

**YANGON UNIVERSITY OF ECONOMICS
MASTER OF ECONOMICS**

**A STUDY ON PRODUCTION AND DISTRIBUTION OF
WATERMELON IN KHAYAN TOWNSHIP
(From 2011 to 2016)**

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JUNE 2018

**YANGON UNIVERISITY OF ECONOMICS
MASTER OF ECONOMICS**

**A STUDY ON PRODUCTION AND DISTRIBUTION OF
WATERMELON IN KHAYAN TOWNSHIP**

(From 2011 to 2016)

A thesis is submitted in fulfillment of the partial requirements for the
Degree of Master of Economics

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This is certify that this thesis entitled "A Study on Production and Distribution of Watermelon in Khayan Township" submitted as a partial fulfillment towards the requirements for the Degree of Master of Economics, has been accepted by the Board of Examiners.

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ABSTRACT

Watermelon has become popular of production and cultivation in fruits market in Myanmar. The study is explored the production and distribution condition of watermelon in Khayan Township. It is reviewed the cultivation and production of watermelon. It is also studied the market situation of watermelon in Khayan Township and the benefit from watermelon cultivation in Khayan Township. The study found that sown areas and production of watermelon are increasing year by year. It is also found that large amount of watermelon are exported to China. By production of watermelon, watermelon growers get the many opportunities and raise the living standards. Therefore, to obtain more and more benefit from watermelon production, the quality of watermelon is needed to match with international quality and it is necessary to improve technology, production process and skills of watermelons growers.

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LIST OF ABBREVIATIONS

NWPB - North Western Bee Products

CHAPTER 1

Introduction

1.1 Rationale of the Study

Watermelon which is a tropical fruit has become popular of production and cultivation. Because of the yearly rise of global population and the global warming, the consumption of fruit like watermelon which are rich in water, fiber, vitamin and mineral has been apparently increased. Concern for more balanced diets involving lower proportion of carbohydrates, fats and oils and a higher proportion of dietary fibers, vitamins and minerals are generally expected to have measurably influenced the growth in fresh produce consumption. A desire for fruit that preserve their nutritional value, natural color, flavor and texture contributes to the development of new market for fresh fruits like watermelons. In Myanmar, the rate of consumption of watermelon increases from 18.189 thousand Tons in 2008 until now, 2018. Because of the increase in local consumption and the export to foreign market, the cultivated areas also increase. Most of the Myanmar's watermelons are exported mainly to the China's Musal market and because there has been an increase in demand of the watermelon in the China market. The number of farmers who grow watermelon in Myanmar has also increased and among the local fruit export market, the export of watermelon is the most numerous. Therefore, the role of watermelon production is increasing year by year.

As for the farmers who cultivate watermelon, they cultivate with the aims such as to get sufficient supply for local market as well as to export to the foreign market. Watermelon has shown a rise in production in Khayan Township. As the planted area has increased, production has increased in the same period, thus point to yield increase. By raising the rate of watermelon export to the foreign market, there are not only several opportunities but also get the benefit for watermelon growers from country sides.

As a perishable commodity, watermelon is sold largely in the domestic market and export market. The marketing season for Khayan's watermelon generally runs from April to October. The growers usually can receive the strongest prices during the first two months of the season which means November and December. In

Khayan Township, watermelons can be marketed through a variety of outlets which include roadside stands, farmers' market and local market.

Both watermelon with seeds and seedless watermelon which are produced from Khayan Township are exported mainly to Musal market. This study aims to observe the cultivation, production and market conditions of watermelon. Besides, the benefit getting from watermelons' growers are presented.

1.2 Objective of the Study

This study aims to observe the cultivation, production and market conditions of watermelon and to explore the benefit getting from watermelons' growers.

1.3 Method of Study

By studying the relevant documents for cultivation of fruits, exploring to the corresponding departments and interviewing the traders, brokers and relevant responsible persons are done.

1.4 Scope and Limitation of Study

Among the various watermelon species, sweet red watermelon, a major export, which is a species with seeds are studied in this thesis. For the study, the condition of watermelon cultivation and production during (2011-2016) is presented by interviewing the needed data at the township, head office while going to the villages in Khayan Township. The data consists of watermelons' prices from 2011 to 2016. For watermelons' prices, seeded and seedless are reported separately.

1.5 Organization of the Study

This thesis is organized into five chapters. Chapter one is introduction. It includes the rationale, objective, method, scope and limitation, and organization of the study. Chapter two contains Background History of Watermelons. Chapter three gives the Cultivation and Production of Watermelon in Khayan Township. Chapter four is watermelon market in Khayan Township. Chapter five is conclusion which describes finding and suggestion.

CHAPTER 2

Background History of Watermelon

2.1 Origin of Watermelon

The watermelon is a flowering plant that originated in Northwest Africa. The first recorded watermelon harvest occurred nearly 500 years ago in Egypt. Originally, watermelon is thought to be found in the Kalahari Desert of Africa. It is depicted in Egyptian hieroglyphics on walls of their ancient buildings. Its native range comes from North Africa to West India.

From there, watermelons spread throughout countries along the Mediterranean Sea by way of merchant ships. By the 7th century, it reached India and from there watermelon has reached China, which is today the world's single largest watermelon producer. In 13th century, watermelon was found that were spread through the rest of Europe via the Moors. The fruits had begun appearing in Europe herbals by 1600. Rest of the Europe didn't state growing watermelons until the 17th century when they were widely accepted as a minor garden crop.

European colonists and slaves Africa introduced the watermelon to the new world. The first ones were grown in Florida in the 16th century. Later, in the 17th century, they were grown in Massachusetts, Peru, Brazil, Panama and many British and Dutch colonies.

In time, different types of watermelons developed. They have different shapes, colors of inside and outside and characteristics. Because seeds of watermelons are a little inconvenient while eating, one of the variants is made not to have them. Seedless watermelons were initially developed in 1939 by Japanese scientists. Seedless watermelons more became popular in the 21st century, rising to nearly 85% of total watermelon sales in the world in 2014. There are today over 1,200 variants of watermelons that are grown in more than 96 countries.

The information of the time when watermelon was started to cultivate is not known precisely in Myanmar. Observing that the figure of watermelon was included in a picture of a museum which is situated in Bagan, people predict that watermelon was cultivated since Bagan era. In the earliest years, watermelon was cultivated as multiple crops for consumption in the field of groundnut and corn and only the excess watermelons were exported to over sea.

In the later years after 1980 watermelon was cultivated specifically with four-squares grid pattern in Khayan township and Dake Oo Township among lower Myanmar and in Sagaing Division among upper Myanmar. Starting from the time, after 1990, Known You Need Company in lower Myanmar, Chinese nationality in upper Myanmar started to cultivate with irrigation bound method and now the whole country cultivate with irrigation bound method starting from the beginning time of watermelon cultivation until now, Khayan Township has been continued to be the first most watermelon cultivation township in lower Myanmar.

2.2 Topography for Watermelon Cultivation

Watermelon is cultivated economically all over Myanmar and the main cultivated areas are Yangon division, Mandalay Division, Sagaing Division, Magway Division, Shan State and Mon State. As Khayan Township is a Township which does agriculture mainly so it is very important that condition of soil is good. Khayan Township is also in the good condition of fertile soil due to the location.

There are three major types of soil in Khayan Township. They are salt-crust soil, sand soil and clay-mixed soil and watermelon is economically cultivated mostly in the sand silt type of soil. 6.0 to 7.5 PH level is the best condition for soil. The fruits are prosperous due to the better methods and the topography of the land to be cultivated.

2.3 Nutrient Factors of Watermelon

Watermelon can be grown to be a qualified and highly nutrient fruits only if we mature the fertile soil step by step and prevent external pests from a day-old until the harvest time. To develop the yield of fruits and to get sufficient nutrition depend on the stages of agriculture and utilization of fertilizer proportionately. As watermelons are 91% water and 6% sugar, they are eaten as dessert, but they are not just sugary sweets. They have high amounts of vitamin C and are low in fat and sodium which makes them healthy food. Watermelon can also be turned into juice. Rind of watermelon is also edible but is rarely eaten raw because of its not so pleasant taste. Its seeds also can be eaten when they are dried and roasted, or ground into flour.

Watermelon is rich in nutrient factors and 91% of water, fibers and potassium are also involved in watermelon by consuming normal size watermelon, 1440 calories

can be burnt for a person who does physical exercise and it can reduce the fat inside the body.

Besides, is also can reduce embolism and unnecessary weight inside the blood. It helps the hair to be strong and glow. Consuming more watermelons, have health benefit on women, children, men and pregnant women. More watermelons in a healthy diet increase the potential of preventing diseases, even some types of cancers. It provides moisture to the skin and prevent from having wrinkles. People who want to lose weight can drink the juice of watermelon.

