CASE STUDY ON PROFITABILITY OF SMALL GROUNDNUT OIL MILLS IN MYINGYAN TOWNSHIP, MANDALAY REGION

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CASE STUDY ON PROFITABILITY OF SMALL GROUNDNUT OIL MILLS IN MYINGYAN TOWNSHIP, MANDALAY REGION

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A Thesis Submitted to the Post-Graduate Committee of the Yezin Agricultural University as a Partial Fulfillment of the Requirements for the Degree of Master of Agricultural Science (Agricultural Economics)

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DECLARATION OF ORIGINALITY

This thesis represents the original work of the author, except where otherwise stated; it has not been submitted previously for a degree or any other University.

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DEDICATED TO MY PARENTS,

U WIN MAUNG AND DAW KHIN OHN YI

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ABSTRACT

This study was mainly focused on the current situation, profitability and its influencing factors on profit of small groundnut oil mills in Myingyan Township. The pilot survey was conducted in December 2014 and then the main survey was done in March 2015. In the study area, selected mills had a raw material processing capacity of approximately 1306 kg per day. But in average, they processed raw material only 172 kg/day in 2014. Raw material (groundnut) price was more or less similar during January to June in 2014. After June, groundnut price was increased due to increase in export price of groundnut to China. Considering the cost of oil milling, there were major three items: fixed investment, raw material and processing costs. Fixed investment cost occupied only about 1.59% of the total cost and the highest amount among fixed investment costs was interest for working capital. Processing cost was only about 1.92% of the total costs and the major contribution of processing cost was labor cost. Among these three items, raw material cost was the highest proportion of the total costs (96.49%). The amount of oil production depends on the method used in oil extraction and the quality of raw material. In the study area, the extraction rate of groundnut was about 40% of oil and 55% of cake. Regarding profitability analysis, Mill-II had the highest benefit cost ratio (BCR) over all costs (1.05) and Mill-IV the lowest (1.00). BCR over variable costs was about 1.07 in Mill-II and 1.02 in Mill-IV. According to the profit function, oil processing profit was positively and significantly influenced by raw material amount, oil price at 1% level and cake price at 5% level. Based on the nature of input price, groundnut price was negatively and significantly influenced on profit at 1% level.

In this study, the capacity of edible oil mills was underutilized. The business environment seems to be not so attractive to use full capacity. Edible oil market was unfavorable for the domestic oil mills because of imported palm oil with low price, exporting groundnut with high price, and inaccessible purity of groundnut oil for consumers. Groundnut oil was mixed up with different cheaper oil, and the majority of consumers were not affordable to differentiate between purity and mixture of groundnut oil. To be attractive business environment of oil mills, public education program for oil consumption is importantly needed. The consumer protection law and FDA law are needed to be reinforced for edible oil market and the public support of SME sector especially for edible oil mills is also critically important.

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LIST OF ABBREVIATIONS

BCR	Benefit-Cost Ratio
BDS	Business Development Services
°C	Degree Celsius
DoA	Department of Agriculture
FAO	Food and Agriculture Organization
FTAs	Free Trade Agreements
GDP	Gross Domestic Product
hp	Horse Power
IFC	International Finance Corporation
kg	Kilogram
M^2	Square Meter
mm	Mille Meter
MMK	Myanmar Kyat
MOAI	Ministry of Agriculture and Irrigation
MOFA	Ministry of Foreign Affairs
MOI	Ministry of Industry
MOC	Ministry of Co-operatives
MT	Metric Ton
No.	Number
R^2	Coefficient of Determination
SDC	Small and Medium Enterprise Development Central Committee
Sig.	Significant Level
SMEs	Small and Medium Enterprises
SMIDB	Small and Medium Industrial Development Bank
UN-DESA	United Nations Department of Economic and Social Affairs
UNIDO	United Nations Industrial Development Organization
USDA	United States Department of Agriculture
YAU	Yezin Agricultural University

LIST OF CONVERSION FACTORS

1 basket of groundnut without shell	=	15 viss
1 viss	=	1.67 kilograms
1 can of groundnut oil	=	115 viss
1 ton	=	1000 kilograms
1 hectare	=	2.471 acres

CHAPTER I

INTRODUCTION

1.1 Background of the Study

Oilseed crops play a vital role accordingly to Myanmar high consumption of edible oil compared to other neighbouring countries. Edible oil in Myanmar is considered as the second most important food item after rice (Favre & Myint 2009). In Myanmar, major oilseed crops include groundnut, sesame, sunflower, rapeseed and niger. These crops cover around 20% of the agricultural land. Sesame seed and groundnut rank as the third and fourth crop in sown acre among cultivated crops. Myanmar is specialized in sesame production having 17% in area of the world production. It is far above the 2.5% share of Myanmar in world's agriculture land. In addition, the yield of sesame is also above world average. In the world, Myanmar ranks at the first position for sesame seed production, six for its groundnut and third for its mustard seed production. Sunflowers, cottonseeds and soya beans rank also in the top 20 of the sown area in Myanmar, but have a small to a negligible share in the world acreage (Wijnands et al. 2014).

Oilseed crops particularly groundnut, sesame, sunflower, soybean, etc. are processed and used as snack (40%) and edible oil (60%) in domestic markets (Tun 2013). Myanmar is a rather small producer of edible oil in the world: its share is 0.5%. According to the FAO statistics, it has no production in palm oil and rapeseed and a negligible production of soya bean oil. Palm, soya and rapeseed oil are the top three world's largest edible oil sources. However, Myanmar is the largest producer of sesame oil, almost 27% of the world production. Second is China with 18%. For groundnut oil, Myanmar's share in world production is 4.5%, which makes it the fourth producer in the world after China (38%), India (24%) and Nigeria (14%) (Wijnands et al. 2014).

Among oilseed crops, groundnut is economically important for Myanmar edible oil market. It has been grown both in rain-fed and irrigated areas. Eighty-five percent of groundnut is grown in Sagaing, Mandalay and Magway Regions. Myanmar is not self-sufficient in edible oil and around one third was imported mainly as palm oil and is importing up to now. Myanmar is a net importer in edible oil. In 2000, the self-sufficiency was 57%, increasing to 68% in 2011 and the highest in 2010 at 72% (Wijnands et al. 2014). The total domestic supply doubled in that period. The quantity of edible oil used for food consumption grew, but less strongly than for other utilizations.

1.2 Domestic Edible Oil Production and Palm Oil Import in Myanmar

The main domestic supplied oil in Myanmar is oil from groundnut, sesame seed, sunflower seed, mustard and niger. However, the main import of palm oil counts for the largest share in the total domestic supply. Domestic edible oil production and palm oil import from 2010-2011 to 2014-2015 are shown in Table 1.1. Demand for edible oil has consistently been moving up due to increase in consumption, which is in turn caused by the increasing population as well as increase in disposable income in developing economies (Mandefro et al 2011). Myanmar people consumed on average between 10 and 15 kilograms per year of edible oil, which was below the world average of 26 kilograms (Wijnands et al. 2014). Currently Myanmar has a population of 54.42 million people (UN-DESA, September 2016). India is also the largest oilseeds and vegetable oil production country in the world, but equally it was the biggest consumer of vegetable oil too. The current per capita consumption levels of India was at 13.3 kilograms for 2010 that was also under the world average (Azhagaiah and Deepa 2012). The consumption level in Myanmar is also expected to increase in coming years due to an increasing income.

Due to the insufficiency of edible oil production in Myanmar, it is annually imported to fulfill the local demand. To bridge the gap between the demand and supply, cheaper palm oil is imported from neighboring countries mainly from Malaysia. The volume of imported palm oil influences on the domestic edible oil production and its price and also oilseed crops production. Generally, when palm oil supplied to the local market is more than quantity demanded or oversupply situation, prices of edible oil decrease sharply.

1.3 Role and Important of Small and Medium Enterprises (SMEs) in Economy

Promoting and sustaining economic growth is in the interest of every nation. Small and medium-sized enterprises (SMEs) are, in many countries, recognized as the backbone of economic growth, contributing significantly to the GDP through job creation and income generation while alleviating poverty (Abe and Dutta 2014). Promoting the development of SMEs, therefore, should be viewed by governments as an effective mechanism in achieving socioeconomic development.

Small scale industrial development is considered not only as a key factor to lift up the per capita income but also a vital mechanism for a transformation of the economy. The performance of the small-scale industries has a direct impact on the growth of the overall

economy. SMEs are also important to economic growth and significantly essential to generate employment (Harvie and Lee 2005). In Southeast Asia, 70% of new jobs creation are claimed to be coming from SMEs and in addition Harvie and Lee (2005) argue that SMEs contribute to more than half of the labor force within the private sector in the region.

SMEs represent over 95% of private enterprises and account for over 50% of employment in the Asia-Pacific region (Abe and Dutta 2014). Indeed, since the late 1970s, SMEs have become regarded as a key agent for industrialization, particularly in the least developed countries, where the role of SMEs holds even more significance since they represent the best prospect to increase overall employment and value added (Shizuki 2001). Many least developed countries seek to provide employment opportunities for those who live below the poverty line. In this way, SMEs have an important role to play not only in the economic growth of the nation but also in the alleviation of poverty and the strengthening of social safety nets.

The contributions of SMEs to GDP and national employment are significant. According to World Bank (2006), close to 140 million SMEs in 130 countries employed around 65% of the workforce. Another World Bank study (Ayyagari and Beck 2003) also indicated that SMEs contribute to over 65% of total employment and 55% of GDP in high-income countries, over 95% of total employment and about 70% of GDP in middle-income countries and over 70% of total employment and 60% of GDP in low-income countries.

SMEs have unique characteristics: labor intensiveness, niche of market focus, low investment requirements and customer-orientation (Abe and Dutta 2014). For SMEs, the separation of ownership and management is often no-existent and they tend to respond to market needs quickly with a flatter organizational structure and flexible operations that can readily adapt to a rapidly changing environment (Abe and Dutta 2014). The development of an entrepreneurial culture is highly associated with the development of SMEs, as they are formed, nurtured and run by entrepreneurs (Kyaw 2008).

SME growth is often constrained by various factors, such as limited access to information and technological know-how, lack of economy of scale, deficiencies in corporate governance and limitations in access to funds. Government interventions have been required to create enabling environments for SME growth. Such interventions

include transparent licensing and permit procedures, financial provisions, information gathering and sharing, infrastructure (along trading routes and borders) and efficient customs procedures (Abe and Dutta 2014).

1.3.1 SMEs in Myanmar

In Myanmar, there are 43,232 registered enterprises of which small enterprises accounted for 72%; medium enterprises 17 %; and large enterprises 11%. SMEs represent the majority portion of business in the private sector of Myanmar. SMEs account for 96% of the economic sectors in both rural and urban areas. It contributes about 80% of total employment, 80% of the country' GDP, 69% of output and 68% of investment value in the country (MOI 2012). Thus Myanmar economic growth totally depends on the development of SMEs in the private sector. Figure 1.1 shows sectorial distribution of SMEs in Myanmar. In this figure, food and beverages industries have the largest share (about 64%) of total enterprises. In consideration for the development of SMEs in Myanmar, it should be emphasized on development of agro-based industries.

In the case of Myanmar, SMEs are frequently under pressure in the domestic markets from cheaper imports and foreign competition especially from China and Thailand (Kyaw 2013). Myanmar currently lacks a unified SME policy. It is important that any initiative to promote SME development was formed as part of a wider private sector development strategy. An important element to consider in the development of SME-supporting policies is the definition of SMEs. The definition of SME varies from country-to-country; however, the definition in Myanmar is seemingly more complex while only targeting small and medium sized manufactures. This situation is hindering the implementation of policies targeting SMEs. The development of an appropriate SME definition is of critical importance to guiding SME development policies and other supporting measures such as SME financing schemes and training programs. The definition could benefit from being more specific, either by the creation of categories divided by subsectors, as is the case in the Thailand, or by including microenterprises, as in Indonesia and Malaysia. Such considerations would help in the design of more targeted SME support and promotion measures.

The current new definition is based on the 1990 Private Industrial Enterprises Law, 1991 Promotion of Cottage Industries Law and 2011 amending the Promotion of Cottage Industries Law (Table 1.2). In the new definition, SMEs can be classified by four

categories: investment amount, annual production capacity, installed power and number of workers. Small sized manufactures has the investment amount of 1 million MMK, annual production value of 10 million MMK, uses less than 25 hp and employs 10 to 50 workers. Medium sized manufactures has the investment amount of 5 million MMK, annual production value of 10 million MMK, uses less than 50 hp and employs 51 to 100 workers. Large sized manufactures has the investment amount of 10 million MMK, annual production value of more than 10 million MMK, uses over 50 hp and employs over 100 workers.

1.3.2 Edible oil mills in Myanmar

In Myanmar, there were over 3600 expeller mills in operation (FAO 2004). Most mills were owned by the private sector. In Myanmar, still a relative large number of oil millers are active. Favre et al. (2009) indicated that in 2006-2007, the Myanmar Edible Oil Dealers' Association had around 3600 members and has almost 3000 in 2014. The scale is predominately small: 67% is classified as small, less than 10% as large and the other is medium size.

For fulfillment of increasing demand of edible oil in Myanmar, the improvement of domestic edible oil mills will be required. Table 1.3 shows the list of edible oil mills in Sagaing, Mandalay and Magway Regions in 2006. The table presented as large, medium and small size of mills based on the Private Industrial Enterprises Law (1990). Among these three regions, Mandalay Region had the largest number of mills with 21 large mills, 98 medium mills and 672 small mills. Within Mandalay Region, Myingyan Township had the largest total number of large, medium and small mills.

Continuous pressing by means of expellers is as widely applied process for the extraction of oil from oilseeds. This expeller milling technology is widespread throughout the country. The expeller consists of a screw (or worm), rotating inside a cylindrical cage (barrel). The material to be pressed is fed between the screw and the barrel and propelled by the rotating screw in a direction parallel to the axis. The configuration of the screw and its shaft is such that the material is progressively compressed as it moves on, towards the discharge end of the cylinder. The compression effect can be achieved by decreasing the clearance between the screw shaft and the cage or by reducing the length of the screw flight in the direction of the axil movement. The gradually increasing pressure releases the oil which flows out of the press through the slots provided on the periphery of the barrel,

while the press-cake continues to move in the direction of the shaft, towards a discharge gate installed at the other extremity of the machine. Before entering the expeller, the oilseeds must be cleaned, dehulled and dried. The process is relatively simple and not capital-intensive.

