chance, Cambodia has gain lots of benefit in trade with foreign partners during the age of global economical revolution.

Later on after the law of commercial and investment are amended, Cambodian government has been creating the Council for the development for Cambodia (CDC). This council was

made in order to control, accept, and take look all the investment projects such as granting an approval and facilitating investors to fulfill procedures of business start-up. The Council for development of Cambodia is a one-stop service for all the investments that have profit between 2 million USD to 50 million USD, In case if the investment has less than 2 million USD then the provincial/municipal investment sub-committee is in charge of that project. If the investment has more than 50 million USD, the CDC has to send this project to ask permission from the Council of Minister because of greater involvement of the foreign project into political and environmental sensitive impacts with long-term plans and strategies. There are three operational bodies for CDC:

- The Cambodia Special Economic Zone Board (CSEZB): for special economic zones designed specifically for factories in a great scale.
- The Cambodian Rehabilitation and Development Board (CRDB): for public investment and international assistance.
- The Cambodian Investment Board (CIB): for private investment

**Table 8 Domestic investment and FDI in agriculture sector**

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Cambodia	3.6	0.4	0.6		4.1	10.4	141	96	38.3	41.9	35.5	23.5
Japan								31.2				0.66
South Korea			11.4					59.4	5.8	3.4	32.7	1.7
Taiwan											3	
India										75		
China						3.7	72.8	33.2	18.6	134	41.9	17.4



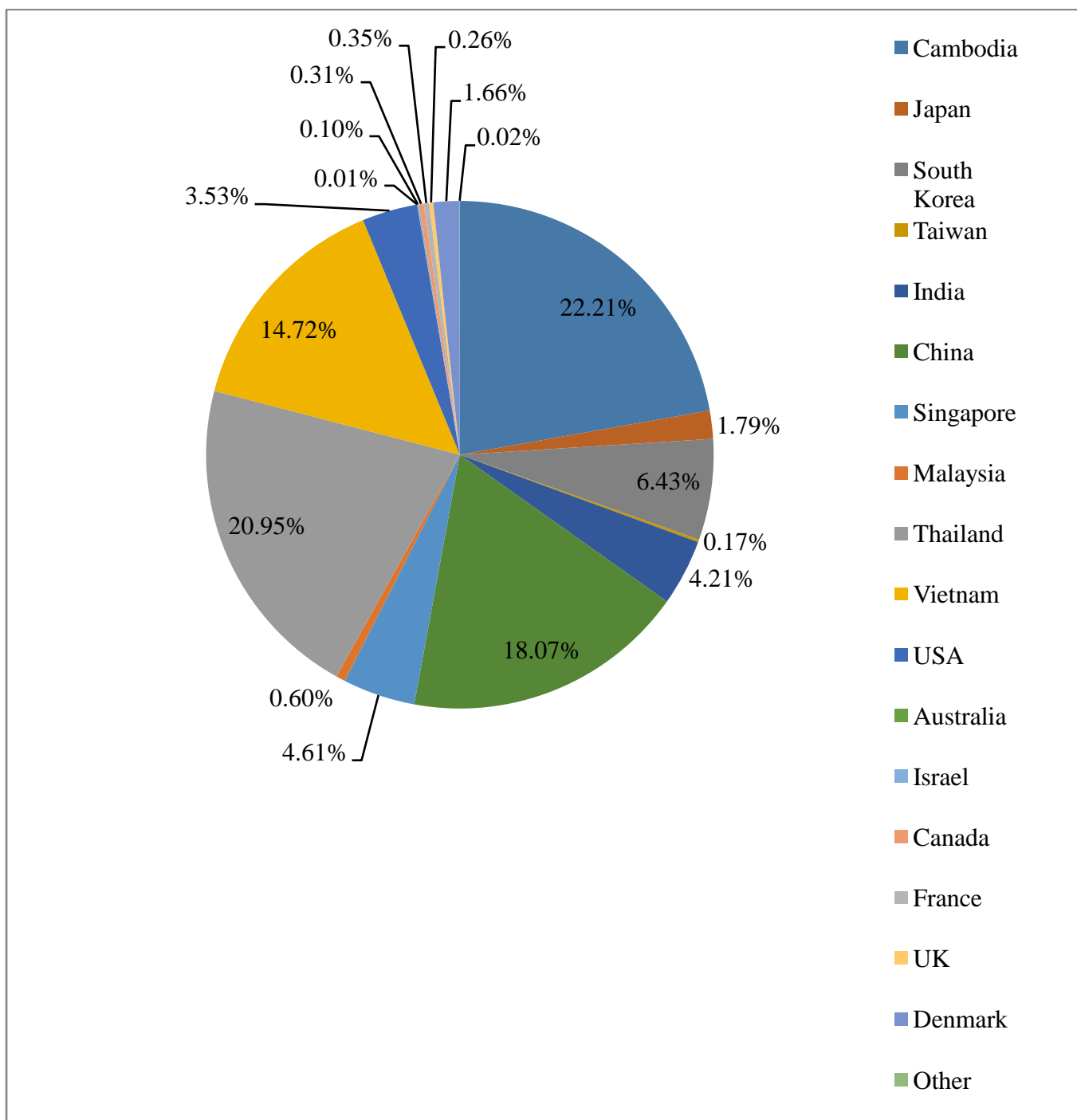
Singapore										82.1		0.016
Malaysia					8.2							2.4
Thailand							73.1	104	22.8	173		
Vietnam							27.4	43.1	20.9	104	59.8	6.8
USA	1.3						58.5				1.7	1.4
Australia												0.25
Israel								1.7				
Canada						5.5						
France									6.2			
UK										2.1		2.5
Denmark											29.5	
Other												0.27
Total (USD million)	4.9	0.4	12	0	12.3	19.6	372.8	368.6	112.6	615.5	204.1	56.89
Total FDI (USD million)	1.3	0	11.4	0	8.2	9.2	231.8	272.6	74.3	573.6	168.6	33.39