Table (2.1) Nutritional Composition of Watermelon

	Fruit	Seeds
Water	91.51	5.05
Energy	32	557
Protein	0.62	28.33
Carbohydrate	7.18	15.31
Vitamin C	9.6	0.1
Vitamin A	366	0
Vitamin E	0.15	0
Vitamin B6	0.144	0.089
Calcium	8	54

Source: www.watermelon.org

2.4 Physical Characteristics of Watermelon

The typical characteristics of watermelon are sweetness, juiness, and crispness. Watermelon has a globe or oblong shape with edible pulp coloration varying from white to cream, honey color, yellow, pale red, red and scarlet. It consists of firm green outer rind with or without stripes and a very polished and hairless surface. Inside of seeded watermelon, there are large amounts of small, dark seeds distributed in the flesh.

Watermelon plants send out trailing, hairy stems that can spread 15 feet or more. The 2-to 10- inch long leaves have deep lobes and grow along the stems on 1-to 5-inch stalks. Greenish yellow, trumpet-shaped male and female flowers measures 1

inch wide. When a watermelon is ripe, the rind turns from bright green to dull green, and the part that touches the ground turns red.

Watermelon is known as *Citrullus lanatus* in botanical circles of the Cucurbitaceae family. Watermelon is a trailing annual with scrambling and climbing stems which can reach 15 feet in length. It has dark, more blue-green leaves and small yellow flowers. The size of watermelon varies from small 3 viss to big 7 viss.

2.5 Types and Varieties of Watermelons

Over the past years, the successful introduction of several hybrid varieties has changed watermelon production. Growers use hybrids to increase yields, improve disease resistance, increase uniformity, and early maturity. As the result of higher quality and yields, there are higher consumer satisfaction and stronger demand.

Color, texture, flavor, size shape and seeded or seedless are major variables can be altered by producer. According to NWPB, over 1,200 varieties of watermelons are grown worldwide in 96 countries. Among the hundred species of seeds from the other countries only the eighteen major species of watermelon are cultivated in ASEAN countries. The cultivated watermelon species in Khayan Township are 855, seedless watermelon, yellow watermelon, sweet red watermelon, and white watermelon. However 855 (big) species are mainly cultivated and produced. In the region of lower Myanmar, 855 which is the species with red flesh inside are cultivated and in the region of upper Myanmar, seedless watermelons are cultivated.

Table (2.2) Varieties and Characteristics of Watermelon Grown in Khayan Township

Types	Size (Viss)	Shape	Rind(color)	Flesh(color)
855	6	oblong	striped	red
Seedless	5	oblong	striped	Bright red
Yellow	5	round	striped	yellow
Sweet Red	6	round	green	red
White	5	oblong	pale green	red

Source: Survey Data in Khayan Township

2.6 Production Stages of Watermelon Cultivation

Myanmar agriculture utilizes the cultivation and producing method to produce seasonal fruits. By doing so, cultivation is done as the first step.

2.6.1 Cultivation

In agriculture, cultivation is usually started to perform as the first step. The nature of cultivation is harrowing the top and bottom of the soil to become coalescence as the natural fertilizers on top of the soil are used up by the absorption and consumption of the plants. Mostly, only after picking up the rubbish and burning them, the farmland starts to be cultivated by employing the workers.

2.6.2 Adding Humus

Adding humus is done as the second step. For the fruitfulness of soil, so humus is added to get the soil condition which is liked by the fruits. Good humus is necessary for adding humus. To get the required humus, manure can be collected and utilized as humus. Moreover, chemical fertilizers are also added to utilize in adding humus it is needed. By doing these step-by-step process, humus which is ready to cultivate can be obtained.

2.6.3 Sowing to get Seedlings

Small plastic bags are necessary in order to sow. It is important to be careful not to contain the pests which may destroy the genes. Therefore, humus pesticide has to be used after making the humus into powder form. After adding humus into the sowing-bags, seeds of watermelon have to be added. The sowing-bags, in which the seeds are added, must be positioned two cubits from each other. The seed must be covered by banana leave to be secure. By sowing to get seedlings, it can protect the danger of pests from outside and the seedlings which are qualified and able to give great outturn can be obtained. The seedling can be transplanted during the two days time of sowing.

2.6.4 Method of Cultivation

When cultivating watermelon, there are 2 methods such as cultivating with bound and cultivating by paneling. Cultivating with bound has to be made two layers such as handling the bound roughly and smoothing the bound. When cultivating with

bound, watermelon is cultivated after paddy is harvested. It is cultivated by positioning the seedlings 2 feet or 2 cubits from each other 40 to 50 cubits of bound per acre have to be ploughed. About over 1000 seedlings can be cultivated.

2.6.5 Way of Getting Seeds

The seeds of watermelon can be bought from agricultural stores in the corresponding townships. There are many varieties of watermelon such as seedless, 855, 168, baby P2 but most of the farmers in lower Myanmar cultivate the 855 species which is red inside. The seedless white ones are cultivated in the region in Upper Myanmar and in other states. A watermelon species namely 855 contain about 1100 seeds per bag and the price for current year, 2018, is 14000 kyats per bag.

2.6.6 Transplanting

Among the various soil type, watermelon is only successful in sand. The two days old seedlings are transplanted after making the soil boundaries. Then, these seedlings are taken out from plastic bags and planted into the already-drilled ground holes. When the seedling are about to be planted, a fungicide which is called Di-thein is sprayed. Then, a path has to be made by separating 11 cubits each in order to that the shoots of the growing seedling can make their way. If there is much rain at the time, the growth of plants is powerful but the outturn of fruit may be weak. Fruit tonic is necessary to be used when the plants are 10 days old 2 packs of Aphyu (pearl), 1 pack of Nitro Phosca mineral sat, 3 packs of Anat, 1 pack of carbohydrate are mixed and the mixture is utilized about 1 tin per plant. For about one-month old seedlings, the fruit tonic, ayawnic and comic are mixed and about one tea-spoon of mixture is used to approximately 37-days old seedling, one week after the flowers bloom. Before getting the age of 45 days, paddy husk bags are cushioned under the fruit have to be pollinated. Pollinated was done by the help of our friend, bees and bumblebees but nowadays pollination is done by spraying with the human workers. Di-thein and matalazin are mixed and sprayed to prevent the growing fruits from the danger of pests starting from the time after pollination. Then, 3 table spoons of ferguson and 1 teaspoon of pesticide which is called Dupon are mixed and spray in order to prevent the danger of Na Myaung Taung.

2.6.7 Harvesting

Watermelon which is a seasonal fruit is started to be cultivated in Thadingyut. There are about 4 and a half month time lasts from the cultivation time of watermelon until the time to harvest. When the plant is 83 days old, it is in the suitable condition to harvest. At that time, one bag of Nitro Phosca and four Pyi (unit measure equivalent to 1/16 th part of a bushel) are fed to the plants once in 5 days after checking the fruits in order to get the good quality fruits. 10days before the harvest time, one pack of mineral salt and half pack of Aphyu is mixed and one bowl of the mixture is fed to plants for the last time. If the watermelons which are at the suitable condition to harvest are left on the plants until they ripen, the harvest time becomes late and they cannot get good price. Besides, they cannot be kept for a long time while transportation, so they are quickly perishable. In the watermelons cultivated land in which much fertilizer is added, the plants are very successful that even the weight of the watermelon is not able to be held by the plant.

CHAPTER 3

Cultivation and Production of Watermelon in Khayan Township

3.1 Overview of Khayan Township

3.1.1 Location

Khayan Township is situated in the southern district in Yangon division in lower Myanmar. It is bounded on the south by Thone Khwa Township, on the east by gulf of Motetama, on the west by Than Hlyin Township and on the north by Kawa Township it is included in the lower region of Myanmar so the climate is moderate and good and it is very suitable to do agriculture.

3.1.2 Area

The area of Khayan Township is 236.75 square miles. When it is measured in acres, the township is about 151518 acres wide. The length from east to west of Khayan Township is 22 miles and south to east length is 16 miles. It has the distance of 33 miles by motorway and 40 miles by railway from Yangon.

3.1.3 Climate

Khayan Township is situated in lower Myanmar so it is a place with temperate climate with Hot, Rainy and Cold seasons. As it is the region with temperate climate, it has 50 to 70 inches of rainfall. The month with the most rainfall is August and the month with the least rainfall is April. Because of the temperate climate, the rain is good and the cultivation and production of fruit are prosperous. So, the weather condition of Khayan Township is appropriate for watermelon production.

3.1.4 Transportation

Khayan Township is situated on the Yangon-Bago highway. It is able to transport by motorway, railway and waterway from Yangon city. It is connected by asphalt-road from Yangon to Bago crossing the Khayan Township.

3.2 Watermelon Cultivated Villages in Khayan Township

Watermelon is cultivated and produced in the villages all over Khayan Township according to the climate and local characteristics of Khayan Township and it is not only sufficient for local consumption but also able to get foreign income by exporting to foreign countries. Watermelon was cultivated only in seasonal time during the earlier days. But nowadays, watermelon is cultivated in the whole year in Khayan Township and it is exported more to the foreign countries so the farmer who cultivate watermelon can gain many advantages as well as there has been many advantages in the fruit sector of Myanmar.