Table 1.1 Domestic edible oil production and palm oil import in Myanmar

Year	Domestic oil production ('000 MT)[1]	Palm oil import ('000 MT)[2]
2010-2011	897	470
2011-2012	831	583
2012-2013	818	581
2013-2014	842	789
2014-2015	861	850

Source: 1 = Department of Agriculture (DoA)

2 = United States Department of Agriculture (USDA)

Table 1.2 Categories of SME in Myanmar

Category	Investment Amount	Annual production capacity	Installed power	Number of workers
Small sized manufactures	1 million MMK	10 million MMK	Less than 25 hp	10 to 50
Medium sized manufactures	5 million MMK	10 million MMK	Less than 50 hp	51 to 100
Large sized manufactures	10 million MMK	More than 10 million MMK	Over 50 hp	Over 100

Source: Ministry of Cooperatives (2013)

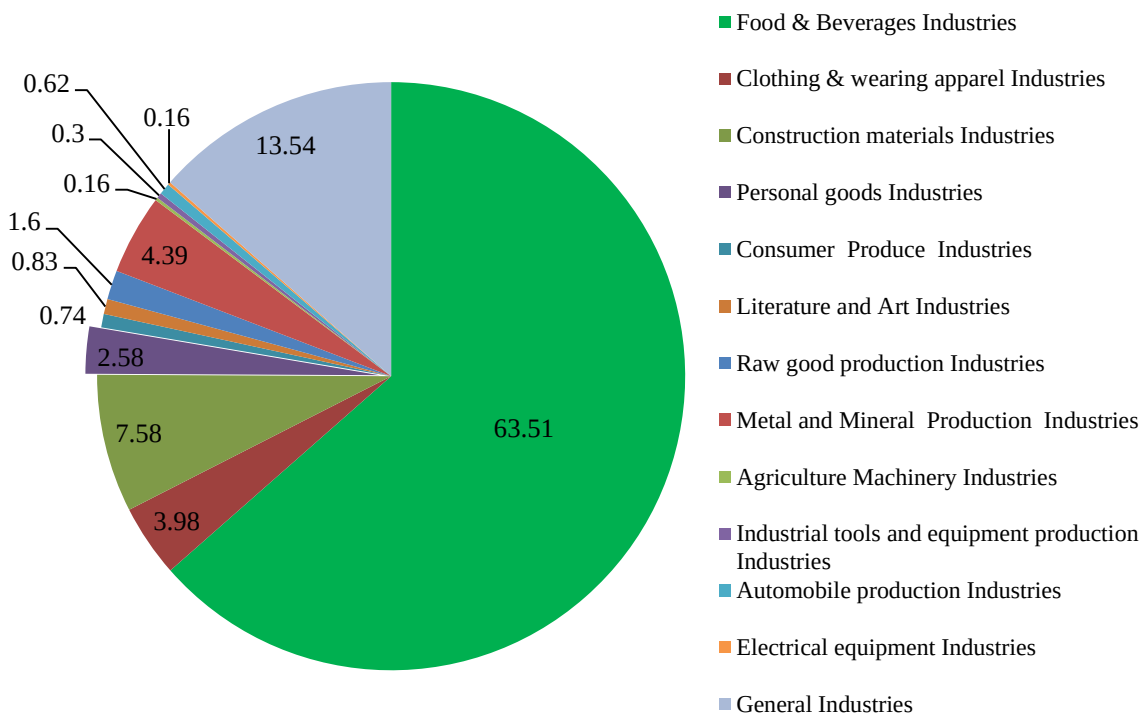


Figure 1.1 Sectorial distributions of SMEs in Myanmar

Source: Central Department of SME Development, MOI 2012

Table 1.3 List of oil crushing mills in Sagaing, Mandalay and Magway Regions

(Unit: Number of Mills)

No.	Location	Size of Mills			Total
		Large	Medium	Small	
1	Sagaing	6	5	101	112
2	Monywa	6	23	153	182
3	Shwebo	4	31	81	116
4	Katha	-	9	90	99
5	Kalay	1	7	67	75
6	Tamu	-	-	5	5
7	Mawlite	-	1	25	26
8	Katni	-	3	74	77
	Sagaing (Total)	**17**	**79**	**596**	**692**
9	Mandalay	5	20	153	178
10	Pyin Oo Lwin	-	-	4	4
11	Kyaukse	3	12	83	98
12	Myingyan	7	28	219	254
13	Meiktila	1	6	45	52
14	Nyaung-U	-	1	11	12
15	Yamethin	5	31	157	193
	Mandalay (Total)	**21**	**98**	**672**	**791**
16	Pakokku	5	52	121	178
17	Magway	3	25	109	137
18	Minbu	-	7	113	120
19	Thayat	4	8	53	65
20	Gangaw	-	-	37	37
	Magway (Total)	**12**	**92**	**433**	**537**
	Grand Total	**50**	**269**	**1,701**	**2,020**

Remark: Large ≥ 50 hp, Medium = 25-50 hp, Small ≤ 25 hp,

Source: MOI 2006

1.4 Problem Statement of the Study

Oilseed crops play an important role in the rural economy of Myanmar, being second only to rice. But despite its importance, the sector has been facing a series of challenges that have constrained its performance. These include a lack of productivity growth, reduced oil extraction levels and quality, limited efficiency of current oil processing operations and lack of national standards for edible oils. The majority of edible oil millers are operating on a small scale. Moreover, the price of imported palm oil and other oil from China are much cheaper than other domestic edible oil prices and exporting the oilseed crops is more profitable than producing edible oils. China has also a growing demand for groundnut seed. It can cause shortage of raw materials for domestic oil mills, and domestic oil millers are hard to operate year-round production. Consequently it is difficult to attain skilled labors and wage labors. Therefore, the availability of sufficient raw material is a major constraint for millers.

There are essentially two major government policy objectives for the oilseed crops subsector:

1. Achieve self-sufficiency in edible oil

2. Maintain edible oil price control to avoid fluctuation

Through the implementation of these policies, Myanmar has adopted restrictive measure on import and export of oilseeds and oilseed products but relatively open policies to the imports of large quantities of cheap palm oil, in an attempt to maintain edible oil prices at a low level on the domestic retail market. As a result, domestic market prices of oilseed crops products are heavily distorted resulting in stagnant production. A shift into the informal economy, whenever it has taken place, came with a cost (security). Myanmar is increasingly dependent on palm oil imports, while domestic production is stagnating.

In the oilseeds sector, the quality standards and quality consciousness are not well developed. It is a common practice to adulterate sesame and groundnut oil by mixing palm and cotton seed oil with little danger that consumers would notice the difference, even for premium quality. To maintain the nutty flavor of mixed oil and increase the dilution rate, artificial flavors are at times added into the oil mix. The adulterations are widespread given the absence of standards and regulations on edible oil.

1.5 Objectives of the Study

The general objective of the study was to assess the determinants on the profit of small edible oil mills in Myingyan Township, Mandalay Region, Myanmar. This study was conducted with the following specific objectives. These were:

- to know the current situation of small groundnut oil mills in Myingyan Township
- to analyze cost and revenue and monthly profit of selected groundnut mills and
- to determine influencing factors on monthly profit of these mills.

CHAPTER II

LITERATURE REVIEW

2.1 Groundnut Utilization in the World

Groundnut (*Arachis hypogaea*) is a crop of global importance. It is widely grown in the tropics and subtropics. Groundnut is mainly used for food and oil extraction (Ntare 2007). Being a Leguminoseae, it contributes also to the N-fertility of soils (Lusas 1979). Groundnut provides an inexpensive source of high quality dietary protein and oil. Groundnut provides considerable amounts of mineral elements to supplement the dietary requirements of humans and farm animals (Asibuo et al. 2008). Today the most important areas of cultivation are China, India, West and North Africa and the United States of America. The main export countries for groundnut oil are Argentina, Sudan and Senegal.

The seed has several uses as whole seed or processed to make groundnut butter, oil soups, stews and other products. The cake has several uses in feed and infant food formulations. The main uses of groundnuts are:

1. Edible oil: Crude groundnut oil is used for cooking in developing countries. It has a slightly sweet, green, and nutty flavor. It deteriorates slowly and may contain aflatoxins that can be inactivated. The oil is not well suited for margarines, due the possible allergic reactions of people.
2. Boiled fresh groundnuts: Unshelled immature groundnuts are eaten in some regions as a delicacy. Commercially, canned or frozen groundnuts are sold.
3. Roasted groundnuts in the shell and/or shelled: Groundnuts can be roasted in dry heat or frying oil and some salt is added and eaten as snacks.
4. Confectionary and cookies industry: Groundnuts are used in candy bars, e.g. mixed with chocolate or in cookies. The variety of candies containing groundnuts is large.
5. Peanut butter: Peanut butter is used as sandwich spread and as an ingredient for bakery and candy products. Peanut butter is semi-perishable and widely available in grocery stores. To improve smoothness and to prevent separation of oil stabilizers are usually added.
6. Groundnut oil cake: The oil cake after oil extraction is a rich in protein used as human food or as feed. The cake contains 40-50% easily digestible protein, 20-25% carbohydrate and 5-15% residual oil (Ntare 2007).

7. Food ingredients: Groundnuts are used for thickening soups or they are made into sauces to be eaten with meat and rice.
8. Groundnut proteins concentrate and flours: These concentrates have high levels of protein and are used in, among others in breads and in curd and cheese type derivatives.

Groundnut has some advantages over other major oilseed crops. With simple roasting and grinding processes, it can be used in many food forms. Furthermore the oil is pleasantly flavored, and do not require severe refining (Lusas 1979).

Groundnut oil also known as peanut oil or arachis oil is mild-tasting oil and is available with a strong peanut flavor and aroma. It contains high oil content (44 to 56%) and 22 to 30% protein on a dry seed basis and is a rich source of minerals (P, Ca, Mg and K) and Vitamins (E, K and B group) (Savage and Keenan, 1994).

Nutrient content in groundnut oil are saturated fatty acid (21.7%) and unsaturated fatty acid (78.3%). The major component of fatty acid among total the fatty acid is the oleic acid which account for 53.4% (Bwar 2000).

Ntare (2007) observed that contamination with aflatoxin can be a major disadvantage of groundnut. High intakes of groundnut products with aflatoxin contamination by Aspergillus fungi might result in liver cancer. Refined oil is free aflatoxin but it remains after advanced industrial processing in the cake. In addition some people are allergic for groundnut and it may cause anaphylactic reactions.

2.2 Domestic Edible Oil Market Situation in Myanmar

Tun (2013) studied Myanmar domestic edible oil market. The oilseed crops especially sesame, groundnut and sunflower are mainly produced in upper Myanmar (Sagaing, Mandalay and Magway Regions) as well as lower Myanmar (Bago, Yangon and Ayeyarwaddy Regions). But, major oilseed crops to produce edible oil are sesame and groundnut. Other oilseed crops are less common to use as edible oil. The most popular edible oil in Myanmar is groundnut oil and it is widely used in lower Myanmar and some part of the upper Myanmar. Most of Myanmar people prefer this oil due to its fragrance and nutritional content. Groundnut main producing areas are Magway, Mandalay, Bago, Sagaing, Yangon and Ayeyarwaddy regions. Pre-monsoon crops are used to grow form February until March and April by irrigation in some areas. Monsoon crops are cultivated in May and June in upper Myanmar. However, monsoon groundnut in mountainous area is

grown in August and September. In upper Myanmar, winter crops are grown in September and October, through it is cultivated in November and December in lower Myanmar after rice. Among the total oilseed crops area, groundnut hold second largest are after sesame. Groundnut grown area was 0.86 million ha in 2009-2010 sharing 35% of total oil production (DoA 2010). Groundnut flows from main production area in the Central Dry Zone and Shan States to processing areas mainly in Mandalay, Pyay and Yangon.

In Myanmar, the edible oil mainly found in the markets is groundnut oil, sesame oil and palm oil. Sunflower oil is especially consumed in growing regions. Niger oil is mostly consume in Shan State and marketed. Moreover, smaller amount of cotton seed oil, rice bran oil and soybean oil are traded in the market. Groundnut oil and sesame oil are marketed as high branded quality oil in major market like Yangon and Mandalay markets and their prices are highest among local edible oil. There are several types of edible oil can be found in the markets according to quality. Groundnut oil mixed with palm oil is marketed as groundnut oil (ordinary) and similarly, sesame oil combined with palm oil and can be seen in the market as sesame oil (ordinary). Palm oil in the markets can also be classified as imported palm oil from Malaysia and palm oil can (16.33 kg) inflow from Thailand. Niger oil and mustard oil are also found on the market in small volume. Soybean, sunflower and rice bran oils are not or rarely found as pure oils on the market.

Normally, central part of Myanmar is relatively sufficient in edible oil and redistributed to other deficit regions. Most of the edible oil (groundnut and sesame oil) entered into the Yangon market is from Yangon nearby regions, Mandalay Regions, Bago Regions and Magway Regions. Some of them are traded again to Mon State and Ayeyarwaddy regions. There is also informal import of palm oil to Yangon market from Thailand through Mawlamyine. Palm oil imported from Malaysia is mainly inflow to Yangon market and supply to other parts of the countries. Therefore it can be found that since Yangon markets is main sources of palm oil inflow, price of palm oil in Yangon markets is cheaper than other regions. Groundnut and sesame oil are entered into Mandalay market from oil mill in the city and surrounding areas, and outflow to the Yangon Region, Shan (south and north), Bago Region, Kachin State, Mon State and Sagaing Region. Palm oil in the Mandalay market is come from Yangon and transported to Sagaing and Shan State (South and north). There is small outflow of niger to Kachin State from Mandalay market.

Oil millers in Myingyan market locally produced edible oil especially to Yangon, Taunggyi, Nay Pyi Taw and Bago Regions. Palm oil traded in Myingyan market is transported from Yangon, Bago, Mawlamyine and Nay Pyi Taw and distributed to Mandalay region and Magwe Regions. The major factors induced edible oil prices movements in Myingyan market are local oilseed supply, palm oil supply and its price, and oil demand from Yangon, Sagaing and Mandalay Regions, and Shan State.

2.3 Constraints of Edible Oil Mills in Myanmar

According to the Myanmar Edible Oil Dealers' Association, it was observed that 75% of all edible oil mills in Mandalay stopped functioning (Wijnands et al. 2014). Insufficient raw materials are often mentioned as one reason for underutilization of the mills. Even in the period directly after harvest, the mills are only working 8 hours a day.

Favre & Myint (2009) stated that considering the average milling capacity per 8 hours and an average of 25 days per month, the total expeller milling capacity for edible oilseed crops is 1.7 million tonnes or 2.2 times over the domestic oilseed crops used for crushing (0.78 million tonnes). Since the installed capacity exceeds the seed availability, many mills are not operating and the ones in function operate only 5 to 6 months per year.

Kruse et al. (1991) observed the reasons concern with limited supply of oilseeds available for processing as follow:

- Lack of financial incentives for farmers to grow oilseeds in comparison to other crops
- Insufficient supplies of improved variety seeds for planting
- Poor planting and harvesting practices by farmers resulting in low yields and low oil content seeds
- Poor agricultural marketing and distribution systems for oilseeds
- Even though installed processing capacity is enough, profitability have been low for numerous reasons including:
- Lack of sufficient oilseeds to process
- Low oil content of available oilseeds
- Artificially low price-setting by parastatal producers

- High transportation costs in obtaining oilseeds
- Lack of foreign exchange to import needed wear parts for machinery.

Therefore processors should be aware of seed quality issues and pay a premium for high oil content seed. The extraction efficiency of all types of processing equipment is dependent both on the quality of seed and preconditioning of seed (Kruse et al. 1991).

Favre & Myint (2009) also identified the main technical constraints on the expeller mills as follow:

- Expellers made in Myanmar are of very old design. This creates the need for multiple pressings, up to seven times resulting in yields of low quality oil.
- Ineffective seed cleaning and as a result, dust and foreign particles enter the expellers. This is particularly the case for sesame.
- Incorrect pretreatment and conditioning of the oil seeds, particularly drying, resulting in low quality raw material being processed. The absence of seed dryers was identified as a constraint during the rainy season as drying can only take place during sunny days, thus hampering milling capacity.
- Absence of cake breaking after the first press resulting in less effective extractions.
- Misalignment of pressing worm and cage components caused by inadequate material, equipment and maintenance skills.
- Poor iron quality used for maintenance which result in short life of expeller parts.

Kruse et al. (1991) also pointed out that working capital requirement is a major constraint for all oil processing activities; the larger the equipment capacity, the more raw materials needed.

Thaung (2011) pointed out that with regard to imported palm oil, supply volume influences the domestic oilseeds crop production and prices of local produce of edible oil. Tun (2013) also indicated that large amount of palm oil import during country's oilseed crop harvest time not only limits oilseed crops productivity but also persuade farmers to grow other profitable crops. Eventually, domestic edible oil prices seem to be significantly influenced and determined by level of palm oil import and its prices because import is only source of major supply to local edible oil markets requirement. Furthermore the current status of inflow of palm oil within Myanmar's oilseed crops sector has several negative impacts for oilseed farmers, consumers and national economy. These impacts

imply lower rural household incomes, unstable market prices, lack of health and nutrient aspects, sluggish productivity growth and draining foreign exchange.