Total domestic investment (USD million)	3.6	0.4	0.6	0	4.1	10.4	141	96	38.3	41.9	35.5	23.5
Share in FDI (%)	26.53	0.	95	0	66.67	46.94	62.1	73.96	65.99	93.19	82.61	58.70
Share in domestic investment (%)	73.47	100	5	0	33.33	53.06	37.82	26.04	34.01	6.81	17.39	41.30

Source: The Council for the Development of Cambodia (CDC) 2010

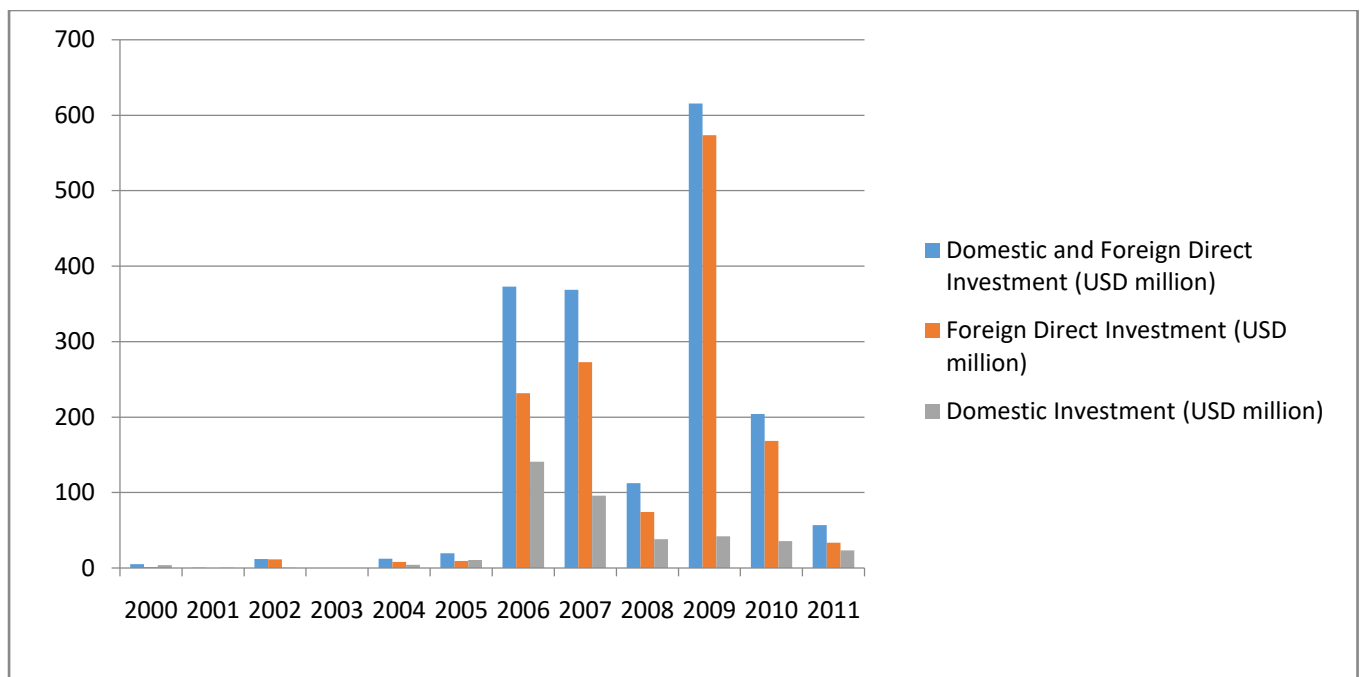
According to the table above, there were many foreign investments which invested on agriculture sector in period 2000-2011. They were from Southeast Asia, Europe, and North America. The major shares of this investment in agriculture sector were China, Vietnam, Thailand, South Korea, India, Singapore, and USA. The total invest from 2000-2011 was 1779.696 USD million. From 2000 till 2011, there was annual domestic investment except in 2003. The reason why there was not domestic investment during that year because of national election. After the national election, there was no party which got the result or seat, so there was no new government after election from July 2003. By the way in 2004, the new government was formed, so it was a new domestic investment again.

**Figure 3 Chart of share in total investment in agriculture sector from 2000 to 2011**



Source: Own processing from table 8

**Figure 4 Domestic investment and FDI in agriculture sector**



Source Own processing from table 8

Comparing between 2000-2011, domestic investment and FDI were too low from 2000-2005. From 2006 and 2007, there was new evolution in agriculture sector in Cambodia. The investment was high, but due to economic crisis in 2008, the investment went down. After that year of crisis, in 2009 it went up fast, but unfortunately it went down again in 2010 and 2011.

#### 4. Analyze

The following table is the main data used for correlation matrix, regression analyzes, logarithmic dissolution factors.

Year	Pepper production	Price of pepper production (USD/tones)	Import quantity of pepper production	Export quantity of pepper production	Domestic investment and FDI in agriculture sector (USD million)	Natural Disaster (number of occurrence)	Harvested area (ha)	Yield (t/ha)
2000	2200	2851.4	0	0	4.9	1	325	6.77
2001	2300	2223.3	1	0	0.4	2	350	6.57
2002	2329	1652.1	0	0	12	2	357	6.52
2003	2400	1647.2	0	52	0	0	369	6.51
2004	2418	1869.4	1	10	12.3	1	374	6.47
2005	2500	1326.3	0	3	19.6	2	400	6.25
2006	2469	2086.2	0	14	372.8	3	384	6.43
2007	2463	2416.1	0	39	368.6	2	382	6.45
2008	2458	2655.1	0	48	112.6	3	380	6.46
2009	2454	2965	0	1	615.5	3	379	6.47
2010	2449	3058.3	0	6	204.1	4	378	6.48
2011	2444	3357.7	717	203	570	1	377	6.49