Watermelon is cultivated in Yangon region, Mandalay region, Magway region, Bago region, Sagaing region, Ayeyarwady region, Tanintharyi region, Mon state and Shan state in Myanmar. The regions in which watermelon cultivated the most are Yangon region, Mandalay region and Sagaing region. Khayan Township is the township in Yangon region in which watermelon cultivated the most.

The local characteristic of Khayan Township is suitable to cultivate watermelon and this is why it is the township in Yangon division in which watermelon is cultivated the most. The cultivated areas of watermelon in Khayan Township were 1.1 acres in total during 2011-2012 and the total yields of watermelon was 185730 numbers.

Khayan Township has a temperate climate as well as sufficient temperature and rainfall and besides, it is a suitable land for watermelon cultivation so watermelon fields are prosperous in this township. The different types of watermelon grown in Khayan Township are 855, seedless watermelon, yellow watermelon, sweet red watermelon, and white watermelon. Among them, 855 or sweet red watermelon is the most cultivated. Every village in Khayan Township cultivates watermelon more or less. The villages watermelon grown in Khayan Township are Kwam Hlyar Shay, Nyaung Pin Kwin, Bagan Taung, Pann Taw Chaung, Kayin Su, Htayan Kan, Kan Bae, Plu Kan, Takaw Kan, Kyee Ni Chaung, Nyaung Lann, Phayarr Pyo, Day Pouk, Kan That, Sakhann Gyi, Pyinn Ma Kone, Kyar Kan, Nyaung Pin Thar, Kyone Kan, Own Pin, Sin Minn I, Kin Punn Chone, Zee Phyu Pin, Plu Pin and Aung Chann Thar villages.

In table (3.1), when observing the watermelon cultivate areas according to the villages, Sa Khan Gyi village, the first most village, cultivated total 364 acres from 2011 to 2016 cultivation seasons and this was 9% of the watermelon cultivated areas

of Khayan Township. The watermelon cultivated areas of Khayan Township are mostly found in the villages in north-east, east and south-east of Khayan Township.

The second most watermelon cultivated village in Khayan Township is Kan Bae village. There was a total of 257 acres of cultivated area in Kan Bae village during 2011-2016 and it was 6% of the cultivated area of Khayan Township.

The third most cultivated watermelons village in Khayan Township is Kyar Kan village. There was a total of 242 acres of Kyar Kan cultivated area in during 2011-2016 and it was 5% of the cultivated area of Khayan Township.

The fourth most watermelon cultivated village in Khayan Township is Pan Taw Chaung village. There was a total of 238 acres cultivated area during 2011-2016 and it was 5% of the cultivated areas of Khayan Township.

The fifth most watermelon cultivated village in Khayan Township is Sin Min I village. There was a total of 223 acres cultivated area during 2011-2016 and it was 4% of the cultivated areas of Khayan Township.

During 2011-2016 watermelon cultivation season, Nyaung Pin Thar village had 4% of the total cultivated areas with 193 acres of cultivated areas, Hta Yan Kan village had 3% of the total cultivated areas with 192 acres of cultivated areas, Zee Phyu Pin village had 3% of the total cultivated area with 184 acres of cultivated areas and Kwan Hlyar Shay village had 2% of the total cultivated area with 169 acres of cultivated areas.

The cultivated areas of watermelon is small in amount in Naung Pin Kwin village, , Bagan Taung village, Pa Lu Kan village, Ta Kaw Kan village, Kyee Ni Chaung village, Nyaung Lann village, Day Pouk village, Kan Thar village, Pyinn Ma Kone village, Kyone Kan village, Plu Pin village and Aung Chan Thar village.

In figure (3.1), among the villages, Sa Kha Gyi village is the most cultivated village. The reason is the condition of soil for cultivation of watermelon is well-drained sandy loam with a pH between 5.5 and 7, the medium levels of nitrogen so this soil condition is better than any other villages in Khayan Township. Another reason is the villagers in Sa Khan Gyi village are growing watermelons than any other crops. Other villages of watermelon cultivation in Khayan township needed to expand and raise the cultivation and production of watermelon to get more benefit. Most increased in watermelon production required improved technology and cultivation system.

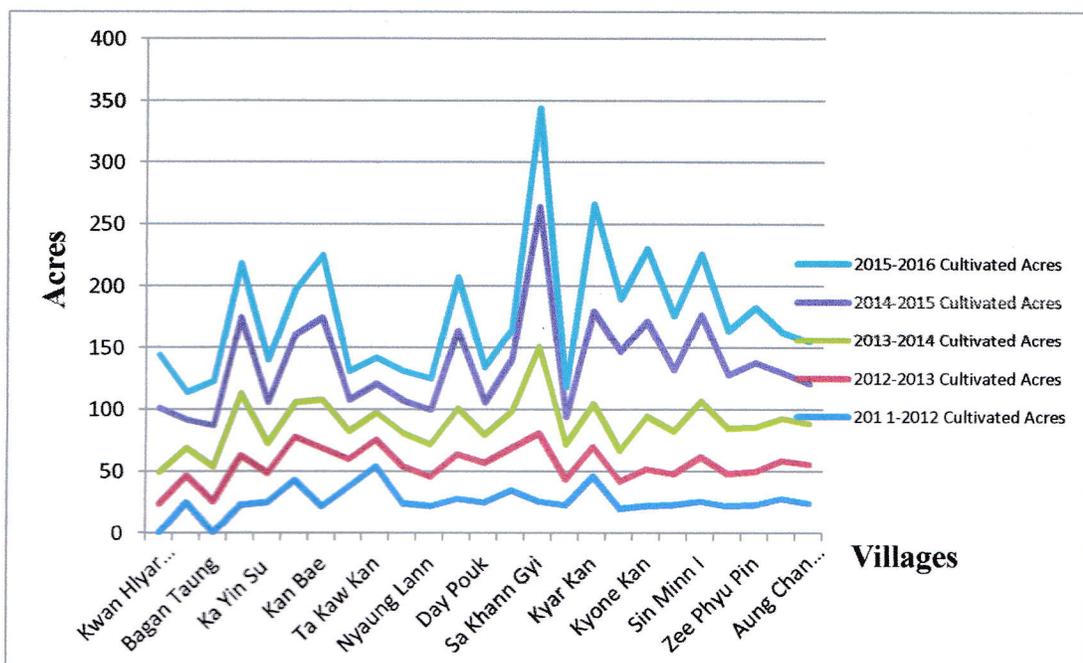
Table 3.1 Cultivated Areas in Khayan Township

No.	Name of Village	201 1-2012 Cultivated Acres	2012-2013 Cultivated Acres	2013-2014 Cultivated Acres	2014-2015 Cultivated Acres	2015-2016 Cultivated Acres
1	Kwan Hlyar Shay	25	24	26	51	43
2	Naung Pin Kwin	23	22	22	23	22
3	Bagan Taung	25	26	28	33	36
4	Pan Taw Chuang	43	40	50	62	43
5	Ka Yin Su	22	24	24	33	34
6	Hta Yan Kan	38	35	28	55	36
7	Kan Bae	54	47	39	67	50
8	Pa Lu Kan	24	22	23	25	23
9	Ta Kaw Kan	22	22	22	23	21
10	Kyee Ni Chaung	28	30	27	26	24
11	Nyaung Lann	25	24	26	28	25
12	Phayarr Pyo	35	36	37	63	43
13	Day Pouk	26	32	23	26	28
14	Kan Thar	23	34	30	42	24

No.	Name of Village	201 1-2012 Cultivated Acres	2012-2013 Cultivated Acres	2013-2014 Cultivated Acres	2014-2015 Cultivated Acres	2015-2016 Cultivated Acres
15	Sa Khann Gyi	46	55	70	113	80
16	Pyinn Ma Kone	20	21	28	22	24
17	Kyar Kan	22	24	35	75	86
18	Nyaung Pin Thar	23	22	25	80	43
19	Kyone Kan	26	30	43	77	58
20	Own Pin	22	25	35	49	44
21	Sin Minn I	23	36	45	70	49
22	Kin Mun Chone	28	26	37	43	36
23	Zee Phyu Pin	24	27	36	52	45
24	Pa Lu Pin	20	31	34	37	33
25	Aung Chan Thar	21	32	33	32	34
	Total	688	747	826	1207	984

Source: Department of Agriculture in Khayan Township

Figure 3.1 Cultivated Areas in Khayan Township



Source: Table (3.1)

3.3 Production of Watermelon

Watermelon production has kept increasing in recent years in Khayan Township from 688 acres of watermelon cultivated area in Khayan Township during 2011-2012 and there became 984 acres of watermelon cultivated area in total during 2015-2016 in table (3.3). The year 2014-2015 was the year with most numerous cultivation areas with a total of 1207 acres during 2011 to 2016.