Favre and Myint (2009) stated that production of edible oil in Myanmar is regionally different and there is no detail record on quantities of domestic edible oil produced from every locally run oil miller around the country. Therefore, it makes more difficult for the government to estimate optimum amount of palm oil to be imported and seasonal amount of import hardly meet actual domestic requirement.

Nyein et al. (2010) revealed that government focused on self-sufficiency and prices stability in oilseeds and edible oils. The domestic deficits in edible oil enforced the government to import certain amount of palm oil discouraging prices of local oilseed crops for farmers.

2.4 Profitability of Small Scale Edible Oil Mill Production

Profitability is the profit earning capacity, which is a crucial factor in contributing to the survival of firms. The perpetual existence of the firm depends on the profit earning capacity of the firm, which is also considered to be the main factor in influencing the reputation of the firm. Profitability consists of two words profit and ability. It is necessary to differentiate between profit and profitability. Profit, from the accounting point of view, is arrived at by deducting from total revenue of an enterprise all amount expended in earning that income. Profitability can be measured as profit shown as a percentage of sales known as profit margin (Balio 2009).

Determining the average profit margin of a small business depends on many factors, including the criteria defining what qualifies as a small business, the type of business, the number of employees required, the cost of capital and the location of the business. Location is important because there are logistical cost issues, state and local taxes, as well as labor cost factors that are unique to each region. Other important factors in determining profit margins include what inventory and cost management systems are used and how efficiently new technology is deployed (Balio 2009).

Azhagaiah and Deepa (2012) studied determinants of profitability of food industry in India. They estimated the impact of size on profitability. The results showed that volatility and growth are the major predictors in determining profitability in case of small size firms. Volatility was highly significantly positively correlated with profitability. It means that the small size firms have to face more challenges to earn additional profit. The

size of firm was also positively correlated with profitability. In medium size firms, growth is important in determining the profitability. Capital intensity has a significant positive coefficient with the profitability of large size firms. The overall result showed that the larger the size of the firm, the more the investment in long lived assets has helped to increase the profitability of the firm unlike the trend in cases of small size and medium size.

United Nations Industrial Development Organization (UNIDO) (2008) studied small scale oil extraction from groundnut and copra. This study was primarily concerned with the choice of technology for the extraction of unrefined oil from groundnut kernel and copra by small-scale mills located in rural and small urban areas. The choice of appropriate oil extraction technology can improve the productivity of investments and labor in this sector and, therefore, the profitability of small-scale production units. However, the choice of technology affected mostly processing costs which represent a relatively small fraction (20-40%) of total production cost. Thus, the market prices of raw materials and oil could have a significant impact on the profitability of the oil extraction mill. There are many other oil products which are good substitutes for groundnut and copra oil and, therefore, the market price of these substitutes will necessarily affect the market price of groundnuts and copra oil. Thus, potential oil producers should carefully investigate the market of raw materials and the market where they intend to sell the produced oil.

The production of unrefined oil by small-scale units should contribute to the fulfillment of the basic needs for low-income group. The small-scale unit may produce oil mostly for the local market. Careful planning of investments in the oil extraction sector will be needed in order to avoid the closing down of small-scale units for lack of raw materials (UNIDO 2008).

2.5 Initiatives to Promote SMEs in Myanmar

Special attention has been paid by the government to protect and promote domestic SMEs as a key player for industrialization, income generation and job creation. The key ministries involved in SME development are the ministries of industry, cooperatives, commerce, finance, national planning and economic development, agriculture and irrigation, and science and technology. The SME Development Central Committee (SDC) was established as a coordinating mechanism among line ministries. The committee is

composed of both government officials and business representatives. A new SME law was developed by working group of SDC. To support SMEs and enable smooth participation in the ASEAN Economic Community (AEC), the Government also created the Central Department of SME Development in 2012, which operates under the Ministry of Industry. In order to promote the development of SME clusters, the Government is aiming to link industrial estates and economic zones with research and training institutions. To improve access to finance for SMEs and to support business and technology incubations, the Small and Medium Industrial Development Bank (SMIDB) has been operating eleven branches throughout Myanmar since 1996. SMIDB plans to offer low-interest three-year loans at 8.5% (IFC 2010).

SMEs in Myanmar encounter several major physical and non-physical challenges relating to access to market and finance. One of challenges concerning market access is a distinct lack of awareness among SMEs themselves of the benefits and implications of free trade agreements (FATs) (Anukoonwattaka and Mikic 2012). The existence of non-tariff barriers prohibits SMEs' access to foreign markets. In terms of access to finance, SMEs in Myanmar are finding it difficult to access funds due to the rigorous collateral-based lending requirements of local banks (Kyaw 2008). This situation makes it even more difficult for micro enterprises to obtain loans, since most of the banks are reluctant to provide loans to high-risk borrowers like them. SMEs in Myanmar thus have to rely on informal sources for funding which charge high interest rates. In summary, SMEs in Myanmar typically face the following limitations (Abe 2013):

a) Absence of a user-friendly legal and regulatory environment
b) Lack of an adequate and modern infrastructure
c) Undeveloped entrepreneurship abilities, i.e. lack of confidence and a high level of risk aversion in taking advantage of new opportunities
d) Inequality for women entrepreneurs
e) Inadequate and/or expensive access to financing
f) Obsolete technology
g) A lack of research and development, innovation facilities and the commercialization thereof
h) Inadequate input of business development services (BDS)

i) Weak linkages with external markets and

j) Poor institutional networking, which bars access to global value chains and the integrating of SMEs into international markets.

CHAPTER III

RESEARCH METHODOLOGY

3.1 Study Area

3.1.1 Description of the study area

The study area was Myingyan Township, Mandalay Region, Myanmar. Mandalay Region is located in the center of the country, bordering Sagaing Region and Magway Region to the west, Shan State to the east, and Bago Region and Kayin State to the south. Mandalay Region is important in Myanmar's economy; accounting for about 15% of the national economy. The region consists of seven districts, which are subdivided into 30 townships including Myingyan Township.

Myingyan Township is situated between North Latitude from 21° 20" and 21° 46" and East Longitude from 95° 15" and 95° 37", and has an area of 374.29 square miles. It lies in the valley of the Ayeyarwady River on the east bank of the river. The area around the town is flat, especially to the north and along the banks of the Ayeyarwady. It is bordered by Natogyi Township on the east, Yeasgyo and Myaung Townships on the west, Taungtha Township on the south and Ngazun Township on the north. Myingyan Township occupies 164.83 thousand acres of total arable land and about 51.23% is upland rain-fed area.

3.1.2 Climate

Myanmar has a tropical monsoon climate and there are three distinct seasons; namely the hot season (March through April), rainy season (May through October) and cool season (November through February). Average temperatures of the central region are between 37°C and 40°C in summer, especially April which is the hottest month. In cool season, the average temperature is 21°C and the lowest temperature is 18°C. Myingyan Township is situated in 76 meter above sea level (maximum sea level is 474 meter and minimum sea level is 61 meter). The average monthly temperature ranges from a minimum of 11.4°C to a maximum of 43°C. A maximum precipitation of 373 mm was found in September and total precipitation was 739 mm in the year 2013. There is no precipitation in January, February, March, April, November and December (Table 3.1).

Table 3.1 Rainy days and precipitation of Myingyan Township in 2013

No.	Months	Rainy days	Total precipitation (mm)
1.	January	-	-
2.	February	-	-
3.	March	-	-
4.	April	-	-
5.	May	6	59.94
6.	June	6	82.04
7.	July	1	5.84
8.	August	9	89.92
9.	September	15	372.87
10.	October	8	128.02
11.	November	-	-
12.	December	-	-
	Total	**45**	**738.63**

Source: General Administrative Department (Myingyan Township), 2014

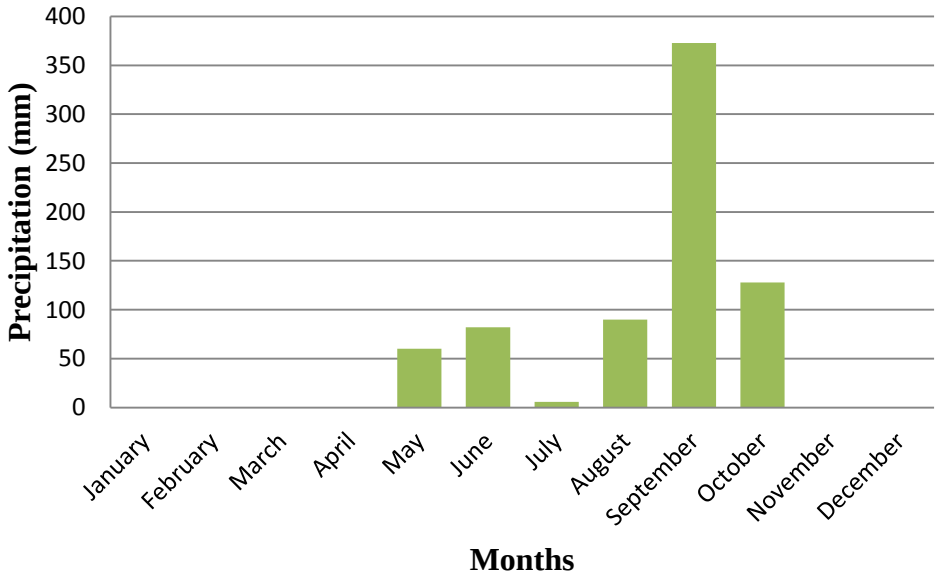


Figure 3.1 Precipitation of Myingyan Township in 2013

Source: General Administrative Department (Myingyan Township), 2014

3.1.3 Sown area and crop production in the study area

Myingyan Township occupies a land area of about 97 thousand hectares in which the cultivable area covered 66.71 thousand hectares (68.81%), wildland covered 1.13 thousand hectares (1.17%), reserved and other forests covered 0.01 thousand hectares (0.01%) and others occupied 29.09 thousand hectares (30.01%). Total cultivable areas was divided into 9.86 thousand hectares of lowland (14.77% of total net sown area), 49.66 thousand hectares of upland (74.45%), 7.19 thousand hectares of alluvial soil (10.78%) and 0.001 thousand hectares of orchard (0.001%) (Table 3.2).

In the study area, farmers grow mainly groundnut, sesame, pigeon pea, green gram, cotton, seed corn and some horticultural crops (onion and pepper). Among these crops, groundnut, sesame, and pigeon pea are mostly grown. The sown area, yield and production of rain-fed groundnut and winter groundnut in Myingyan Township from 2010-2011 to 2014-2015 are shown in Table 3.3 and 3.4.

The sown area of rain-fed groundnut significantly increased from 3.68 thousand hectares in 2010-2011 to 6.41 thousand hectares in 2014-2015. Production of rain-fed groundnut also increased from 4.72 thousand tonnes in 2010-2011 to 8.17 thousand tonnes in 2014-2015. The sown area of winter groundnut recorded that there was no significant increase during these five years from 2010-2011 (2.31 thousand hectares) to 2014-2015 (2.49 thousand hectares). But production increased from 3.65 thousand tonnes in 2010-2011 to 4.36 thousand tonnes in 2014-2015. This was because the yield was increased from 1.58 tonnes per hectare in 2010-2011 to 1.75 tonnes per hectare in 2014-2015. The increase in the sown area, harvested area and production of rain-fed groundnut was more than that of winter groundnut.

Table 3.2 Land utilization in Myingyan Township (2014-2015)

No.	Types of land	Area ('000 hectare)	Percentage in total sown area (%)
1.	Net sown area		
	a) Lowland	9.86	14.77*
	b) Upland	49.66	74.45*
	c) Alluvial soil	7.19	10.78*
	d) Orchard	0.001	0.001*
	Total net sown area	66.71	68.81
2.	Wildland	1.13	1.17
3.	Reserved and other forest	0.01	0.01
4.	Others	29.09	30.01
	Total area	**96.94**	**100**

Source: General Administrative Department (Myingyan Township), 2014

Note: * means percentage in net sown area

Table 3.3 Rain-fed groundnut sown area, harvested area, yield and production in Myingyan Township from 2010-2011 to 2014-2015

Year	Sown area ('000 ha)	Harvested area ('000 ha)	Yield (MT/ha)	Production ('000 MT)
2010-2011	3.68	3.68	1.29	4.72
2011-2012	3.72	3.72	1.29	4.78
2012-2013	5.03	5.03	1.30	6.54
2013-2014	5.88	5.88	1.27	7.49
2014-2015	6.41	6.41	1.27	8.17

Source: DoA (Myingyan) 2015

Table 3.4 Winter groundnut sown area, harvested area, yield and production in Myingyan Township from 2010-2011 to 2014-2015

Year	Sown area ('000 ha)	Harvested area ('000 ha)	Yield (MT/ha)	Production ('000 MT)
2010-2011	2.31	2.31	1.58	3.65
2011-2012	2.76	2.76	1.55	4.29
2012-2013	3.22	3.22	1.54	4.95
2013-2014	2.15	2.15	1.54	3.31
2014-2015	2.49	2.49	1.75	4.36

Source: DoA (Myingyan) 2015

3.2 Data Collection and Sampling Method

Data collection was based on a personal interview and secondary data from the relevant ministerial reports of Ministry of Agriculture and Irrigation (MOAI), Ministry of Industry (MOI), Ministry of Foreign Affairs (MOFA), Ministry of Co-operatives (MOC), SMEs Development Central Committee (SDC) and Department of Agriculture (DoA). As primary data collection, the purposive sampling procedure for selection of the oil mills was used. The pilot survey was conducted in December 2014 and then the main survey was done in March 2015. The total of 5 small groundnut oil mills was selected and interviewed with a structural questionnaire. The survey collected information about the background information of the mills as well as detailed information of operators. Moreover, the determinant factors on annual profit of oil mill and constraints for the operation of the mills were collected.

3.3 Method of Analysis

Both qualitative and quantitative data were firstly complied in the Microsoft Excel program. In this study, descriptive statistics such as the mean, percentages, and frequencies were computed to describe the socio-economic characteristics (e.g., age, educational attainment and family labor) of the sample millers.

3.3.1 Methodological framework for the estimation of production costs and revenues

Methodological framework for the estimation of production costs and revenues has eleven steps. The framework was sketched on monthly basis within a year**.**

Step 1

Firstly determine the daily and monthly quantities of raw material (groundnuts) to be processed and then calculate the output, using the extraction rates associated with the processing method used. The oil extraction rates should be considered as average rate obtained under fairly good processing conditions.

Step 2

To determine fixed investment cost, it contains cost of land, buildings, drying ground and equipment cost.

Step 3

The working capital required is dependent on the adopted levels of stocks of finished goods and raw material amount.

Step 4

To estimate total investment cost as the sum of investment costs and working capital.

Step 5

To determine the fixed investment monthly cost for every investment components. Firstly the annual fixed investment cost is determined. This cost is a function of the interest rate assumed. Let this be I percent per year. Given the value of I and knowing the useful life of the piece of equipment, the annual fixed investment cost can be calculated in the following manner: For interest I percent per annum and a useful life U, to obtain the corresponding factor F from a discount table (Appendix 9). Let the investment cost of the component be Z: then the annual fixed investment cost is equal to Z/F. In this manner, cost for each investment item can be calculated including building, drying ground and equipment. Since land has an infinite life, the annual cost may be assumed to be equal to the annual rental rate. The annual cost of spares and maintenance – which may be assumed to be equal to 7.5 percent of total equipment costs – should be added to the other annual fixed costs in order to obtain the total annual fixed costs. To get the fixed investment monthly cost, the annual cost is divided by twelve.

Step 6

To estimate the working capital monthly cost as the monthly interest paid on the amount of working capital.