Source: combination from table 2 4 6 and 8

#### 4.1. Correlation Matrix Analysis

**Table 9 Correlation Matrix Analysis**

	Pepper production	Price of pepper production (USD/tones)	Import quantity of pepper production	Export quantity of pepper production	Domestic investment and FDI in agriculture sector (USD million)	Natural Disaster (number of occurrence)	Harvested area (ha)	Yield (t/ha)
Pepper production	1							
Price of pepper production (USD/tones)	-0.052	1						
Import quantity of pepper production	0.132	0.495	1					
Export quantity of pepper production	0.241	0.444	<b>0.941</b>	1				
Domestic investment and FDI in agriculture sector (USD million)	0.482	0.631	0.512	0.482	1			

Natural Disaster (number of occurrence)	0.384	0.306	-0.280	-0.339	0.319	1		
Harvested area (ha)	<b>0.986</b>	-0.177	0.093	0.182	0.389	0.353	1	
Yield (t/ha)	<b>-0.891</b>	0.403	0.0024	-0.047	-0.187	-0.296	<b>0.952</b>	1

Source: Own processing from Excel

**Table 10 P-value of factors in correlation matrix analysis**

Pepper production	Price of pepper production (USD/tones)	Import quantity of pepper production	Export quantity of pepper production	Domestic investment and FDI in agriculture sector (USD million)	Natural Disaster (number of occurrence)	Harvested area (ha)	Yield (t/ha)
Pepper production	1						
Price of pepper production (USD/tones)	0.87	1					
Import quantity of pepper production	0.698	0.121	1				
Export quantity of pepper production	0.475	0.171	<b>0.00001</b>	<b>5</b>	1		

Domestic investment and FDI in agriculture sector (USD million)	0.133	0.037	0.107	0.133	1			
Natural Disaster (number of occurrence)	0.243	0.36	0.404	0.307	0.338	1		
Harvested area (ha)	<b>0.00000</b> <b>0003</b>	0.602	0.785	0.592	0.237	0.286	1	
Yield (t/ha)	<b>0.00023</b>	0.219	0.994	0.891	0.581	0.376	<b>0.000</b> <b>0635</b>	1

Source: Own processing computed from <http://www.danielsoper.com/statcalc3/calc.aspx?id=44>

#### **4.2. Regression Analysis (Ordinary Least Square)**

Dependent variable (Y) = Pepper production

Independent variables:

- X1 = Price of pepper production (USD/ton)
- X2 = Import quantity of pepper production
- X3 = Export quantity of pepper production
- X4 = Total investment in agriculture sector (USD million)
- X5 = Natural Disaster (Number of occurrence)



**Table 11 Regression Analysis (Ordinary Least Square) result**

Model 1: OLS, using observations 2000-2011 (T = 12)				
Dependent variable: <b>Pepper production with Original data</b>				
	Coefficient	std. Error	t-ratio	p-value
Constant	2470.79	78.0101	31.67	6.58e-08 ***
Price of pepper production (USD/ton)	-0.106519	0.0375105	-2.840	0.0296 **
Import quantity of pepper production (000 ton)	-0.341643	0.252193	-1.355	0.2243
Export quantity of pepper production (000 ton)	2.00679	0.912981	2.198	0.0703 *
Total investment in agricultural sector (USD million)	0.204111	0.109008	1.872	0.1103
Natural disaster (number of occurrence)	52.1531	21.0478	2.478	0.0479 **
Mean dependent variable	2407	S.D. dependent variable	87.45077	
Sum squared residual	19127.02	S.E. of regression	56.46093	
R-squared	0.772633	Adjusted R-squared	0.583160	
F(5, 6)	4.077810	P-value(F)	0.058333	
Log-likelihood	-61.27097	Akaike criterion	134.5419	
Schwarz criterion	137.4514	Hannan-Quinn	133.4648	
Rho	0.325291	Durbin-Watson	1.328054	