The top five producing villages are Sa Khan Gyi village, Kyar Kan, Kan Bae, Pan Taww Chaung and Sin Min I village. In 2016, Sa Khan Gyi village accounted for 9 percent of Khayan’s watermelon production.

In table (3.3) when observing the cultivation and production of watermelon in Khayan Township, Sa Khan Gyi village is the first most watermelon cultivated village. There was 688 acres of watermelon cultivated area in Khayan Township during 2011-2012 and there became 984 acres of watermelon cultivated area in total during 2015-2016. The year 2014-2015 was the year with most numerous cultivation areas with a total of 1207 acres during 2011 to 2016.

In table(3.2), the watermelon yield of Khayan Township was 1230 number per acres during 2011-2012 and net yield was 846,240 numbers. During 2012-2013, watermelon cultivated areas increased to 747 acres and net yield increased to

1,083,150 in numbers. The net yield of watermelons increased to 1,131,620 in numbers during 2013-2014 and the cultivated acres also increased to 826 acres. The cultivated acres and yield a little increased during 2013-2014, because of the wrong harvest time to get qualified watermelon as well as there was an increase in demand. During 2014-2015 the cultivated acres of watermelon was increased to 1207 acres, and the yield also increased to 1,701,870 in numbers to set a record. This is because the price of Chinese was increased in 2014-2015. As China is the country to which the watermelon is mainly exported, the farmer who cultivate watermelons gain many advantages due to the rise of Chinese Yuan's price and cultivated acres and the net yield also increased.

The cultivated acres was decreased compared to the previous acres, to become 984 acres and also the yield was decreased by one fourth of the previous yield, to become 1,279,200 in numbers during 2015-2016 watermelon cultivation season. The yield per acre and the yield of watermelons are concerned with the quality of watermelons and the climate. The yield also can decrease if it is not cultivated systematically. It is observed that there was not apparent decrease as 1230 in number of watermelons per acres in average was produced during 2011-2012 and 1300 in numbers of watermelons per acres in average was produced 2015-2016.

One of the principle factors responsible for the increased production of watermelon is the need to use land. Watermelon can be planted at the beginning of the winter season, not requiring additional artificial irrigation facilities in the absence of rain. This makes their cultivation cost effective. Their shorter growing period from planation to harvest is another plus.

Most watermelons are available from October through April in Khayan Township with November through January being the peak production period. Exported watermelons are usually available from November until April with peak export months.

Watermelon production in Khayan Township is concentrated mainly in the North and East area. Annual production in each village fluctuates from year to year, depending on harvested area, supply and demand. Sa Khan Gyi village's watermelons producers are the leading suppliers of watermelon in Khayan Township. However, the average price get for Sa Khan Gyi's watermelons are not the highest one compared to the others. Because growing season for this village is early so they get the higher early price season price. But around the middle of the season, the largest price drops usually

occurs because watermelons grown in other villages begin to ripe and which will bring the price down rapidly for Sa Kha Gyi's watermelons.

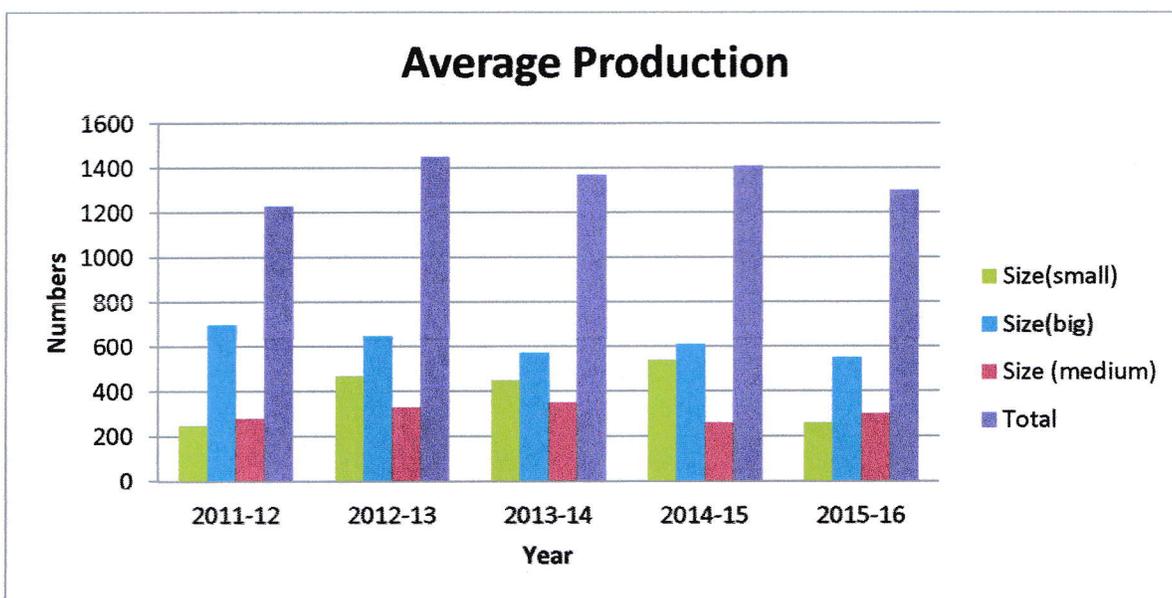
The local characteristics of Khayan Township such as location, topography, climate, soil, market condition and transportation condition are supporting to the cultivation and production of watermelon. Besides, there is the right to cultivate, produce and trading of watermelon freely, so the watermelon cultivated farmers will gain more advantages. During 2015-2016, there was 984 acres of cultivated land and appropriations should be earmarked in order to expand the cultivated acres in the upcoming years. By expanding the cultivate acres, watermelon can be exported more and foreign income will be got more, there will be more occupations for watermelon growers and the living standards of growers will rise so the income and business would be prosperous by improving the production and cultivated areas.

Table 3.2 Average Production of Watermelon per Acre

Year	Size(big)	Size (medium)	Size(small)	Total
2011-12	700	280	250	1230
2012-13	650	330	470	1450
2013-14	570	350	450	1370
2014-15	610	260	540	1410
2015-16	550	300	260	1300

Source: Agriculture Department in Khayan Township

Figure 3.2 Average Production of Watermelon per Acre



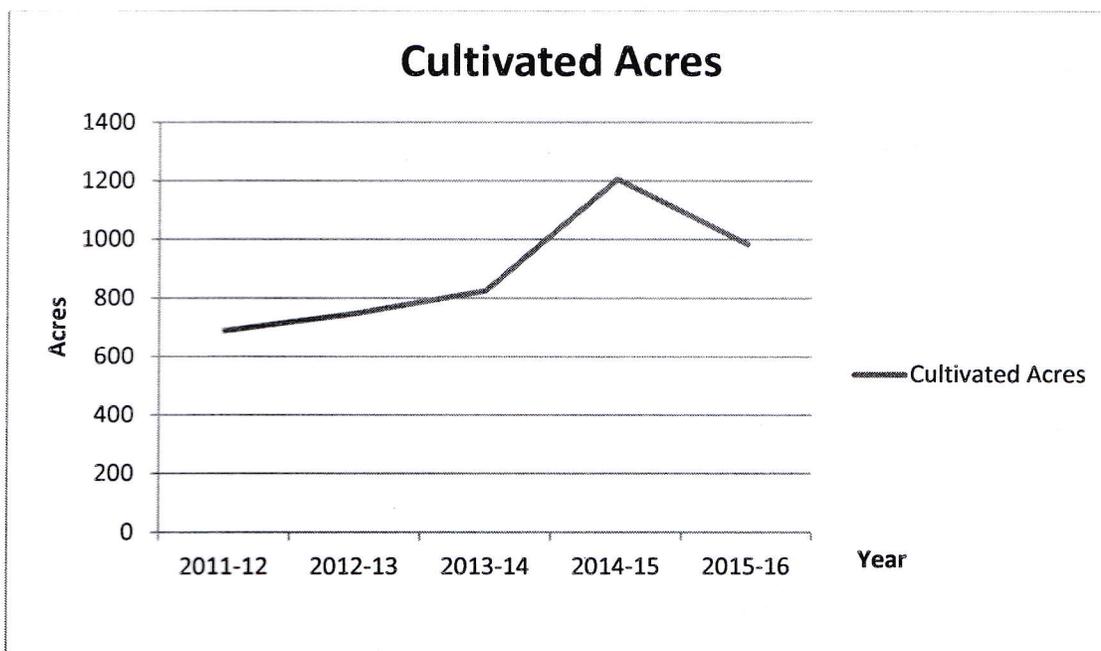
Source: Table (3.2)