Step 7

To estimate total fixed monthly cost as the sum of monthly fixed costs (step 5) and interest paid on working capital (step 6).

Step 8

The sum of the monthly variable costs is calculated. These include the monthly costs of: raw material, electricity, filter cloth, tins or drums, labor and tax.

Step 9

To estimate the total monthly costs as the sum of monthly fixed costs and monthly variable costs.

Step 10

To estimate total monthly revenues as the sum of two components: revenue from the sale of oil and revenue from the sale of cake.

Step 11

To estimate the monthly gross profits by subtracting total revenues from total costs.

This methodological framework is briefly described in Figure 3.2. Benefit cost ratio (BCR) was used as profitability for each mill. To know the short-run profitability condition of the mills, the return above variable cost was also calculated.

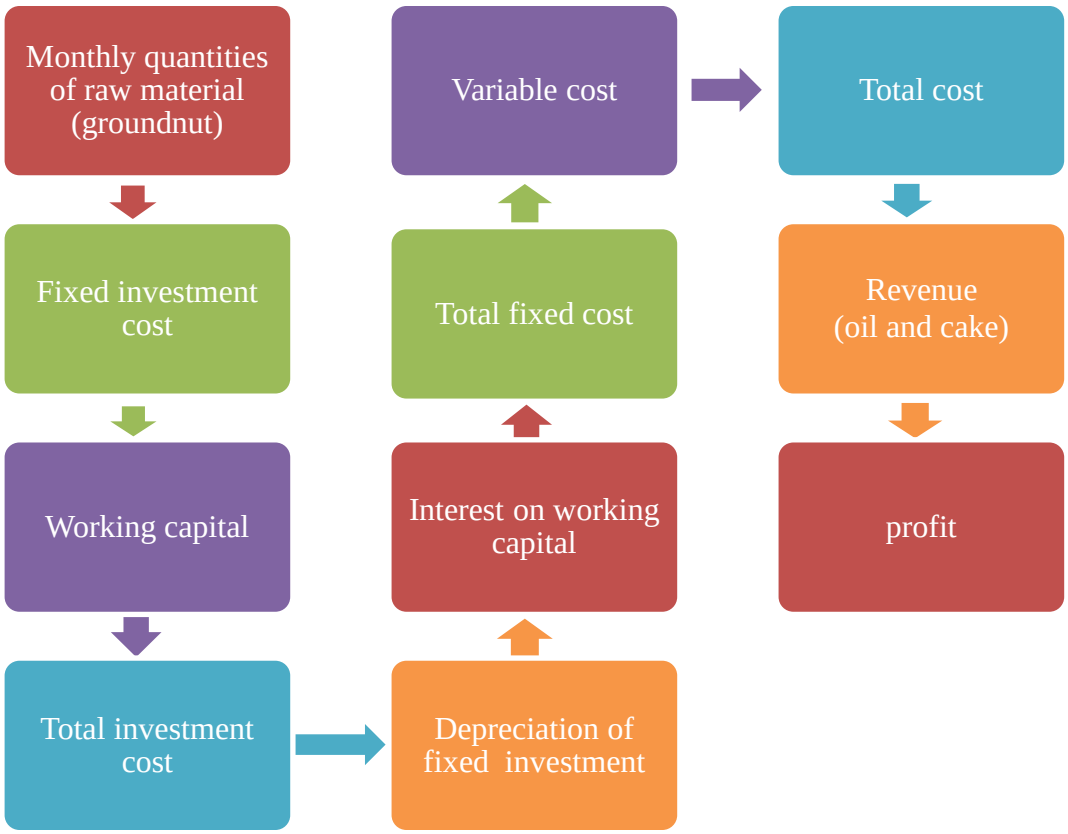


Figure 3.2 Methodological frameworks for the estimation of production costs and revenues

Source: United Nations Industrial Development Organization (UNIDO) (2008)

3.3.2 Break-even prices of raw material and oil

Break-even analysis is a business tool widely used across all industries to evaluate business performance in terms of costs, since this is a supply-side analysis. Break-even analysis is an important aspect of a good business plan, since it helps the business determine the cost structures, and the number of units that need to be sold in order to cover the cost or make a profit. Break-even analysis is usually done as part of a business plan to see the how practical the business idea is, and whether or not it is worth pursuing. Even after a business has been set-up, break-even analysis can be immensely helpful in the pricing and promotion process, along with cost control.

A break-even analysis is an analysis to determine the point at which revenue received equals the costs associated with receiving the revenue. Break-even analysis calculates what is known as a margin of safety, the amount that revenues exceed the break-even point. This is the amount that revenues can fall while still staying above the break-even point. The Break-even point is a level of production where the total costs are equal to the total revenue. Thus at the breakeven level, there is neither profit nor loss. Production level below the break-even-point will result into loss while production above break-even point will result in profits.

a) Break-even price of raw material

Break-even price of raw material means the maximum price of raw material which should be paid by the producer in order to break even if the assumed processing costs (i.e. total monthly costs excluding the cost of raw material) and assumed market prices of oil and cake are to be valid. This maximum raw material price can be calculated as follow:

- Calculate processing cost by subtracting the cost of raw material from total monthly cost.
- Calculate the total amount which may be paid for raw material in order to break even by subtracting the processing cost from the total revenue.
- Finally, calculate the maximum price of raw material in order to break even by dividing the cost of raw material calculated in second step by the total amount of raw material per month (UNIDO 2008).

b) Break-even price of oil

An analysis similar to that carried out for the price of raw materials may also be carried out in relation to the price of groundnut oil. In this case, break-even price of

groundnut oil is the minimum price at which the oil must be sold in order to break even, given the assumed processing costs and market price of the raw material. This minimum price may be obtained as follow:

Break-even price of groundnut oil = (Total monthly cost – revenue from sale of cake) * Monthly oil produced

(UNIDO 2008)

3.3.3 The determinant factors on monthly profit of the selected groundnut oil mills

To know the determinants on the monthly profit of the selected groundnut oil mills, linear regression profit function was used. The dependent variable was monthly profit and seven independent variables and one dummy variable which related to profit were shown in as follow:

$$\mathbf{LnY_t = \beta_0 + \beta_1 LnX_{1t} + \beta_2 LnX_{2t} + \beta_3 LnX_{3t} + \beta_4 LnX_{4t} + - - - + \beta_7 LnX_{7t} + D_s + u_t}$$

Where;

Y_t = Profit (000 MMK/month)

X_1 = Processed raw material (Groundnut) (Kg/month)

X_2 = Groundnut price (MMK/Kg)

X_3 = Oil price (MMK/Kg)

X_4 = Cake price (MMK/Kg)

X_5 = Labor cost (MMK/month)

X_6 = Electricity cost (MMK/month)

X_7 = Tax payment (MMK/month)

D_s = Season (groundnut season = 1, off season = 0)

β = Unknown parameter to be estimated

u_t = Disturbance term

Source: Stankov et al. (2015)

3.3.4 Empirical model for the factors influenced the monthly profit of oil processing

The study expected from the independent variables which affected the factors influencing the monthly profit. In the study, the monthly profits were used monthly data form the selected five groundnut oil mills during 2014. The selected independent variables were processed raw material (groundnut), groundnut price, oil price, cake price, labor cost, electricity cost and tax payment. Dummy variable was also used based on the groundnut harvesting season to know the seasonal effect. A complete decision of the variables specified and types of measures that have been employed is shown in Table 3.5.

Table 3.5 Expected sign of the independent variables in monthly profit of oil processing

Independent variables	Unit	Expected sing
Processed raw material (Groundnut)	kg/month	(+)
Groundnut price	MMK/kg	(-)
Oil price	MMK/kg	(+)
Cake price	MMK/kg	(+)
Labor cost	MMK/kg	(+,-)
Electricity cost	MMK/kg	(+,-)
Tax payment	MMK/kg	(+,-)
Season	-	(+,-)

CHAPTER IV

RESULTS AND DISCUSSION

4.1 Description of Selected Oil Millers

4.1.1 Socio-economic characteristics of selected oil millers

Socio-economic characteristics of selected oil millers in the study area are showed in Table 4.1. In selected five oil millers, the only one female owner was found and the others were male owners. The selected oil millers have an average of about 58 years old with about twenty-year experience in oil milling. The average schooling year was seven years referred to those who had an education of secondary level. The education level of millers was assumed an indicator of ability to make a proper decision in their milling. In the selected millers, the average family size was five members and the average family labor was only three.

4.1.2 Oil extraction by expeller mills

In the study area, there are three main stages of oil-processing in expeller mill. These are pretreatment stage, extraction stage and post extraction treatment stage. The first stage is prior to the extraction stage such as cleaning, dehaulling and drying. The second stage, extraction, involves the separation of the raw material into oil and residue (cake). Post extraction treatments comprise the packaging of the oil and cake for marketing. The basic necessary equipment for expeller type oil mills in study area are as follow:

a) Oil expeller unit

b) Sieve for raw material

c) Filtration unit for oil output and

d) Engine or electric motor.

4.1.3 Fixed assets and equipment of selected groundnut mills

Fixed assets and equipment of selected oil mills are shown in Table 4.2. Industrial zone in the study area was established with 360 plants since 1998. The local government allocated the land as the plots of 930 square meters for each business unit. In order to get the permission of the land ownership, each business unit cost 5 lakhs of MMK. Among 360 plants, 84 plants were oil milling industries and only 16 mills (about 20%) are currently able to operate for groundnut and sesame oil production. The selected five oil

mills started operation since the year 2000. Each area of Mill I and V was 930 square meters but that of Mill II, III and IV was only the half, 465 square meters. The building area of oil mills occupied 23%, 72 %, 41 %, 29 % and 42 % of land areas in Mill-I, II, III, IV and V respectively. The rest of the area was used for their house, drying ground for raw material and storage place for output. The houses of Mill-I, II and III were together with their mills and Mill-IV and V were separately on the other place.

The result indicates that each of selected mills processed by one sieve, two expellers and one power motor. The sieve was mainly used for the purification of raw material. Formerly, the selected mills were operated by diesel engine and so they had fuel cost. From 2003, the local government supported electricity for industrial use. And then, diesel engines were replaced by electric motors and the selected mills had only cost of electricity that was much lower than the fuel cost. The purpose of filtration unit was to obtain pure oil because the oil produced from the expeller usually mix with some cake. Mill-I, II, III and IV possess only one filtration unit for oil but Mill-V possess two filtration units. It showed that previously Mill- V was operating in large scale so that they used two filtration units in order to cover the filtration time. In all selected mills, the current milling amount of raw material can be handled by using one filtration unit.

Table 4.1 Socio-economic characteristics of selected oil millers in the study area

Item	Mill					Mean	Min.	Max.
	I	II	III	IV	V			
Gender	Female	Male	Male	Male	Male			
Marital status	Single	Married	Married	Married	Married			
Age (Year)	49	61	65	50	64	57.8	49	65
Experience (Year)	15	23	15	25	20	19.6	15	25
Education (Year)	14	5	4	10	4	7.4	4	14
Family size (No.)	1	7	8	4	5	5	1	8
Family labor (No.)	1	3	5	3	3	3	1	5

Table 4.2 Fixed assets and equipment of selected mills

Fixed assets and equipment	Mill				
	I	II	III	IV	V
Land area (m^2)	930	465	465	465	930
Mill building area (m^2)	214	334	188	134	390
Mill building area (% of land area)	23	72	41	29	42
Sieve for raw material (No.)	1	1	1	1	1
Oil expeller	2	2	2	2	2
Filtration unit for oil (No.)	1	1	1	1	2
Electric motor (No.)	1	1	1	1	1

4.1.4 Purchased year and value of fixed assets and equipment of selected groundnut mills

Purchased year and value of fixed assets and equipment of selected groundnut mills are shown in Table 4.3. The results indicated that in all selected mills, land plot, building and filtration unit for oil were purchased since the year 2000. At the same period, Mill-I, II and III started operation with tow expellers. However, Mill-IV and V only operated with one expeller and then Mill-IV fitted another one in 2003 and Mill-V in 2005. Mill-III, IV and V purchased sieve for raw material in the year 2000 and Mill-IV and V in 2003. The results also showed that Mill-III, IV and V purified raw material by using the sieve since 2000 but Mill-I and II by using human labor until 2003. For power source in milling, all selected mills used electric motor since 2003. Before that time, diesel engine played an important role in power supply. Later as the local government provided electricity, all mills had changed power source from diesel engine to electric motor.

In this table, total costs of all fixed assets and equipment in selected five mills were 6.45, 10.3, 6.8, 8.05 and 14.3 million kyats respectively. Among them, Mill-V had the highest amount and Mill-I had the lowest amount of fixed assets. In all mills except Mill-II, oil expeller cost occupied the highest proportion in total cost. Among oil expeller costs, there was an increasing trend in purchased price from 2000 to 2005. In 2000, the price was less than 2 million kyats and it increased 2.8 million kyats in 2003 and 6.5 million kyats in 2005.

Table 4.3 Purchased year and value of fixed assets and equipment of selected mills

Fixed assets and equipment	Mill-I		Mill-II		Mill-III		Mill-IV		Mill-V	
	Purchased year	Value (Million MMK)	Purchased year	Value (Million MMK)	Purchased year	Value (Million MMK)	Purchased year	Value (Million MMK)	Purchased year	Value (Million MMK)
Land plot	2000	0.5	2000	0.25	2000	0.25	2000	0.25	2000	0.5
Building	2000	1.9	2000	6	2000	2	2000	2	2000	3.5
Oil expellers	2000	1.2	2000	1	2000	1.65	2000	1.7	2000	1.5
	2000	1.2	2000	1	2000	1.65	2003	2.8	2005	6.5
		2.4*		2*		3.3*		4.5*		8*
Filtration unit for oil	2000	0.3	2000	0.35	2000	0.35	2000	0.5	2000	1
Sieve for raw material	2003	1.2	2003	1.1	2000	0.2	2000	0.1	2000	0.3
Electric motor	2003	0.1	2003	0.6	2003	0.7	2003	0.7	2003	1
Total		**6.45**		**10.3**		**6.8**		**8.05**		**14.3**

Note: * means total cost of oil expellers

4.2 Economic Comparison of Selected Groundnut Mills

This section provides an economic comparison of the five selected groundnut mills. Comparison was made with respect to total investment costs, total monthly cost and revenue and profitability (monthly profit and benefit-cost ratio) of the mills. These comparisons were based on a number of assumptions regarding interest rate and useful life for the calculation of monthly fixed investment cost, and cost of spares and maintenance. The summary of the various cost and revenue items associated with the five groundnut mills was provided in following section.

4.2.1 Percentage compositions in total cost of selected mills

Total cost for oil production could be divided into three items. They are a) fixed investment cost, b) raw material cost and c) processing cost. In fixed investment cost, oil expeller, filtration unit, sieve, electric motor, building, rental value of land, maintenance cost and interest for working capital were included. To determine the fixed monthly investment cost for every investment, firstly it was needed to determine the fixed annual investment cost. The annual cost for equipment had been considered based on the useful life of the equipment and interest rate. According to the useful life and interest rate, the corresponding discount factor was obtained from discount table. The useful life for oil expeller, filtration unit and building was 30 years each and that of sieve and electric motor was 10 years each. In this analysis, interest rate was 12% per annum which was the interest rate of Myanmar Economic Bank. For the land item, the annual cost was equal to the annual rental rate that was equal to the interest rate. The annual maintenance cost was equal to 7.5 percent of the total cost. In the consideration of working capital amount, it was directly related to the level of stocks of the finished goods and raw material amount. The total days for finished goods and raw material were 30 days. Based on the working capital amount, interest for working capital was calculated and the interest rate was also 12%. During the year 2014, Mill-I, Mill-II, Mill-III, Mill-IV and Mill-V operated 270, 264, 312,120 and 220 days respectively. Among the selected mills, Mill-III had the largest number of working days (312 days) and Mill-IV had the lowest (120 days).