Source: Own processing computed from Gretl

### 4.3. Logarithmic dissolution factors analysis

**Table 12 Logarithmic dissolution factors result**

Year	2000- 2001	2001- 2002	2002- 2003	2003- 2004	2004 - 2005	2005- 2006	2006- 2007	2007- 2008	2008- 2009	2009- 2010	2010 – 2011
Change of pepper production	100	29	71	18	82	-31	-6	-5	-4	-5	-5
Index harvested Area	1.08	1.02	1.033	1.013	1.069	0.96	0.99	0.99	0.99	0.99	0.99
Index yield	0.97	0.99	0.99	0.99	0.96	1.028	1.003	1.001	1.001	1.001	1.001
Index production	1.045	1.012	1.03	1.0075	1.033	0.98	0.99	0.99	0.99	0.99	0.99
ln Iharvested / ln Iproduction	1.67	1.58	1.10	1.80	2.02	3.27	2.15	2.58	1.62	1.3	1.3
ln Iyield / ln Iproduction	-0.67	-0.61	-0.05	-0.82	-1.04	-2.28	-1.28	-0.76	-0.95	-0.76	-0.75
Sum of lns	<b>0.99</b>	<b>0.97</b>	<b>1.05</b>	<b>0.98</b>	<b>0.98</b>	<b>1</b>	<b>0.87</b>	<b>1.82</b>	<b>0.67</b>	<b>0.54</b>	<b>0.54</b>
Change in production influenced by harvested area (000 tons)	166.72	45.83	78.17	32.42	165.25	101.42	12.88	12.92	-6.47	-6.48	-6.48
Change in	-67.46	-17.68	-3.63	-14.85	-85.06	70.54	7.66	3.81	3.80	3.79	3.77

production influenced by yield(000 tons)											
<b>Sum of changes (000 tons)</b>	<b>99.26</b>	<b>28.15</b>	<b>74.54</b>	<b>17.58</b>	<b>80.19</b>	<b>-30.88</b>	<b>-5.22</b>	<b>-9.10</b>	<b>-2.67</b>	<b>-2.69</b>	<b>-2.71</b>

### 5. Result and Conclusion

Due to the result of correlation matrix from table 9 compare to two tailed probability or p value of 0.01

- The correlation between export quantity of pepper production and import quantity of pepper production is at rate of 0.941, which is 99% statistical significant.
- The correlation between harvest area and pepper production is at rate of 0.986, which is 99% statistical significant.
- The correlation between yield and pepper production is at rate of -0.891, which is 99% statistical significant.
- The correlation between yield and harvest area is at rate of -0.952, which is 99% statistical significant.

According to another result of table regression analysis

$$Y = 2470.79 - 0.11X_1 - 0.34X_2 + 2.007X_3 + 0.204X_4 + 52.15X_5$$

P-value is 0.10. If any independent variables are below 0.1, they are significant, if they are above 0.1, they are not significant. Base on the result of regression, there are constant and 3 independent variables which are price of pepper production, export, and natural disaster are significant while the others are not. Goodness of fit  $R^2 = 0.77$  and Adjusted  $R^2 = 0.58$ .

So we are 90% confident that

- If  $X_1$  (price of pepper production) increases by 1USD/ton, pepper production decreases by 0.11 ton.
- If  $X_2$  (import of pepper production) increase by 1 ton, pepper production decreases by 0.34 ton.

- If X3 (export of pepper production) increase by 1 ton, pepper production increases by 2.007 ton.
- If X4 (investment on agriculture sector) increase by 1 million USD, pepper production increases by 0.204 ton.
- If X5 (natural disaster) increase by one time of occur, pepper production increases by 52.15 tons.
- If X1, X2, X3, X4, and X5 are zero, pepper production increases by 2470.79 tons.

Base on the result shown above:

- Hypothesis (Price of pepper production had a negative influence on pepper in the whole period from 2000-2011 in Cambodia) is proved.
- Hypothesis (Import of pepper production had a negative influence on pepper in the whole period from 2000-2011 in Cambodia) is proved.
- Hypothesis (Export of pepper production had a positive influence on pepper in the whole period from 2000-2011 in Cambodia) is proved.
- Hypothesis (Investment on the pepper production in agriculture sector had a positive influence in the whole period from 2000-2011 in Cambodia) is proved.
- Hypothesis (Natural disaster had a positive influence on pepper in the whole period from 2000-2011 in Cambodia) is proved.