Table 3.3 Production of Watermelon and the Net Yield in Khayan Township

Years	Cultivated Acres	Yield per Acre(no)	Total Net Yield (no)
2011-12	688	1230	846240
2012-13	747	1450	1083150
2013-14	826	1370	1131620
2014-15	1207	1410	1701870
2015-16	984	1300	1279200

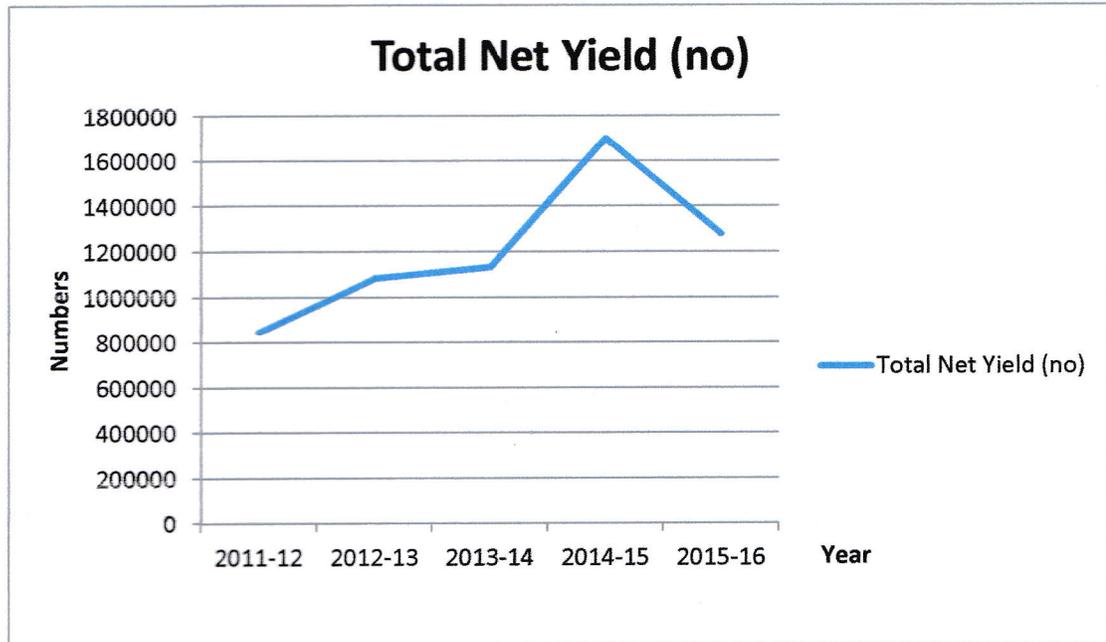
Source: Department of Agriculture Department in Khayan Township.

Figure 3.3 Cultivated Acres of Watermelon in Khayan Township



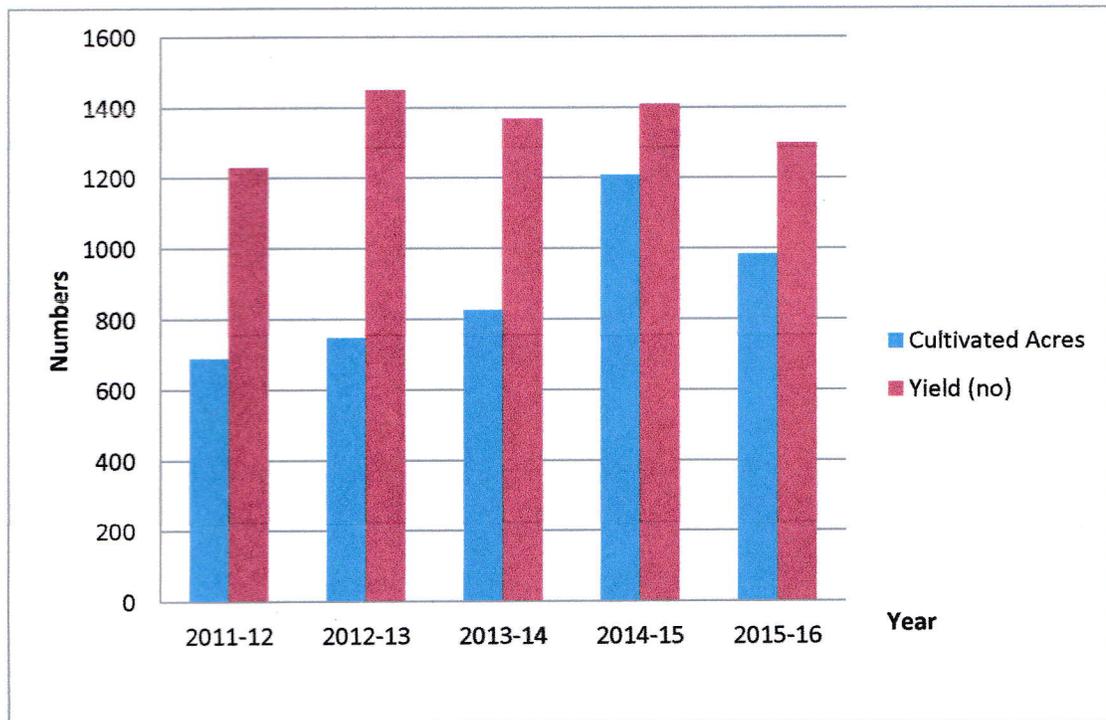
Source: Table (3.3)

Figure 3.4 Production of Watermelons in Khayan Township.



Source: Table (3.3)

Figure 3.5 Production of Watermelon and Net Yield in Khayan Township



Source: Table (3.3)

3.4 Befall-able Diseases and Condition of Utilizing Pesticides.

The major diseases which have potential to befall in cultivating watermelon are

- Daung Hnee Fungi Disease
- Pin Nyoe Pin Thay Disease (plant withers and dies)

When cultivating watermelon, the danger of other pests which have potential to befall are also necessary to take notice. Not to befall the pests such as flea, plant louse, cricket and Phoe Lamin locust, and when the pests befall, it is especially necessary to destroy them with effective pesticides.

The preventive medicine for pests should be spread once in 5-7 days, depending on the danger of befallen pests from the stage of seedling until 14 days before harvest. When spreading preventive medicine, it should be spread only in the morning and evening time. Spreading the preventive medicine in the hot afternoon time should be avoided.

In order to prevent and destroy flea, plant louse, Buu Phayone, yellow locust, and red spider-tick, the mixture obtained from

- Either by mixing 30% of iodine, EC 30 cc with 2 gallons of water
- Or by mixing 40% of Dyacenen, EC 30 cc with 2 gallons of water

could be used to spread the plants.

The befall-able diseases such as Mhae Phyouk Suun Disease, Daung Nhee Mho Ywat Chouk Disease and Pin Si Chouk Disease are befallen, the mixture obtained by mixing 75% wp of Labelite, 75% wp of Deconay, 25-30 gram of Ridomale(MZ) fungicide and 2 gallons of water should be spread.

If Pin Nyoe Disease is befallen, 80% wp of Homone mixture powder 5 grams is mixed with 1 kilogram of seeds and can be prevented the disease by nurturing. If plant louse and flea are not destroyed, other viral diseases can be befallen. The leaves which are suffered by the disease droop and curl inward and become small. The joints are short and the forms of fruits are not right and shrink. The inside layer of the fruit is not soft but rough. Those virus infected plants should be plucked and destroyed by burning with fire. After handling the infected plants, the tools and materials which have been used must be immersed in 5% of Sodium Hypochlorite juice before use.

CHAPTER 4

Watermelon Market in Khayan Township

4.1 Distribution Channel of Watermelon

Watermelons obtained from cultivation inside Khayan Township are not only used for consumption in local but also exported to foreign neighboring countries for getting foreign income. Watermelons which are produced from regions among Myanmar including Khayan Township were exported to borderland of Myanmar, Musal market by farmers. Watermelon cultivated farmers in Khayan Township mostly cultivate watermelon species such as seedless (small) and (big).

Distribution of watermelon produces to consumers can be undertaken in two ways; indirectly or directly. Selling watermelon directly provides farmers with the opportunity to explore the more benefit. Watermelon products are different from other agricultural products. They comprise many small plots in many production areas around the township and are often located in areas distant from their main markets. Price normally depends on volume and the quality of watermelon.

Watermelon from different growing areas is sold through wholesalers, distributors and retailers. Another is by selling to the individual buyer get the benefit that includes reduced transportation costs and increase sales and profit.

In Khan Township, there is a direct distribution by watermelon's growers to the consumers. One of the main advantages of direct distribution to consumers is the opportunity to reduce distribution costs and to add value to the watermelon. In this way, the profit is increased.

Another distribution way is farm stall sales. This form of distribution has the advantages for watermelon's growers. Because customers can harvest watermelons on their own so the growers do not need to harvest. It also reduces the transportation costs. The result is lower prices and more attract to the consumers.

The main performers in the distribution channel are brokers, traders, agents from foreign companies, etc. The distribution channel of watermelon cultivated farmers in Khayan Township is as follow.