The fixed annual investment cost could be obtained by the summation of the annual cost of oil expeller, filtration unit, sieve, electric motor, building, land, maintenance and interest for working capital. To get the fixed investment monthly cost, the annual cost was divided by twelve. In the selected mills, Mill-I had the lowest amount of fixed investment

cost (2620 thousand MMK per month) and Mill-III had the highest amount (7216 thousand MMK per month) (Appendix 4).

The percentage compositions of fixed investment monthly cost in selected mills are shown in Figure 4.1. In this figure, it was observed that the major cost item for fixed investment cost was interest for working capital (54-83%). This was because the selected mills had very long duration between buying raw material and selling finished oil output (30 days). Among the selected five mills, Mill-III had the highest percentage of interest for working capital (83%) and Mill-IV had the lowest amount (54%).

In processing cost, cost of electricity, filter cloth, drum, labor and tax were included. The percentage compositions of processing cost in selected mills are shown in Figure 4.2. It was observed that the major cost items for processing were labor cost (46-69%) and electricity cost (17-33%). Among the selected mills, Mill-II had the highest percentage in labor cost (69%) and Mill-III had the lowest (46%). It can be concluded that the Mill-III had the most effective labor utilization. For all mills, the lowest composition in processing cost was filter cloth cost (1-2%). It could be considered that the summation of raw material cost and processing cost was the variable cost.

Table 4.4 shows the total cost of oil production. Among these three items, raw material cost was the highest proportion for total cost (more than 95%) in all mills. Therefore, fixed investment cost and processing cost had less influence on oil milling.

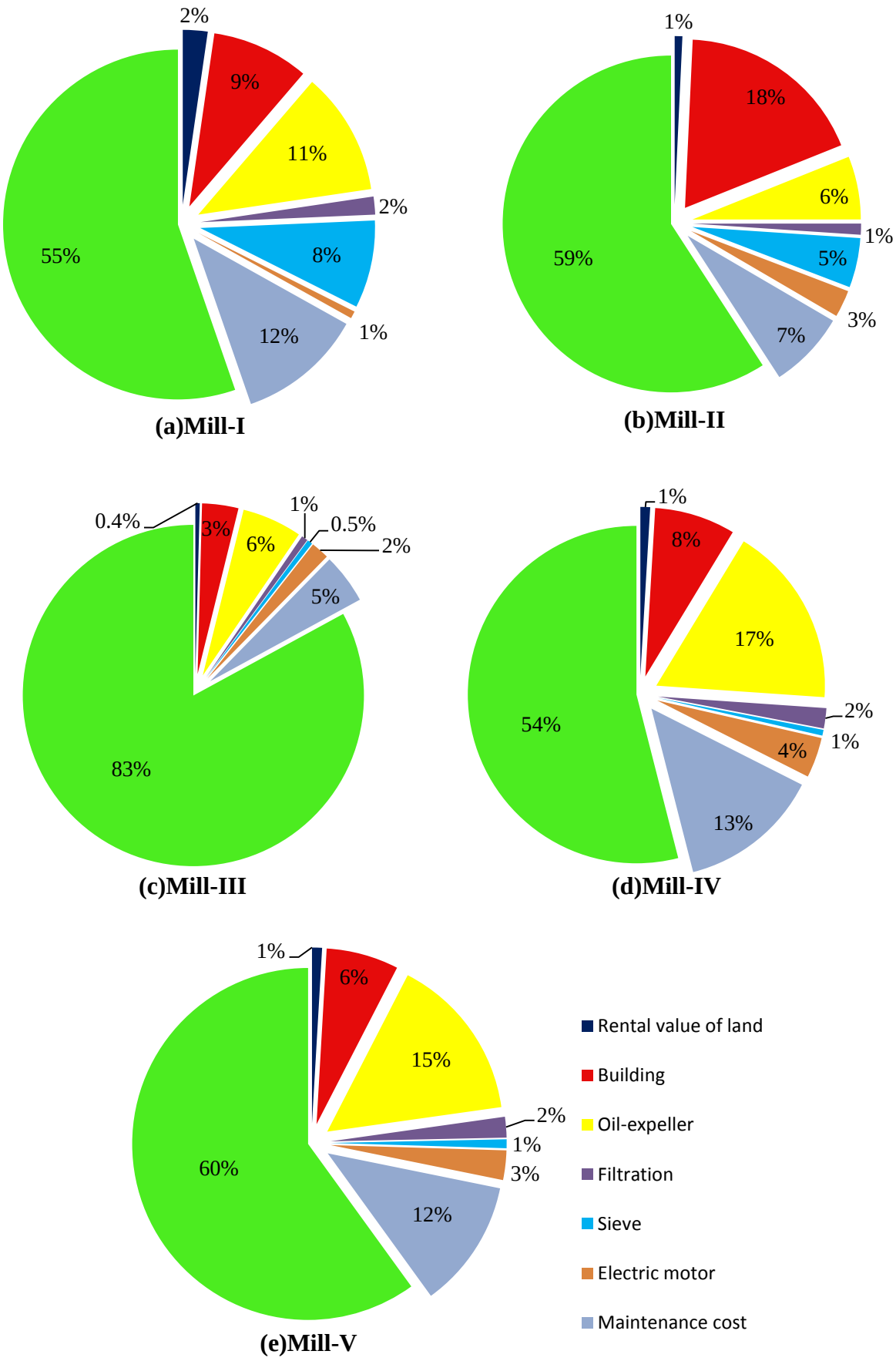


Figure 4.1 Percentage compositions in fixed investment cost of selected mills

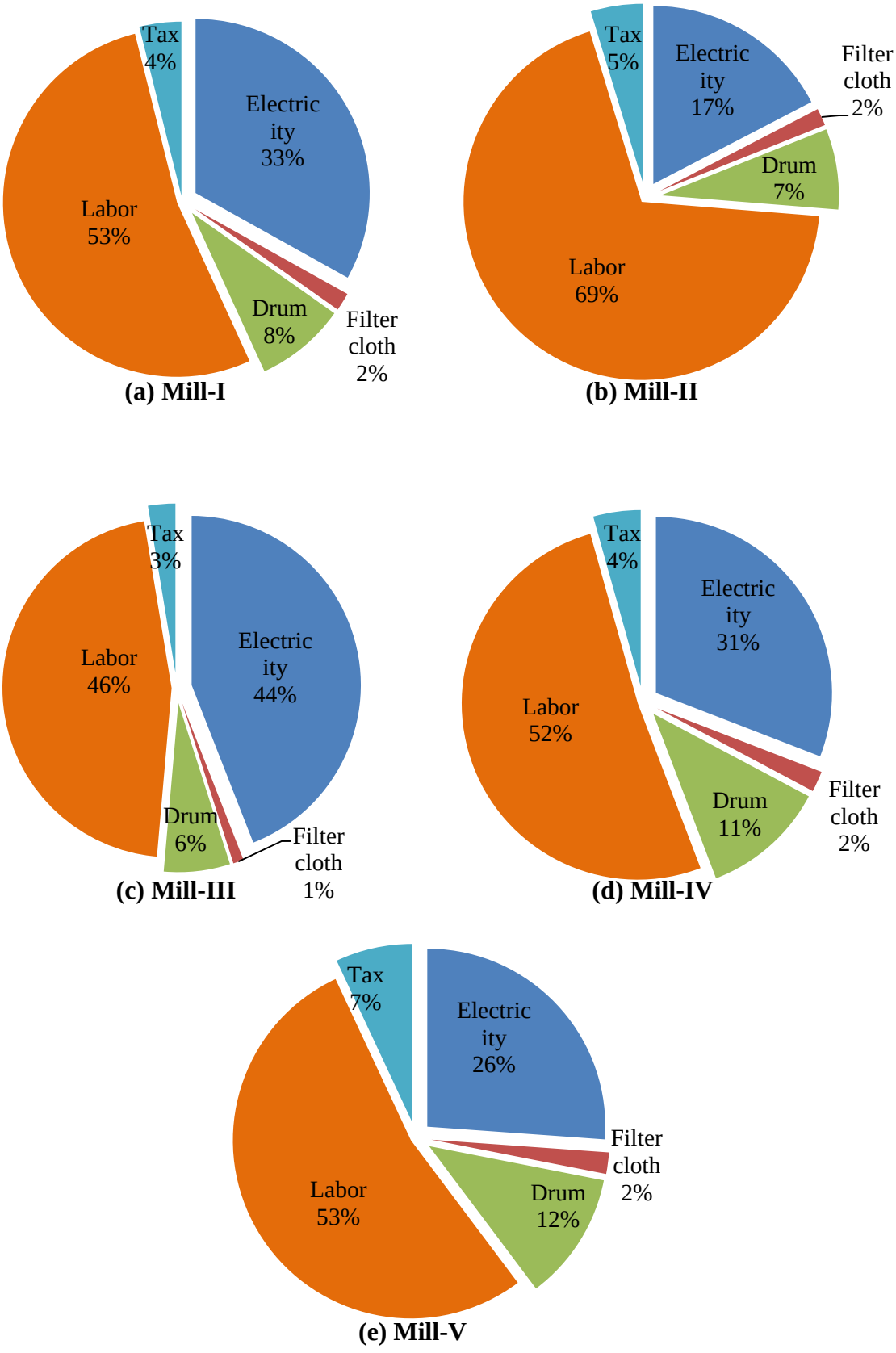


Figure 4.2 Percentage compositions in processing cost of selected mills

Table 4.4 Percentage compositions in total costs for oil production of selected mills

Mills	Percentage		
	Fixed investment cost	**Raw Material cost**	**Processing cost**
Mill-I	1.73	95.90	2.36
Mill-II	1.64	96.83	1.53
Mill-III	1.17	97.28	1.55
Mill-IV	1.77	95.34	2.89
Mill-V	1.62	97.11	1.27
Average	**1.56**	**96.49**	**1.92**

4.2.2 Total amount of raw material (groundnut) processed per month during 2014

Total amount of raw material processed within one month in selected oil mills during 2014 are shown in Figure 4.3 (a) and Table 4.5. Among these mills, Mill-III processed the highest amount of raw material (30-90 MT) than the other mills (7-45 MT) throughout the year except January and November. Mill-I operated the lowest amount of raw material compared with the other mills except three months of May, June and July. During these months, Mill-IV was the lowest one (<10 MT). During 2014, all mills processed the highest raw material in January while Mill-III processed the highest amount in March, July and October. As the year-round processing, Mill-III processed the highest amount of raw material and Mill-I processed the lowest amount. The selected mills had a raw material processing capacity of approximately 1306 kg per day. But in average, they processed raw material only about 172 kg/day in 2014.

From January to April, all mills had nearly the same trend of raw material amount processed. In February, the amount of raw materials processed by each mill was lower than in January, which means there was a decreasing trend. But in March, raw material amount processed by mills were in increasing trend. It was observed that the monthly amount of raw material processed by each mill was changed with up and down sequence. As the amount of oil produced in one month could not be sold within this month, mills had to continue selling oil until the following month. Therefore the mills changed the amount of raw materials processed alternatively.

4.2.3 Monthly Price of raw material

Monthly groundnut raw material price during 2014 had been expressed in Figure 4.3 (b) and Table 4.6. Almost all the millers' buying prices from January to June were nearly the same. During these months, the lowest price was 880 thousand kyats per MT and the highest was 919 thousand kyats per MT. Started from July, the groundnut raw material price began rise because export price to China was increased. The result indicated that the raw material buying prices of Mill-I and Mill-II were comparatively lower than the others. After that, the price gradually increased and it was arrived to the highest price, 1144 thousand kyats per MT, in December.

According to the 2014 price data, it was observed an increasing trend in price. The price of raw material was related to the groundnut harvesting season of the study area. The harvesting period of groundnut in Myingyan area is from October to March. The sudden

increase in groundnut price caused raw material insufficiency for local oil mills. Therefore, local oil mills had to buy more from other areas, especially from Magway, Mandalay and Kyaukpandaung Townships. The price of raw material from Magway, Mandalay and Kyaukpandaung markets were usually higher than that of local market because of transportation cost. For Myingyan Township, the transportation cost from Magway, Mandalay, Kyaukpandaung and Mahlaing Townships were 27, 18, 15 and 10 kyats per viss respectively. Sometimes local oil mills had to buy raw material from Pyinmana and Lawe and the transportation cost was 30 kyats per viss from both townships.

Normally, large processing mills (Mill-III, IV and V) required a huge amount of raw material than small processing mills (Mill-I and II). In order to obtain sufficient amount, the large mills purchased the raw material with higher price than the small mills. However, in November and December, the millers' demand met with enough local supply, and so they didn't need to buy raw material from other areas. Therefore there was no price difference between these selected mills.

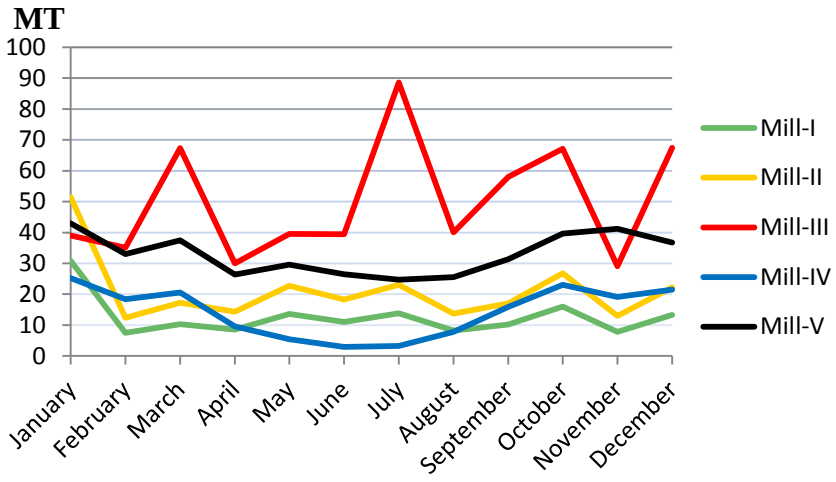
4.2.4 Oil output per month during 2014

As Mill-III processed the highest amount of raw materials, it also produced the highest amount of oil outputs (15-35 MT) during the whole year. Mill-V had more or less the same level of oil outputs from 10 to 17 MT for the whole year. Mill-I, II and IV produced oil outputs according to their amount of raw materials processed. They had the lowest amount of mill processing properly due to their weak competition in purchasing of raw materials (Figure 4.3 (c) and Table 4.7).

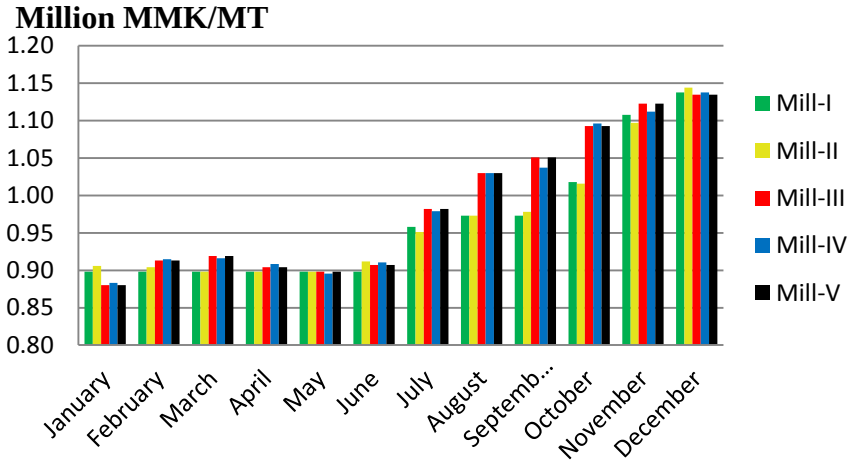
The amount of oil production of the mills was directly related to the amount of raw material processed and depended on the extraction rate and oil extraction method. Generally, the extraction rate of groundnut by using expeller method was ranging from 40 to 45 % of oil. In study area, the extraction rate of groundnut in selected mills was about 40 % of oil and 55 % of cake. It means that 100 kilogram of groundnut raw material could produce 40 kilogram of oil and 55 kilogram of cake with expeller mill. The remaining 5 % might be the moisture content of raw material and processing loss.