According to Logarithmic dissolution factor result, if index equals to 1 which means there is no change. However if the index is more than 1 which means there is increasing change. But in other hand if the index is less than 1 which means there is decreasing change. According to table 12 indices of harvest, yield, and pepper production changed annually from 2000-2011. Definitely, the changes of harvest and yield play a vital role in change of pepper production. So, there are 11 scenarios from 2000 to 2011 as following:

- In 2000-2001 there was an increasing change in pepper production at level of 100 tons. Increasing change in harvest areas influenced pepper production positively or productively at the rate of 166.72% of 100 tons which means that it was equal to unit of 166.72 tons while there was a decreasing change in yield influenced pepper production negatively or counterproductively at the rate of 67.46% of 100 tons which means that it was equal to unit of 67.46 tons.
- In 2001-2002 there was an increasing change in pepper production at level of 29 tons. Increasing change in harvest areas influenced pepper production positively or

productively at the rate of 158.04% of 29 which means that it was equal to unit of 45.83 tons while there was a decreasing change in yield influenced pepper production negatively or counter productivity at the rate of 60.97% of 29 tons which means it was equal to unit of 17.68 tons.

- In 2002-2003 there was an increasing change in pepper production at level of 71 tons. Increasing change in harvest areas influenced pepper production positively or productively at the rate of 110.09% of 71 which means it was equal to unit of 78.17 tons while there was a decreasing change in yield influenced pepper production negatively or counterproductively at the rate of 5.11% of 71 which means it was equal to unit of 3.63 tons.
- In 2003-2004 there was an increasing change in pepper production at level of 18 tons. Increasing change in harvest areas influenced pepper production positively or productively at the rate of 180.13% of 18 which means it was equal to unit of 32.42 tons while there was a decreasing change in yield influenced pepper production negatively or counterproductively at the rate of 82.49% of 18 which mean it was equal to unit of 14.85 tons.
- In 2004-2005 there was an increasing change in pepper production at level of 82 tons. Increasing change in harvest areas influenced pepper production positively or productively at the rate of 201.53% of 82 which means it was equal to unit of 165.25 tons while there was a decreasing change in yield influenced pepper production negatively or counterproductively at the rate of 103.73% of 82 which means it was equal to unit of 85.06 tons.
- In 2005-2006 there was a decreasing change in pepper production at level of 31 tons. Decreasing change in harvest areas influenced pepper production negatively or counterproductively at the rate of 327.16% of 31 which means it was equal to unit of 101.42 tons while there was an increasing change in yield influenced pepper production positively or productively at the rate of 227.55% of 31 which mean it was equal to unit of 70.54 tons.
- In 2006-2007 there was a decreasing change in pepper production at level of 6 tons. Decreasing change in harvest areas influenced pepper production negatively or counterproductively at the rate of 214.62% of 6 which means it was equal to unit of 12.88 tons while there was an increasing change in yield influenced pepper

production positively or productively at the rate of 127.64% of 6 which means it was equal to unit of 7.66 tons.

- In 2007-2008 there was a decreasing change in pepper production at level of 5 tons. Decreasing change in harvest areas influenced pepper production negatively or counterproductively at the rate of 258.32% of 5 which means it was equal to unit of 12.92 tons while there was an increasing change in yield influenced pepper production positively or productively at the rate of 76.24% of 5 which means it was equal to unit of 3.81 tons.
- 2008-2009 there was a decreasing change in pepper production at level of 4 tons. Decreasing change in harvest areas influenced pepper production negatively or counterproductively at the rate of 161.79% of 4 which means it was equal to unit of 6.47 ton while there was an increasing change in yield influenced pepper production positively or productively at the rate of 94.97% of 4 which means it was equal to unit of 3.80 tons.
- 2009-2010 there was a decreasing change in pepper production at level of 5 tons. Decreasing change in harvest areas influenced pepper production negatively or counterproductively at the rate of 129.54% of 5 which means it was equal to unit of 6.47 tons while there was an increasing change in yield influenced pepper production positively or productively at the rate of 75.72% of 5 which means it was equal to unit of 3.79 tons.
- 2010-2011 there was a decreasing change in pepper production at level of 5 tons. Decreasing change in harvest areas influenced pepper production negatively or counterproductively at the rate of 129.62% of 5 which means it was equal to unit of 6.48 tons while there was an increasing change in yield influenced pepper production positively or productively at the rate of 75.45% of 5 which means it was equal to unit of 3.77 tons.