Labor, equipment and materials costs are the major costs of handling and transporting watermelons from the field to the market. Handling consists of six steps:

harvest, field truck unloading, loading of the over-the –road trailer, transportation from growing areas to the market.

The watermelon buying centers in Khayan Township buy the good quality watermelons from watermelon cultivated villages in Khayan Township and trade by connecting not only with the various states and divisions in Myanmar but also with the traders in Musal Trade Zone. An important distribution channel for watermelons which are produced from Kha Yan Township is China Musal market

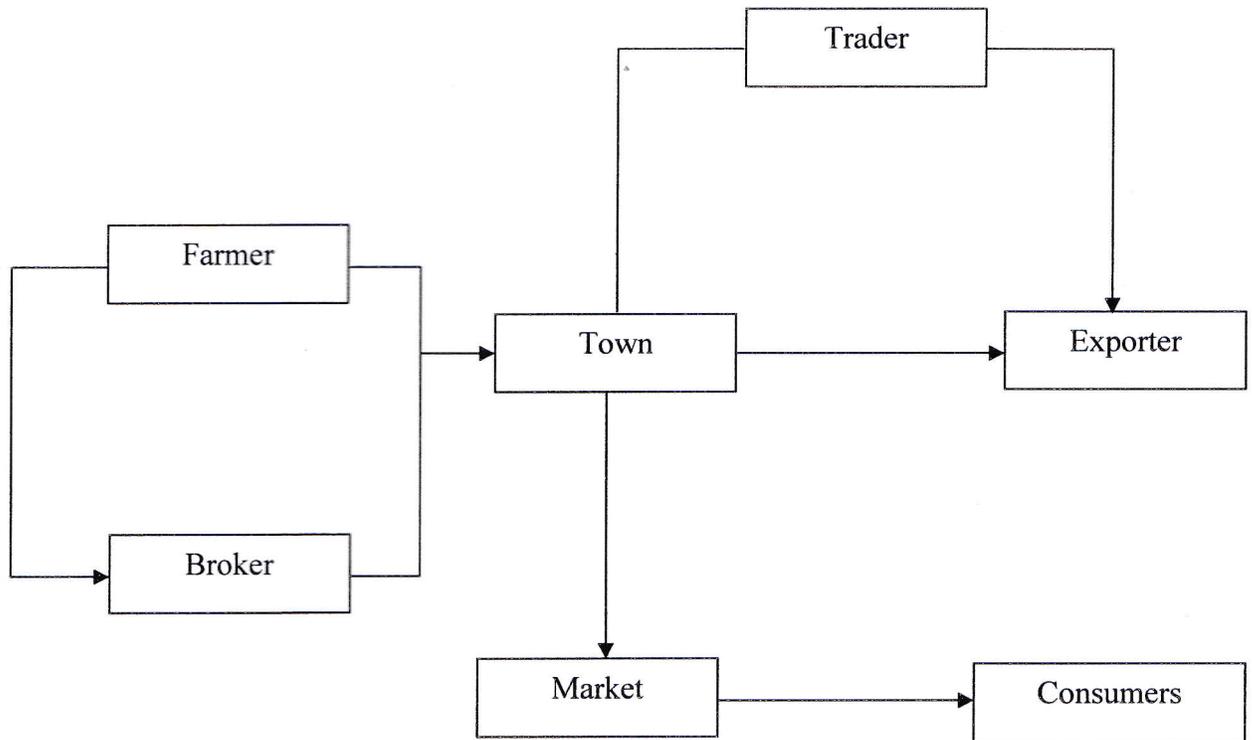
The yield of watermelons from Khayan Township was that there was 1207 acres of cultivated acres in 2014-2015 and the net yield of watermelon for that year is 1701870 in numbers. The amount of yield from Khayan Township in 2014-2015 was included as about one-fifth of the foreign exported amount.

The amount of produced watermelon from Khayan Township during 2014-2015 was the most numerous in cultivation, production and foreign export. Most watermelon cultivated farmers try to produce good quality watermelon to be able to export to foreign market. Watermelon cultivated farmers in Khayan Township export 855 (big) which is the one with seeds and seedless to export so that foreign income can be obtained.

Most of the watermelons obtained by cultivation in Khayan Township were exported to foreign countries and only a little is distributed for local consumption.

Watermelons which are produced from Myanmar are cultivated not only for local consumption but also for foreign export. Because of the global warming, consumption of health-support fruits like watermelon will always be existed. Therefore, watermelon market will always improving in local and foreign so Myanmar will gain many advantages and profits by expanding and cultivating watermelons. Figure (4.1) shows the marketing channel of watermelon in Khayan township.

Figure (4.1) Marketing Channel of Watermelon



Source: Survey Data

4.2 Seasonal Changes of Watermelon Market in Khayan Township

Since watermelon is perishable commodity, they are hard to store and carry into producing months. Most of the watermelons are sold to the export market. Due to domestic production, the demand on watermelon is highly seasonal as well.

Domestic production of watermelon is highly seasonal like other fruits. The marketing season for Myanmar's watermelons starts in October and ends in April. In table(4.1), the prices of watermelon change according to the season. These prices are analyzed by surveying during 2015-2016. The growers usually receive the strongest prices during the first two months of the seasonal, which means from November to early January. This is because as the demand from China has increased, so the supply from market is increased and the price is higher too.

The reason why the prices fall in the early harvest, October is selling more poor quality of the watermelons, export buyers purchasing the watermelons at a cut price, falling price at the China Musal's market. The price fell down because of the

low quality watermelons since these watermelons are grown and harvesting during the rainy season.

In November and December, more demand from China's market, purchasing at a higher price, less watermelons in the China market and buying more watermelons led to the highest prices rising.

March and April got the lowest prices because there is no demand from China market, less consumption of watermelons, still having leftover watermelons, less purchasing of the foreign buyer. As a result, price decreased from February to April and this month is off-season of the watermelon production. In Khayan Township, watermelons can be marketed through a variety of outlets, which are roadside stands, farmers' market and local markets.

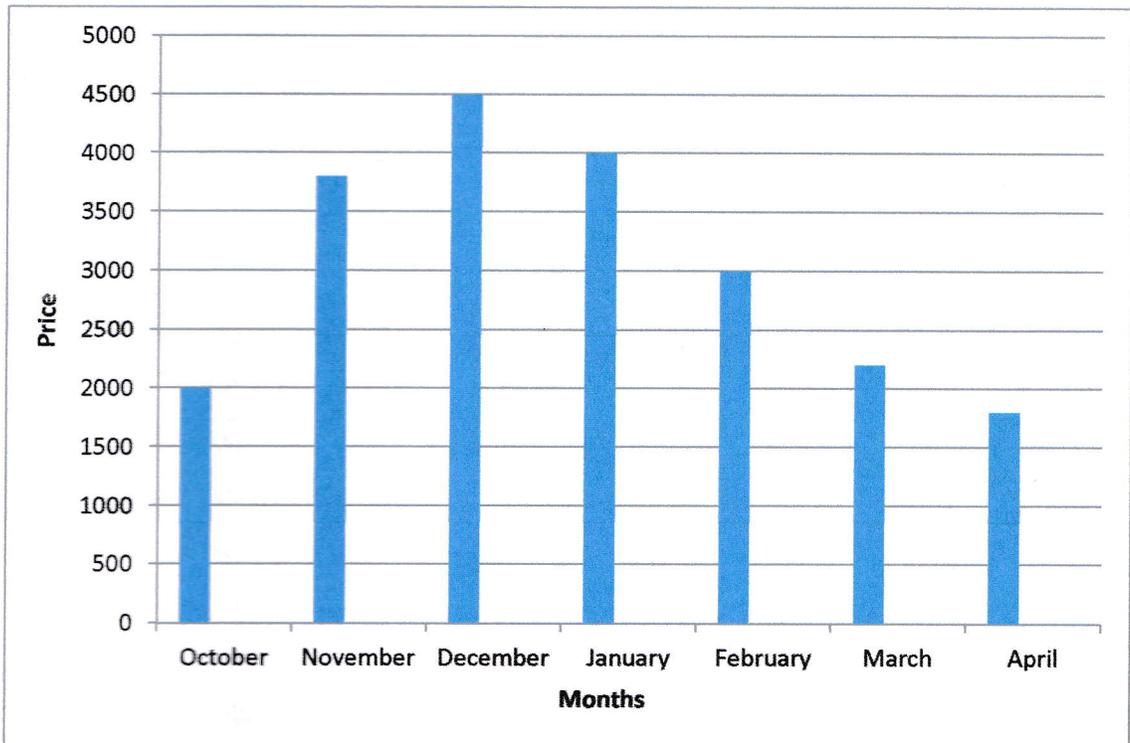
If compared with the price changes of watermelons at the beginning and end of the watermelon season, it can be found that the price of watermelon in October and April became less than that of December.