4.2.5 Monthly prices of groundnut oil in selected mills

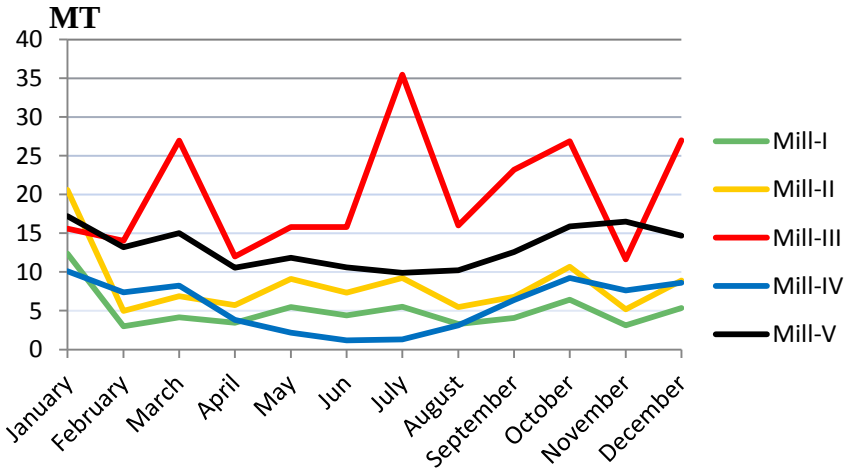
The monthly prices of groundnut oil for selected mills in the year 2014 are shown in Figure 4.3 (d) and Table 4.8. These prices were farmgate price of the mills. According to the year round data except January, the price trend of oil was the increasing trend and nearly the same with the raw material price trend. During 2014, the lowest price was 1647 thousand kyats per MT and the highest was 2275 thousand kyats per MT. For all mills, it was observed that there was a little change in the oil price and it was round about 1700 thousand kyats per MT in early months from January to June. But in July, Mill-I and II faced a sudden increase about 300 thousand kyats per MT in oil price from 1677 to 1976 thousand kyats per MT. In other 3 mills, such sudden increment was occurred in August. And then, the price of all mills was gradually increased and reached about 2275 thousand kyats per MT at the end of the year.



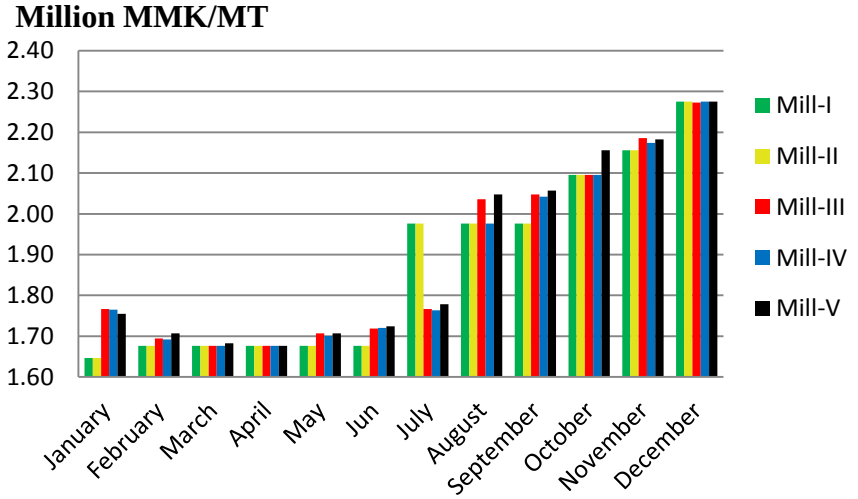
(a) Raw material processed per month of the selected mills



(b) Monthly raw material price of the selected mills



(c) Monthly oil output of the selected mills



(d) Monthly oil price of the selected mills

Figure 4.3 Economic comparison of oil production in selected mills

Table 4.5 Total amount of raw material (groundnut) processed of selected mills during 2014

Months	MT/month				
	Mill-I	**Mill-II**	**Mill-III**	**Mill-IV**	**Mill -V**
January	30.88	51.46	39.01	25.22	42.97
February	7.46	12.43	35.10	18.40	33.00
March	10.33	17.22	67.34	20.55	37.50
April	8.58	14.31	30.01	9.60	26.37
May	13.67	22.78	39.54	5.44	29.55
Jun	11.00	18.33	39.46	2.97	26.50
July	13.83	23.06	88.58	3.28	24.68
August	8.21	13.68	40.00	7.85	25.59
September	10.21	17.01	57.99	15.93	31.39
October	16.04	26.74	67.15	23.05	39.68
November	7.79	12.99	29.10	19.09	41.21
December	13.33	22.22	67.47	21.53	36.71
Total	**151.33**	**252.22**	**600.74**	**172.92**	**395.14**

Table 4.6 Price of raw material (groundnut) of selected mills during 2014

Months	Thousand MMK/MT				
	Mill-I	**Mill-II**	**Mill-III**	**Mill-IV**	**Mill -V**
January	898	906	880	883	880
February	898	904	913	915	913
March	898	898	919	916	919
April	898	898	904	908	904
May	898	898	898	896	898
Jun	898	912	907	911	907
July	958	951	982	979	982
August	973	973	1030	1030	1030
September	973	978	1051	1037	1051
October	1018	1016	1093	1096	1093
November	1108	1097	1123	1112	1123
December	1138	1144	1135	1138	1135
Average	**963**	**965**	**986**	**985**	**986**

Table 4.7 Oil output of selected mills during 2014

Months	MT/month				
	Mill-I	**Mill-II**	**Mill-III**	**Mill-IV**	**Mill-V**
January	12.35	20.58	15.60	10.09	17.19
February	2.98	4.97	14.04	7.36	13.20
March	4.13	6.89	26.94	8.22	15.00
April	3.43	5.72	12.00	3.84	10.55
May	5.47	9.11	15.81	2.18	11.82
Jun	4.40	7.33	15.78	1.19	10.60
July	5.53	9.22	35.43	1.31	9.87
August	3.28	5.47	16.00	3.14	10.24
September	4.08	6.81	23.19	6.37	12.55
October	6.42	10.69	26.86	9.22	15.87
November	3.12	5.19	11.64	7.64	16.48
December	5.33	8.89	26.99	8.61	14.68
Total	**60.53**	**100.89**	**240.30**	**69.17**	**158.06**

Table 4.8 Price of oil output of selected mills during 2014

Months	Thousand MMK per MT				
	Mill-I	**Mill-II**	**Mill-III**	**Mill-IV**	**Mill -V**
January	1647	1647	1766	1765	1754
February	1677	1677	1695	1692	1707
March	1677	1677	1677	1677	1683
April	1677	1677	1677	1677	1677
May	1677	1677	1707	1701	1707
Jun	1677	1677	1719	1720	1725
July	1976	1976	1766	1763	1778
August	1976	1976	2036	1976	2048
September	1976	1976	2048	2042	2057
October	2096	2096	2096	2096	2156
November	2156	2156	2186	2174	2183
December	2275	2275	2272	2275	2275
Average	**1874**	**1874**	**1887**	**1880**	**1896**

4.2.6 Monthly profits of selected oil mills

The monthly profits of selected oil mills are shown in Table 4.9. Most of the mills had been running the profitable condition during the year 2014. Mill-I faced the unprofitable condition for only one moth in February, Mill-II in Jun and Mill-III in July respectively. In Mill-IV, the unprofitable condition occurred for 6 months from March to August. However Mill-V operated the production under the profitable condition for the whole year. Among the mills, Mill-III had the highest amount of year around profit (20.99 million kyats) and Mill-IV had the lowest amount (4.57 million kyats).

In all mills, the highest profit was found in January and December. The result also indicated that the profit was mostly related to the amount of raw material processed in selected mills. However, in March and July, the profit of Mill-III and V declined even the amount of raw material increased. It can be explained that the amount of oil produced in one month could not be sold within this month and it had to continue selling till the following month.

4.2.7 Benefit-cost ratio over all costs of selected mills

The benefit-cost ratios over all costs of selected mills are shown in Table 4.10. Among the selected mills, Mill-II had the highest benefit-cost ratio (1.09) in July and September while Mill-IV had the lowest benefit-cost ratio (only 0.87) in July. BCR over variable cost was about 1.07 in Mill-II and 1.02 in Mill-IV (Table 4.11). For the whole year data, Mill-II had also the highest benefit cost ratio above total cost (1.05) and the lowest (1.00) in Mill-IV. BCR 1 means the break-even condition for long run. In the selected mills, the average BCR was only 1.03.

Table 4.9 Monthly profits of selected oil mills

Months	Profits (Thousand MMK)				
	Mill-I	**Mill-II**	**Mill-III**	**Mill-IV**	**Mill-V**
January	1,030	1,589	3,744	2,230	4,113
February	-70	185	854	256	1,138
March	184	585	329	-203	101
April	207	419	35	-245	224
May	179	391	1,341	-180	1,083
Jun	37	-103	922	-349	735
July	1,110	2,137	-1,563	-489	565
August	512	971	2,309	-72	1,551
September	837	1,523	3,175	751	1,720
October	1,840	3,337	3,166	674	2,581
November	130	631	995	727	1,767
December	754	1,403	5,684	1,466	2,923
Total	**6,751**	**13,069**	**20,991**	**4,566**	**17,373**

4.2.8 Break-even prices of raw material and oil (groundnut)

Break-even analysis is used to determine the point at which revenue received equals the costs associated with receiving the revenue. Break-even analysis calculates what is known as a margin of safety, the amount that revenues exceed the break-even point. This is the amount that revenues can fall while still staying above the break-even point. Break-even analysis is a supply-side analysis; it only analyzes the costs of the sales. It does not analyze how demand may be affected at different price levels. Break-even analysis looks at the level of fixed costs relative to the profit earned by each additional unit produced and sold. Fixed costs are expenses that an industry must pay independent of any business activity. In general, the industry with lower fixed costs will have a lower break-even point of sale.

The break-even prices for raw material in the selected oil mills during 2014 were shown in Figure 4.4. In Mill-I, the actual price of raw material was higher than that of break-even price in February and it was nearly the same in June. In Mill-II, the actual price of raw material was nearly the same with break-even price of raw material in June. In Mill-III and Mill-V, the actual price of raw material was higher than that of break-even price in July and it was nearly the same in March and April. In Mill-IV, the actual price of raw material was higher than that of break-even price from March to August. The break-even prices for oil in the selected oil mills during 2014 were shown in Figure 4.5. It was observed that the same conditions between actual price and break-even price of oil as raw material price in the selected mills.

According to the break-even analysis for raw material price, Mill-II faced the condition that the actual price of raw material was higher than that of break-even price in only one month during the whole year 2014. Similarly in Mill- II, the actual price of groundnut oil was lower than that of break-even price in only one month. It was assumed that Mill-II had the best situation in milling through the year.

Table 4.10 Benefit-cost ratios over all costs of selected mills

Months	Mill-I	Mill-II	Mill-III	Mill-IV	Mill-V
January	1.04	1.03	1.11	1.10	1.11
February	0.99	1.02	1.03	1.01	1.04
March	1.02	1.04	1.01	0.99	1.00
April	1.03	1.03	1.00	0.97	1.01
May	1.01	1.02	1.04	0.97	1.04
Jun	1.00	0.99	1.02	0.89	1.03
July	1.08	1.09	0.98	0.87	0.98
August	1.06	1.07	1.05	0.99	1.06
September	1.08	1.09	1.05	1.04	1.05
October	1.11	1.12	1.04	1.03	1.06
November	1.01	1.04	1.03	1.03	1.04
December	1.05	1.05	1.07	1.06	1.07
Average	**1.04**	**1.05**	**1.04**	**1.00**	**1.04**

Table 4.11 Benefit-cost ratios over variable costs of selected mills

Months	Mill-I	Mill-II	Mill-III	Mill-IV	Mill-V
January	1.05	1.05	1.12	1.11	1.12
February	1.01	1.04	1.04	1.03	1.05
March	1.04	1.06	1.02	1.01	1.02
April	1.05	1.05	1.01	1.00	1.03
May	1.03	1.04	1.05	1.00	1.06
Jun	1.02	1.01	1.04	0.94	1.05
July	1.10	1.11	0.99	0.91	1.00
August	1.08	1.09	1.07	1.02	1.08
September	1.10	1.11	1.06	1.06	1.07
October	1.13	1.14	1.05	1.04	1.07
November	1.03	1.06	1.04	1.05	1.05
December	1.06	1.07	1.08	1.07	1.08
Average	**1.06**	**1.07**	**1.05**	**1.02**	**1.06**