Regarding to all influences of the logarithmic dissolution factors result are not 100% correct or accurate because of imprecise sources of data and rounding of the number. To see how accuracy of data is based on the sum of the logarithms that is the indicator of measuring accuracy. When the sum of the logarithms equals to 1, it means that the data are accurate. However, in this logarithmic dissolution factors result, all sums of the logarithms from 2000-2011 were not equal to 1 except 2002-2003, 2005-2006, and 2007-2008. Unfortunately there were 4 sums of logarithms which were really far from 1. There were 2005-2006, 2008-2009,

2009-2010, and 2010-2011. In this sense it can be proved that the influence of factor shown in the result of analysis were nearly 100% accurate.

In conclusion, after conducting those three analyses such as correlation matrix analysis, regression analysis, and logarithm dissolution factors analysis, pepper production in Cambodia from 2000-2011 go up and down from time to time base on price of pepper production, import and export quantity of pepper production, investment in agriculture sector, natural disaster, harvest area and yield.

Luckily, Cambodia is a small country which located in one of the best locations. There are no big disasters such as earthquake, volcano, or any other tough disasters. However, there were flood and drought caused regularly, but the level of those disasters was low if compared to other countries around the world. Investment in agriculture sector from the beginning of 2000 was in low amount because there was civil war in Cambodia, and it finished late in 1998. It took little bit long to build confident for domestic and foreign investors. In 2004, involving and joining WTO really improved and helped Cambodia to step further more. After this agreement, there were many investors. Even pepper production didn't increase rapidly, but the price of pepper production increased rapidly, and in 2012 pepper production in Kampot province was given award from European Union base on the original taste and organic product.

However, in 2008 there was economic crisis spread around the world, but fortunately pepper production was not a big production like rice or another production, so the price didn't decrease. Unfortunately, the investment in agriculture sector decreased, and the main victims were farmers who production rice, maize, or another products. Nevertheless, everything became better in all sectors just few years later, but it moved slowly.

Based on result of regression analysis constant, price, export quantity of pepper production, and natural disaster were significant in influencing pepper production in Cambodia in the whole period of 2000-2011.

## **6. Recommendation**

Recently in 2015 the ASEAN Economic Community was just started. Kampot Pepper production was accepted to be an organic product by EU in 2016 base on the taste, quality, and organic. This is the positive impact for Cambodian pepper production in the future. Not just only Kampot pepper, but there are many places which grow this plants. The farmers are looking forward to the future of this small production. Unfortunately, there is not just only advantage but also disadvantage too when ASEAN Economic Community opens completely. The advantages are such as: local people get more jobs and opportunities to study abroad and gain experience to work in Cambodia, free tariff policy for export, and more foreign investment ...etc while disadvantages are such as: more foreign products than domestic products from ASEAN Economic Community. Cambodia has been improved in agriculture sector and hosted the first ASEAN summit in 2012. However Cambodian government needs to be more careful about all their approaches to the market situation in the future which is very competitive based on the main source of income from agriculture sector for the majority of rural Cambodian.

Improving the agriculture sector for pepper production starts by Cambodian government, otherwise this production will face some serious problems in the way that most farmers become disappointed and unemployed while the agricultural commodities including pepper are imported from foreign country like in 2011. This kind of competition will force rural Cambodian farmers to lose their job. Therefore there should be:

- a market for this small production because in Cambodia farmers are the one who find market and they take care everything.
- a lecture or program of teaching domestic farmers how to produce more pepper efficiently by using modern technology, tools, equipment, and less chemical fertilizer.
- an encourage farmers to produce pepper production on a certain level of acceptable quality and find market abroad in order to get ready for any competition and prevent losing its own market in both local and abroad because of quality of pepper.



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