Table (4.1) Price Changes according to Seasons

Watermelon in and off-season	Price per Number(kyats)
October	2000
November	3800
December	4500
January	4000
February	3000
March	2200
April	1800

Source: Survey Data in Khayan Township

Figure (4.2) Price Changes according to Seasons



Source: Table(4.1)

4.3 Average Cost per Acre and Return in Cultivating Watermelon

The cost per acres in agricultural differs according to the time and location. The cost of the different years cannot be the same because of the changes of inputs which are used in cultivating watermelon.

By saying cost per acre, it means the cost of maintaining soil, the cost of maintaining cultivated land, the cost per acre in cultivating watermelon, the cost of utilizing tractor is included in the cost of maintaining soil are shown in table (4.2). The cost of maintain the boundary firstly and the cost of maintaining cultivated land. In sowing, the cost of sowing-bags and the cost of adding seeds are included in sowing. And the costs for carrying, setting and positioning in soil of the seedling are also included. The cost for taking care of the plant and the cost for inputs such as seeds, posts and plastic bags are included. The average cost per acre in cultivating watermelon is generally about 1288900 kyats. The income which is returned by cultivating watermelon per acre is about 3000000 kyats per acre.

Table 4.2 Average Cost per Acre in Cultivating Watermelon

No	Process of Watermelon Cultivation	Counts	Number	Costs per unit (kyats)	Costs (kyats)
1.	Soil Reforming -tractor	machine	2	20000	40000
2.	Paneling -first time paneling -second time paneling	person person	20 40	1500 1500	30000 60000
3.	Cultivation -the cost of sowing-bags -the cost of seedlings-bags -the cost of watering	person person person	2 2 2	3000 3000 3000	6000 6000 6000
4.	Cultivation -carrying the plants -sowing the plants -watering the plants	person Person person	10 5 3	6000 3000 7000	30000 15000 21000
5.	Treating the plants -eliminating low-quality plants -doing hoe -drifting the fruit tonic -feeding the soil	times person times times	3 10 7 3	107000 3000 6000 4000	107000 30000 42000 12000
6.	Inputs -seedlings -plastic-bags -soil -Urea -Gypsum -Fruit tonic -transporting the watermelon -Compound (15;15;15)	pack pack pack bag bag times times bag	4 4 8 8 2 1 850 15	12000 350 1500 20000 22000 10000 100 40000	48000 1400 12000 160000 44000 10000 8500 600000
	Total				1288900

Source: Survey Data in Khayan Township

When calculating the cost of production in cultivating watermelon, the cost in 2016 which have been observed by going on field study are utilized. When calculating income per acre, the seasonal price of watermelon in 2016 is taken as average and used. The reason of calculating so is to be fair by judging that the trade time of farmers cannot be the same.

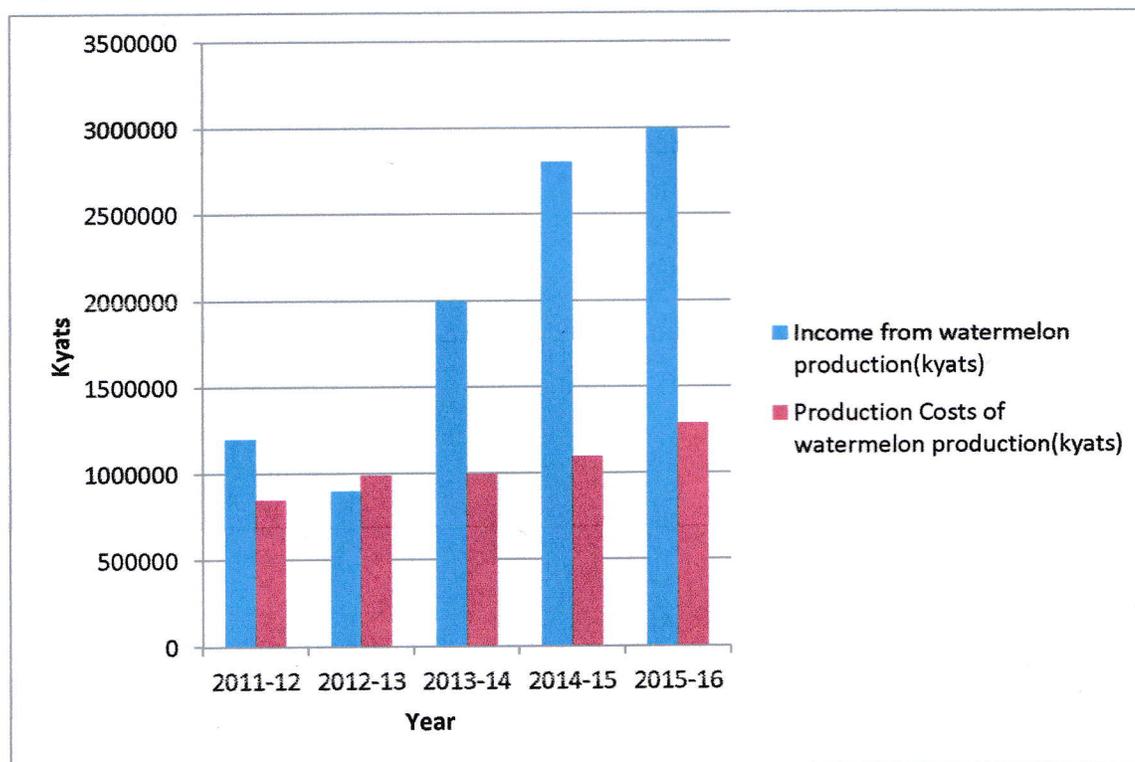
In table (4.3), the income and production costs of watermelons per acre are reported from the year 2011 to 2016. According to this table, the income got from watermelon's production increased year to year can be said. But in the year 2012-2013, the production costs are higher than income. This is because the prices of fruit tonic are raised. So there are many low quality watermelon plants and thus there are too many costs in eliminating these low quality plants. In that year, watermelons growers got the loss compared with the other year.

Table (4.3) Income and Production Costs of Watermelon per Acre

Year	Income from watermelon production(kyats)	Production Costs of watermelon production(kyats)
2011-12	1200000	850000
2012-13	900000	990000
2013-14	2000000	1000000
2014-15	2800000	1100000
2015-16	3000000	1290000

Source: Survey Data in Khayan Township

Figure (4.3) Income and Production Costs of Watermelon Production



Source: Table (4.3)

4.4 Price of Watermelon

The prices for all watermelons are reported yearly from 2011 to 2016. The price of watermelon varies through years. The price of watermelons has average 3250 kyats per number and it ranges from a low of 2500 kyats to a high of 6000 kyats per number. Other competing watermelons including the yellow watermelon, white watermelon, striped watermelon have their prices reported in this data set as well. The yellow watermelons averaged 4000 kyats per number, which is higher than watermelon prices. The average price of white watermelons is 3500 kyats and striped watermelon is about 3000 kyats.

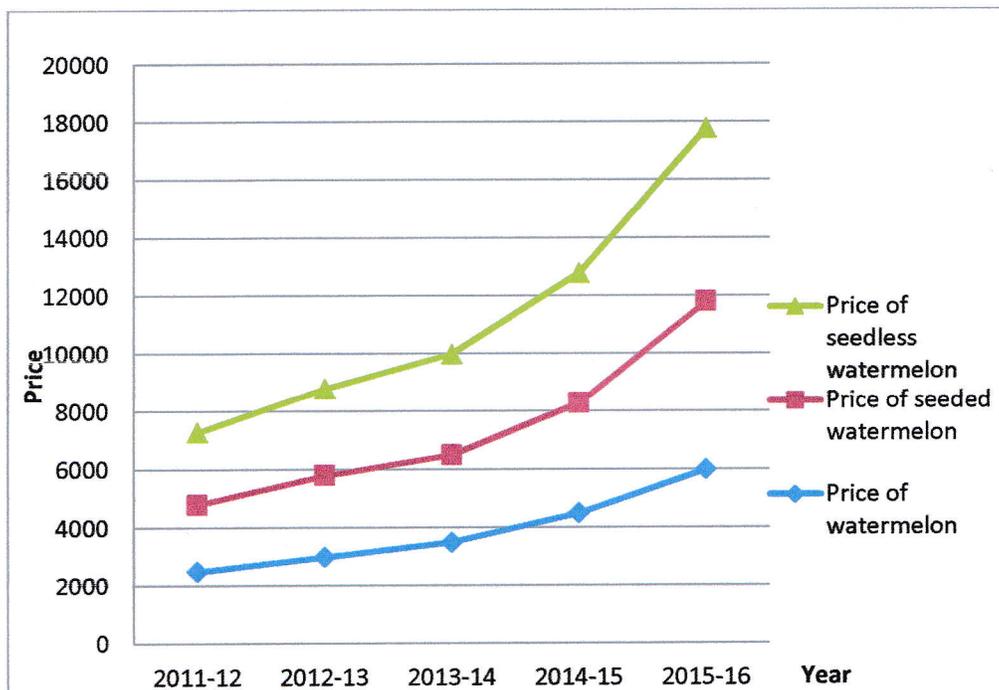
Two things need to be mentioned from table (4.4). First all watermelons have strong seasonal pattern. Watermelons prices are lower in-season and reach the lowest price around July; watermelons prices are higher in off-season and reach the highest prices around December. All these watermelons follow the same seasonal patterns. The prices of watermelon are increasing year by year. This is because as the demand from China increased, the demand also increased so there was more profit and it was possible to export more.