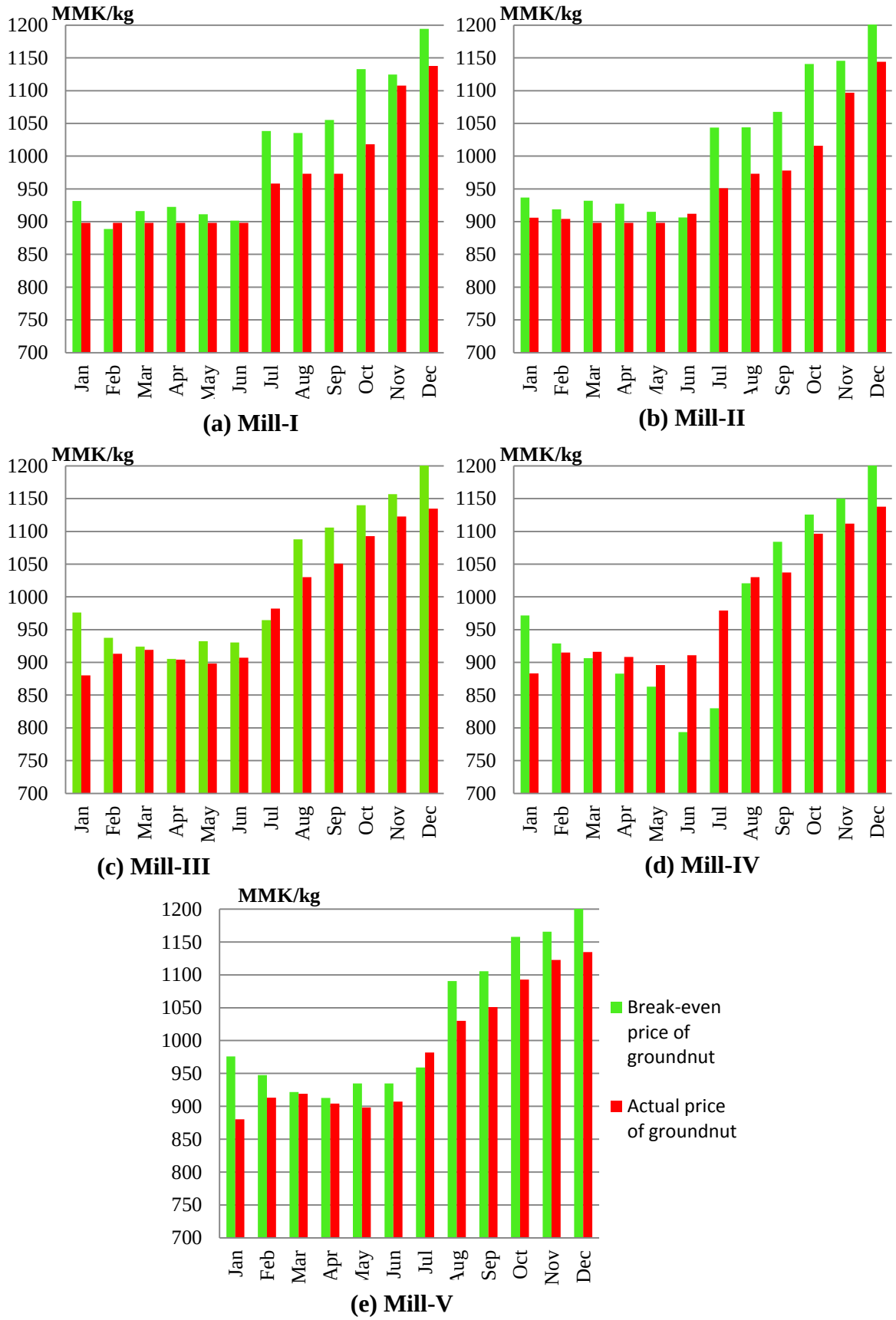


Figure 4.4 Break-even prices of raw material (groundnut) for selected mills

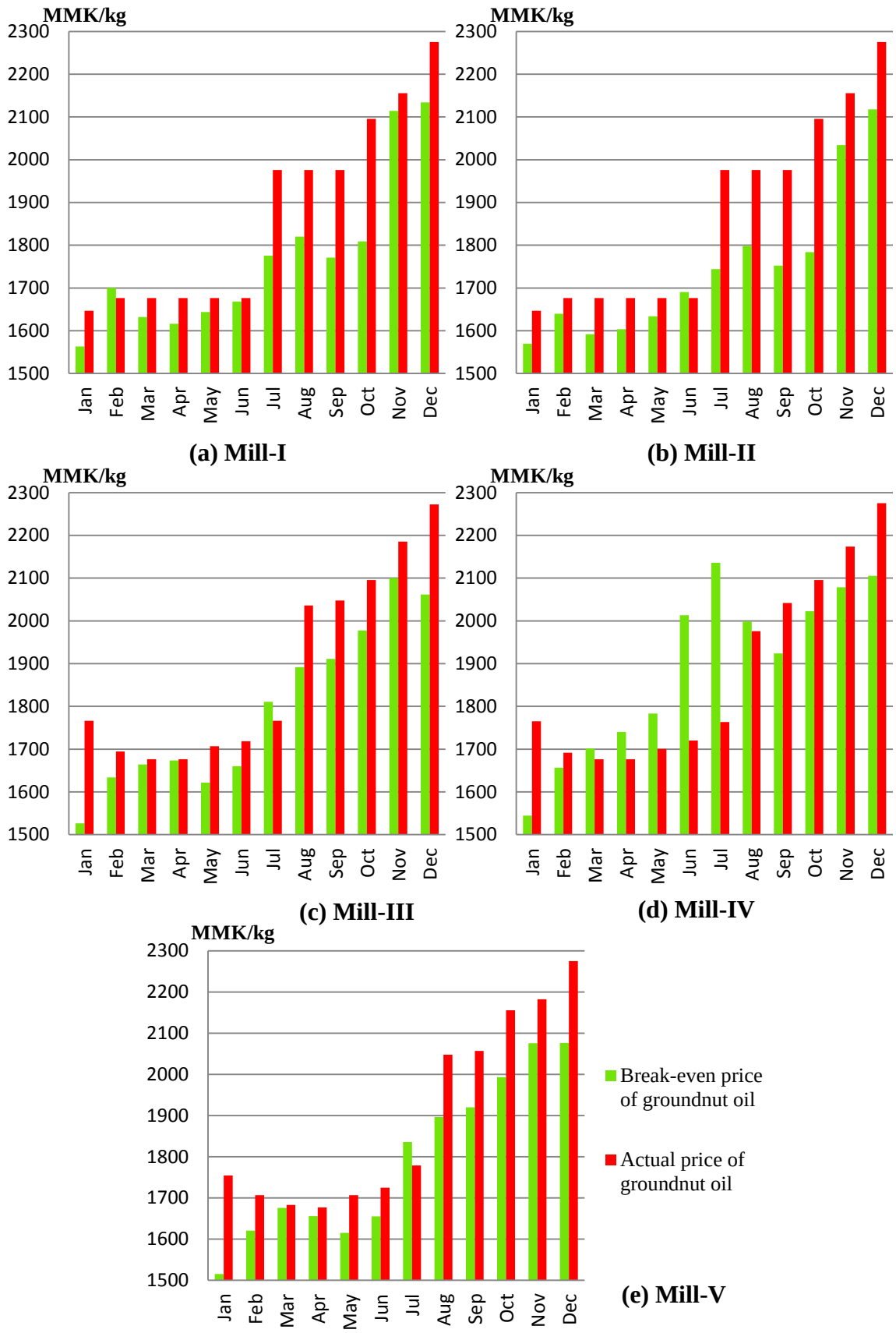


Figure 4.5 Break-even prices of groundnut oil for selected mills

4.3 The Determinant Factors on Profit of the Selected Oil Mills

In the regression analysis for the profit function of groundnut oil processing, the independent variables were processed raw material, groundnut price, oil price, cake price, labor cost, electricity cost and tax. Dummy variable was also used based on the groundnut harvesting season to know the seasonal effect. The mean, minimum and maximum values of the dependent and independent variables are given in Table 4.12.

According to the descriptive statistics, the selected mills had the average monthly profit of 1.05 million kyats and the average processed raw material was 26.21 ton per month. In the selected mills, the average price of raw material (groundnut), oil and cake were 977, 1882 and 544 kyats per kilogram respectively. For oil milling, the average monthly costs of labor and electricity were 238.97 and 150.85 thousand kyats correspondingly. The average amount paid for production tax was 19.20 thousand kyats.

Table 4.13 showed the regression analysis of the determinant factors on profit of the selected oil mills. According to the profit function of groundnut oil processing, oil processing profit of selected oil mills was positively and significantly influenced by processed raw material amount and oil price at 1% level and cake price at 5% level respectively. It means that increase in the raw material amount, price of oil and price of cake can increase the profit. The more increase in raw material amount, the more profit. If one percent increases in processed raw material, monthly profit will be increased by 0.78%. This situation reveals that those mills were running in profitable condition. Therefore, these mills should increase their productivity.

The increase in oil and cake price can cause the increase in profit. According to the regression estimates, if one percent increases in oil price and cake price, the oil processing monthly profit will be increased by 12.61% and 8.25% respectively. This situation coincided with the real situation.

Based on the nature of input price, groundnut price was negatively and significantly influenced on profit at 1 percent level. It means that if one percent increases in groundnut price, the monthly profit will be decreased by 16.22%. The adjusted R^2 points out that the model was significant and it can explain the variation in groundnut oil processing profit by 64%.

Table 4.12 Descriptive statistics of dependent and independent variables of the regression model

(n = 60)

Variables	Unit	Mean	Minimum	Maximum	Standard Deviation
Profit	million MMK/month	1.05	-1.56	5.68	1.29
Processed raw material (Groundnut)	kg/month	26206	2973	88578	17667.05
Groundnut price	MMK/kg	977	880	1144	88.18
Oil price	MMK/kg	1882	1647	2275	217.16
Cake price	MMK/kg	544	491	611	38.02
Labor cost	MMK/month	238967	105000	364000	77108.54
Electricity cost	MMK/month	150847	37600	549400	119487.41
Tax	MMK/month	19201	11583	29844	6229.33

Table 4.13 Regression result of the determinants on profit

(n = 60)

Variables	Unstandardized Coefficients (B)	Standardized Coefficients (β)	t-value	Sig.
Constant	-38.99***		-2.82	0.007
Processed raw material (Groundnut)	0.776***	0.46	3.978	0.000
Groundnut price	-16.217***	-1.177	-4.37	0.000
Oil price	12.613***	1.175	3.68	0.001
Cake price	8.245**	0.472	2.196	0.033
Labor cost	0.506	0.144	1.356	0.181
Electricity cost	-0.192	-0.116	-1.075	0.287
Tax	0.558	0.146	1.485	0.144
Season	-0.288	-0.12	-1.025	0.31

R^2 = 0.69, Adjusted R^2 = 0.642, F = 14.205***

Note: ***, ** and * are significant level at 1 %, 5 % and 10 % level respectively

CHAPTER V

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

In this study, the average age of the selected five millers was around 58 years old with about twenty-year experience in oil milling. Most of them finished secondary education level but only one female miller was a graduate. There were only three to five family members in selected millers' households. In the study area, the millers used only expeller type oil mill for oil production. This type is widely used for the extraction of oil from oilseeds throughout the country. The oil extraction process was relatively simple and not capital-intensive.

All mills started their operations since the Myingyan Industrial Zone was established in the year 2000. The major necessary fixed assets for oil milling were oil expeller, sieve for raw material, filtration unit for oil output and electric motor. The values of fixed assets were differing by purchase year because of inflation at that time. In selected mills, Mill-V had the highest total fixed costs of assets (14.3 million kyats).

Considering the cost of oil milling, there were major three items: fixed investment, raw material and processing costs. In fixed investment cost, interest for working capital was the major proportion. The interest for working capital was directly related to the amount of raw material processed. Among these three items, raw material cost was the highest proportion of the total costs (96.49%). Therefore, fixed investment cost and processing cost had less influence on oil milling. This condition revealed that these mills required capital to expand their production. If the government fulfills this capital requirement, they will continue their operation properly. And then they can compete with other imported edible oil.

Among the selected mills, Mill-III had the largest number of working days. Mill-III had the highest proportion of interest for working capital and the lowest proportion of labor cost. It can be concluded that Mill-III processed the highest amount of raw materials with the most effective labor utilization. The amount of oil production of the mills was directly related to the amount of raw material processed and depended on the extraction rate and oil extraction method of oil mill. The extraction rate with expeller method of selected mills was about 40% of oil and 55% of cake. The remaining 5% were the

moisture content of raw material and processing loss. Therefore, Mill-III also produced the highest amount of oil outputs among the selected mills.

Although there were increasing trends in both raw material and oil price, the raw material buying prices of Mill-I and Mill-II were comparatively lower than the others mills in 2014. It revealed that they were more efficient in buying of raw material. The price of raw material was directly related to the groundnut harvesting season in the study area. The groundnut harvesting period in Myingyan area was from October to March. During off-season, the major raw material sources were Magway, Mandalay and Kyaukpandaung markets for all mills.

According to profitability analysis, most of the mills had been running with profitable condition during the year 2014. Among the mills, Mill-III had the highest amount of year round profits (20.99 million kyats) probably due to the processing of higher amount of raw material. In benefit-cost analysis, there was no much different between BCR over all costs and over variable costs. Mill-II had the highest BCR over all costs (1.05) and over variable costs (1.07). Based on the results of the break-even analysis for raw material price and oil price, it was assumed that Mill-II had the best situation in milling through the year. These results were consistent with the results found in the benefit-cost analysis.

Regarding to regression analysis of profit function, the significant influencing factors of monthly profit in the selected mills were processed raw material amount, groundnut price, oil price and cake price. Monthly profit had positive relationship with processed raw material amount, oil price and cake price, and had negative relationship with groundnut price. Other things being equal, if one percent increased in raw material amount, oil price and cake price, monthly profit was increased by 0.78%, 12.61% and 8.25% respectively. If groundnut price was increased by 1%, the monthly profit will be decreased by 16.22%. The adjusted R^2 points out that the model was significant and it can explain the variation in groundnut oil processing profit by 64%.

5.2 Recommendation

According to the results, it was observed the underutilization of the mills' capacities. Based on the results, it was found that the selected mills were operating underutilized condition. Although they had a lot of investment, they were getting average only 1.03 BCR indicating that this very low BCR made millers not to expand their

business. The business environment seems to have no attractive to use full capacity. Edible oil market was unfavorable for the domestic oil mills because of these reasons: *first*, imported palm oil price was much lower than the domestic market price of groundnut oil; *second*, farmers wanted to sell their groundnut to export market rather than to millers because export price was higher than the price paid by millers; *third*, pure groundnut oil market was distorted by mixing different cheaper oils such as palm oil, cotton seed oil and so on, adding with artificial flavor; and *finally*, consumers did not want to pay higher price for groundnut oil since they cannot easily distinguish the quality.

To be an attractive business environment of the oil mills, the following points are recommended. *First*, increasing the public awareness on groundnut oil that is suitable for health; *second*, ethics of businessmen involved in edible oil industry will have to improve by reinforcing the consumer protection law, Food and Drug Administration law and etc.; and *third*, if any, several classes of groundnut oils in the market, which are variously mixed with other edible oils, must be easily distinguished by consumers in order to choose their necessary demand. The last and important fact is the capital investment aids from the government and the millers and/or edible oil merchant association to be reduces the over burden of interest for working capital loans.

REFERENCES

Abe, M. 2013. New Three-Year Policy Framework for the Development of SMEs in Myanmar (2014-2016). Unpublished.

Abe, M. and M. K. Dutta. 2014. A new policy framework for Myanmar's SME development (No. 142). United Nations Economic and Social Commission for Asia and the Pacific (ESCAP).

Anukoonwattaka, W. and M. Mikic 2012. Myanmar: Opening Up to Its Trade and Foreign Direct Investment Potential. UNESCAP Trade and Investment Division, Staff Working Paper 01/12. Bangkok.

Asibuo, J. Y., R. Akromah, O. Safo-Kantanka, H. K. Adu-Dapaah, S. Ohemeng-Dapaah, and A. Agyeman. 2008. Chemical composition of groundnut, *Arachis hypogaea* (L) landraces. African Journal of Biotechnology, 7(13).

Ayyagari, M and T. Beck. 2003. Small and medium enterprises across the globe: A new database, World Bank Policy Research Working Paper No. 3127. Washington, DC: World Bank

Azhagaiah, R. and R. Deepa. 2012. Determinants of Profitability of Food Industry in India: A Size-Wise Analysis. Management (18544223), 7(2).

Balio, T. 2009. United Artists. The Company That Changed the Film Industry. Volume 2, 1951–1978. University of Wisconsin Press.

Boonen, S. J. 2007. Determinants of innovation in SMEs: comparing family and non-family SMEs in The Netherlands (Top Thesis).

Bwar, A. C. 2000. Myanma Food Consumption Pattern and Edible Oil (Myanma Sar Thone Mu Da Lae Hnint Sar Thone Si) (In Myanmar). Yangon: Time Linn Books.

DoA. 2015. Major crop production in Myingyan Township. Department of Agriculture. Myingyan Township, Ministry of Agriculture and Irrigation, Myanmar.

FAO. 2004. Myanmar oilcrops development project (FAO/TCP/MYA/2904). Preparation Report. Voulme 1 – Main Report, Investment Centre Division. Rome.

Favre, R. and K. Myint. 2009. An analysis of the Myanmar edible oil crops sub-sector. Rural Infrastructure and Agro-Industries Division, Food and Agriculture Organization of the United Nations.

Harvie, C. and B. C. Lee. 2005. Public policy and SME development. Sustaining Growth and Performance in East Asia: The Role of Small and Medium Sized Enterprises, 3(11.3), p.301.

IFC. 2010. The SME Banking Knowledge Guide. International Finance Corporation, World Bank Group. Washington D.C. Available from ww.ifc.org/wps/wcm/connect/b4f9 be0049585ff9a192b519583b6d16/SMEE.pdf?MOD=AJPERES.

Kyaw, A. 2008. Financing Small and Medium Enterprises in Myanmar. Institute of Developing Economies - Japanese External Trade Corporation. IDE Discussion Paper No. 148. April 2008. Chiba

Linn, T. 2013. Value chain analysis of sesame in Magway Township, Research report, Yezin Agricultural Univesrity.