Table (4.4) Price of Watermelon (total, seeded, seedless)

Year	Price of watermelon	Price of seeded watermelon	Price of seedless watermelon
2011-12	2500	2300	2500
2012-13	3000	2800	3000
2013-14	3500	3000	3500
2014-15	4500	3800	4500
2015-16	6000	5800	6000
Average	3900	3540	3900

Source: Survey Data in Khayan Township

Figure (4.4) Price of Watermelon (total, seeded, seedless)



Source: Table (4.4)

4.5 Benefit from Watermelon Cultivation

The watermelon cultivated farmers in Khayan Township have been cultivating watermelon since 10 years ago. From relying on the local market as the seasonal fruit unit starting to export to borderland, their business condition has begun to develop more.

There are 53 village groups in Khayan Township and there are about 10 thousand acres of cultivated area. Most of the villages emphasize on agriculture and they cultivate Pe Te Sein and watermelon mainly for the winter seasonal fruit because of the difficulties of agricultural water.

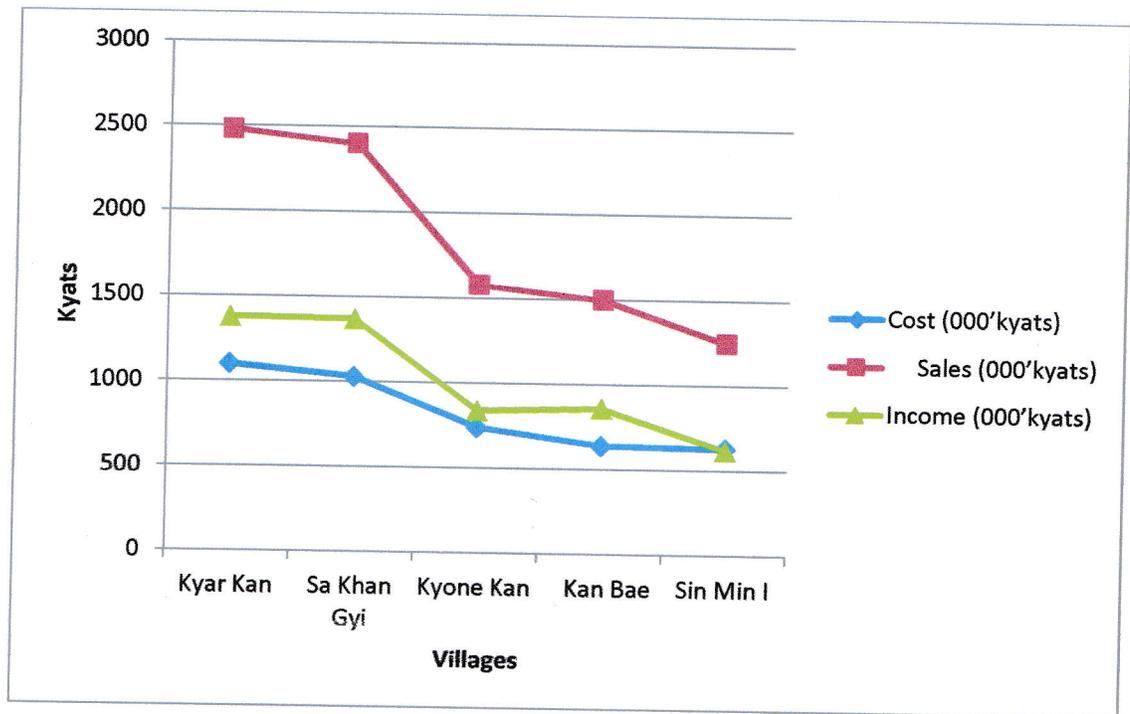
Table (4.5) Income and Expenditure of Watermelon Cultivation in Khayan Township

Name of Villages	Cultivated Acres	Cost ('000kyats)	Sales ('000kyats)	Income ('000kyats)	Increase/Decrease
Kyar Kan	86	1100	2480	1380	+
Sa Khan Gyi	80	1030	2400	1370	+
Kyone Kan	58	740	1580	840	+
Kan Bae	50	640	1500	860	+
Sin Min I	49	630	1250	620	+
Total	323	4140	9210	5070	+

Source: Survey Data in Khayan Township

In above table (4.5), the cost and income from cultivation of the 5 most watermelon cultivated villages in Kahyan Township during 2016 were analyzed by surveying. Among the village, Kyar Kan possesses the largest amount of cultivated acres and the cost is also the largest and get the benefit most. The living standards of watermelons growers in Khayan Township are raised. The second largest in cultivated acres is Sa Khan Gyi village. The income is also the second largest so the benefit gets from watermelon cultivation and differ according to the different incomes and production cost.

Figure (4.5) Income and Expenditure of Watermelon Cultivation in Khayan Township



Source: Table (4.5)

CHAPTER 5

Conclusion

5.1 Findings

Agriculture is a major source of livelihood for people in Khayan Township. There are many subject matter observed in studying the cultivation, production and distribution of watermelon in Khayan Township. Khayan Township is the township with most numerous amount of watermelon cultivation in lower Myanmar. The watermelon cultivation in Khayan Township is found to be not only for local consumption but also for getting foreign income by exporting.

Watermelons have become popular agriculture product in fruit sector for domestic consumption and for foreign export item. So, most of the farmers become interested in those particular watermelons due to the better advantages of production profit. They can be easily grown and get the profit. Khayan Township occupies favourable climate for growing watermelons. Watermelons have a great demand for export potential. Production of watermelons is dramatically increasing due to high demand for local consumption and export. Out of varieties of watermelons, 855, Seedless watermelons, yellow watermelons, sweet red watermelons and white watermelons are major varieties in production.

Between 2011 and 2016, sown area of watermelons had risen from 688 acres to 984 acres. For increasing sown area, total production of watermelons was 846240 in 2011-2012 which rose to 1279200 in 2015-2016. As living standards of watermelons growers raised, changing fruit consumption pattern had created more demand for watermelons. Improvement in production of watermelons can make many benefits for watermelons growers.

By the analysis of the above conditions, watermelon cultivation is found to be quite little in improvement generally. There was 688 acres of watermelon cultivated area in 2011 and in 2016, the cultivated areas become 984 acres so it can be said increasing in cultivated acres. It is also studied the price for watermelons. According to monthly price of watermelons, it is found that the price is changing according to seasons which are depending on harvest and market condition. During the study period, it was found that the export of watermelon from Khayan Township much depended on the condition of China market.

Although Khayan Township is a township with great yield of watermelon, the quality of produced watermelon is found to have requirements to reach the

international market. As watermelon can be easily traded in local and foreign markets, it is observed that there are many good prospects in future for the watermelon farmers.

5.2 Suggestions

The major difficulties encountered in performing Myanmar's watermelon cultivation are rise of cost, requirements to obtain the good-gene seeds and the need to utilize modern cultivation methods which are needed to increase the yield. To improve the production of watermelons, the cultivated areas must be expanded as well as the new technologies, i.e., the usage of machineries and the method of cultivation. Furthermore, the inputs such as quality watermelons seeds, fruit tonics, pesticides, must be easily got by farmers to increase yield and the production of watermelons.

It is also necessary to increase the production rate and to reduce the costs in order to be able to compete with foreign market. Moreover, to reduce the transportation fee, it is necessary to get a fast and convenient road and communications. Requirement for fruit is very much even in the local. It is also necessary to develop the economical cultivated farmlands to cultivate watermelons which are suitable with climate and topography and are able to be sold in competition in international market due to the market-competing region according to divisions and states among Myanmar. The good quality of watermelons which is able to compete to get to the condition which are able to be exported to foreign countries and international markets should be produced. However, there are still requirements such as investment, skillfulness in technology, transportation to markets, etc. Only when everything is combined and connected together, watermelon cultivation will improve gradually.

Therefore, the government and the public sectors must combine and solve to increase the cultivation and production of watermelon in order to contribute substantially in fruit sector of Myanmar. For marketing efficiency, watermelon must be grown with quality seeds by using agricultural inputs efficiently such as fertilizers, fruit tonics and pesticides with world standard. By expanding the cultivate acres, watermelon can be exported more to export and foreign income will be got more, there will be more occupations for countryside and the living standards of watermelon growers will rise so the income and business would be prosperous by developing the economical watermelon cultivated areas.

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