Lusas E.W. 1979. Food uses of peanut protein. Journal of the American Oil Chemists' Society 56:425-430. DOI: 10.1007/bf02671530

Mandefro, F., S. Drost, and J. van Wijk. 2011. The Edible Oil and Oilseeds Value Chain in Ethiopia.

MOC. 2013. Small-Scale Industries Department, Ministry of Co-operatives. Myanmar.

Moe, S. A. 2015. The impact of world palm oil price changes on edible oil industry of Myanmar, Master Thesis, Yezin Agricultural University.

MOHA. 2014. General Description of Myingyan Township, General Administrative Department, Ministry of Home Affaire. Myanmar.

MOI 2006. Central Department of SME Development, Ministry of Industry. Myanmar.

MOI. 2012. Central Department of SME Development, Ministry of Industry. Myanmar.

Ntare, B. R. 2007. Arachis hypogaea L., in: H. A. M. v. d. Vossen and G. S. Mkamilo (Eds.), PROTA

Nyein, K. M., P. Sirisupluxana, and B. Titapiwatanakun. 2010. The Effects of Trade Liberalization on Groundnut Market in Myanmar. Applied Economic Journals, 17 (1), 27-41. (Plant Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale), http://www.prota4u.org/search.asp, Wageningen.

Savage, G.P. and J. I. Keenan. 1994. The composition and nutritive value of groundnut kernels. In The Groundnut Crop (pp. 173-213). Springer Netherlands.

Sertse, Y., M. D. R. d. Wildt, Y. Dijkxhoorn, and M. G. Danse. 2011. Small-scale edible oil milling operations: Alternative business models for Ethiopia.

Shizuki, N. 2001. SME development. Excerpts from United Nations Industrial Development Organization paper for Gulf Organization Industrial Consulting conference. May 2001.

Stankov, K., St. Stoyanova, and D. Petrov. 2015. Regression analysis of profit per 1 kg milk produced in selected dairy cattle farms. International Journal of Current Microbiology Applied Sciences. ISSN: 2319-7706 Volume 4 Number 2 (pp. 713-719). http://www.ijcmas.com

Thaung, N. N. 2011. Integration of Myanmar Domestic Agricultural Marketing into ASEAN. Journal of Management Policy and Practice, 12 (5), 99-101

Tun, A. M. 2013. Study on Myanmar edible oil market: Inflow of palm oil from international market and domestic edible oil market volatility, Master Thesis, Ritsumeika University.

Tun, H. H. 2013. Supply chain management of groundnut production in Magway Township, Master Thesis, Yezin Agricultural University.

UNIDO. 2008. United Nations Industrial Development Organization, Small-scale oil extraction from groundnuts and copra. Technology ser. UNIDO/ILO technical memorandum.

Wijnands, J.H., J. Biersteker, L. F. Hagedoorn, and W. J. Louisse. 2014. Business opportunities and food safety of the Myanmar edible oil sector. LEI Wageningen UR.

World Bank. 2006. International Financial Corporation Report: Micro, Small and Medium Enterprises. Washington D.C.: The World Bank.

APPENDICES

Appendix 1 Sectorial distributions of SMEs in Myanmar

No.	SMIs	Quantity of SMEs			
		Large	**Medium**	**Small**	**Total**
1	Food & Beverages Industries	2369	4110	20976	27455
2	Clothing & wearing apparel Industries	341	380	1001	1722
3	Construction materials Industries	510	650	2117	3277
4	Personal goods Industries	375	410	330	1115
5	Consumer Produce Industries	144	79	97	320
6	Literature and Art Industries	60	117	183	360
7	Raw good production Industries	169	240	282	691
8	Metal and Mineral Production Industries	315	381	1204	1900
9	Agriculture Machinery Industries	9	25	37	71
10	Industrial tools and equipment production Industries	15	49	66	130
11	Automobile production Industries	194	40	33	267
12	Electrical equipment Industries	43	15	12	70
13	General Industries	264	791	4799	5854
	Total	**4808**	**7287**	**31137**	**43232**

Source: Central Department of SME Development, MOI 2012

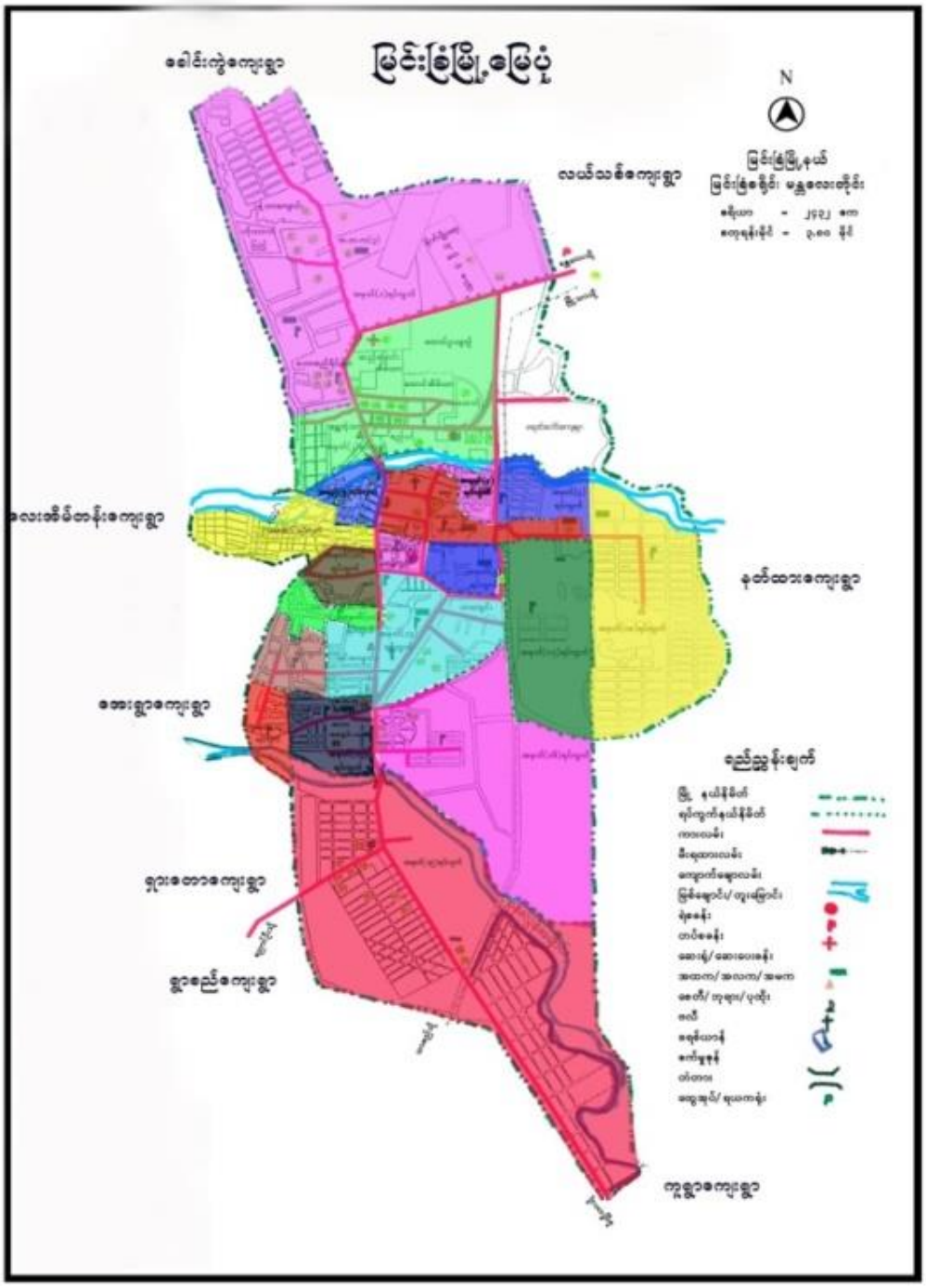
Appendix 2 Quantity of SMEs in Mandalay Regions

No.	Townships	Quantity of SMEs			
		Large	**Medium**	**Small**	**Total**
1	Aungmyethazan	14	39	23	**76**
2	Chanayethazan	6	22	16	**44**
3	Mahaaungmye	4	8	9	**21**
4	Chanmyathazi	2	9	2	**13**
5	Pyigyidagun	29	45	2	**76**
6	Amarapura	2	11	6	**19**
7	Patheingyi	2	0	2	**4**
8	Pyinoolwin	1	1	1	**3**
9	Madaya	0	4	12	**16**
10	Singu	0	1	2	**3**
11	Mogok	0	0	1	**1**
12	Thabeikkyin	0	0	0	**0**
13	Kyaukse	2	7	16	**25**
14	Sintgaing	0	5	3	**8**
15	Myittha	1	5	12	**18**
16	Tada-U	0	4	11	**15**
17	Myingyan	26	60	5	**91**
18	Taungtha	0	8	21	**29**
19	Natogyi	0	16	7	**23**
20	Kyaukpadaung	3	20	32	**55**
21	Nyaung-U	0	2	7	**9**
22	Yamethin	0	5	9	**14**
23	Pyawbwe	0	5	13	**18**
24	Meiktila	4	24	16	**44**
25	Mahlaing	0	20	16	**36**
26	Thazi	2	11	5	**18**
27	Wundwin	1	9	0	**10**
28	Ngazun	5	0	1	**6**
	Total	**104**	**341**	**250**	**695**

Remark: Large ≥ 50 hp, Medium = 25-50 hp, Small ≤ 25 hp

Source: Central Department of SME Development, MOI 2012

Appendix 3 Map of Myingyan Township



Appendix 4 Compositions in fixed investment cost of selected mills

No.	Item	Thousand MMK/month				
		Mill-I	**Mill-II**	**Mill-III**	**Mill-IV**	**Mill-V**
1.	Rental value of land	60	30	30	30	60
2.	Building	236	744	248	248	434
3.	Oil-expeller	298	248	409	558	993
4.	Filtration	43	43	43	62	124
5.	Sieve	212	195	35	18	53
6.	Electric motor	18	106	124	124	177
7.	Maintenance cost	304	304	341	435	773
8.	Interest for working capital	1,449	2,421	5,985	1,731	3,917
	Total fixed investment cost	**2,620**	**4,091**	**7,216**	**3,206**	**6,531**

Appendix 5 Compositions in processing cost of selected mills

No.	Item	Thousand MMK/month				
		Mill-I	**Mill-II**	**Mill-III**	**Mill-IV**	**Mill-V**
1.	Electricity	98	55	353	135	112
2.	Filter cloth	5	5	4	8	8
3.	Drum	25	23	50	50	50
4.	Labor	158	220	364	225	228
5.	Tax	12	15	21	19	30
	Total Processing costs	298	319	792	437	428

Appendix 6 Raw material cost of selected mills during 2014

Month	Thousand MMK/month				
	Mill-I	**Mill-II**	**Mill-III**	**Mill-IV**	**Mill-V**
January	27,732	46,621	34,337	22,273	37,820
February	6,699	11,237	32,050	16,833	30,134
March	9,281	15,466	61,899	18,830	34,471
April	7,710	12,846	27,135	8,723	23,843
May	12,275	20,454	35,513	4,877	26,540
Jun	9,880	16,720	35,798	2,707	24,039
July	13,253	21,926	86,987	3,213	24,239
August	7,987	13,311	41,203	8,084	26,357
September	9,933	16,640	60,937	16,523	32,983
October	16,330	27,164	73,382	25,268	43,362
November	8,631	14,246	32,672	21,226	46,271
December	15,170	25,422	76,556	24,501	41,652
Total	**144,883**	**242,053**	**598,468**	**173,056**	**391,712**

Appendix 7 Break-even prices of raw material (groundnut) for selected mills

Months	MMK/Kg									
	Mill-I		Mill-II		Mill-III		Mill-IV		Mill-V	
	Break-even price	Actual price	Break-even price	Actual price	Break-even price	Actual price	Break-even price	Actual price	Break-even price	Actual price
January	932	898	937	906	976	880	972	883	976	880
February	889	898	919	904	938	913	929	915	948	913
March	916	898	932	898	924	919	906	916	922	919
April	922	898	927	898	905	904	883	908	913	904
May	911	898	915	898	932	898	863	896	935	898
Jun	902	898	906	912	931	907	794	911	935	907
July	1038	958	1044	951	964	982	830	979	959	982
August	1035	973	1044	973	1088	1030	1021	1030	1091	1030
September	1055	973	1068	978	1106	1051	1084	1037	1106	1051
October	1133	1018	1141	1016	1140	1093	1126	1096	1158	1093
November	1124	1108	1146	1097	1157	1123	1150	1112	1166	1123
December	1194	1138	1207	1144	1219	1135	1206	1138	1214	1135

Appendix 8 Break-even prices of groundnut oil for selected mills

Months	MMK/Kg									
	Mill-I		Mill-II		Mill-III		Mill-IV		Mill-V	
	Break-even price	Actual price	Break-even price	Actual price	Break-even price	Actual price	Break-even price	Actual price	Break-even price	Actual price
January	1563	1647	1569	1647	1527	1766	1544	1765	1515	1754
February	1700	1677	1639	1677	1634	1695	1657	1692	1620	1707
March	1632	1677	1592	1677	1664	1677	1701	1677	1676	1683
April	1616	1677	1603	1677	1674	1677	1740	1677	1655	1677
May	1644	1677	1634	1677	1622	1707	1783	1701	1615	1707
Jun	1668	1677	1691	1677	1660	1719	2013	1720	1655	1725
July	1775	1976	1744	1976	1811	1766	2136	1763	1836	1778
August	1820	1976	1799	1976	1892	2036	1999	1976	1896	2048
September	1771	1976	1752	1976	1911	2048	1924	2042	1920	2057
October	1809	2096	1784	2096	1978	2096	2023	2096	1993	2156
November	2114	2156	2034	2156	2100	2186	2078	2174	2075	2183
December	2134	2275	2118	2275	2062	2272	2105	2275	2076	2275

Appendix 9 Present worth of an annuity factor

	5%	6%	8%	10%	12%	14%	15%	16%	18%	20%	22%	24%	25%	26%	28%	50%	55%	40%
1	0.952	0.945	0.926	0.909	0.895	0.877	0.870	0.862	0.847	0.855	0.820	0.806	0.800	0.794	0.781	0.769	0.741	0.714
2	1.859	1.855	1.785	1.756	1.690	1.647	1.626	1.605	1.566	1.528	1.492	1.457	1.440	1.424	1.592	1.561	1.289	1.224
5	2.725	2.675	2.577	2.487	2.402	2.522	2.285	2.246	2.174	2.106	2.042	1.901	1.952	1.925	1.868	1.816	1.696	1.589
4	5.546	5.465	5.512	5.170	5.057	2.914	2.855	2.798	2.690	2.589	2.494	2.404	2.562	2.520	2.241	2.166	1.997	1.849
5	4.550	4.212	5.995	5.791	5.605	5.455	5.552	5.274	5.127	2.991	2.864	2.745	2.689	2.655	2.552	2.456	2.220	2.055
6	5.076	4.917	4.625	4.555	4.111	5.889	5.784	5.685	5.498	5.526	5.167	5.020	2.951	2.885	2.759	2.645	2.585	2.168
7	5.786	5.582	5.206	4.868	4.564	4.288	4.160	4.059	5.812	5.605	5.416	5.242	5.161	5.085	2.957	2.802	2.508	2.265
8	6.465	6.210	5.747	5.555	4.968	4.659	4.487	4.544	4.078	5.857	5.619	5.421	5.529	5.241	5.076	2.925	2.598	2.551
9	7.108	6.802	6.247	5.759	5.528	4.946	4.772	4.607	4.505	4.051	5.786	5.566	5.465	5.566	5.184	5.019	2.665	2.579
10	7.722	7.560	6.710	6.145	5.650	5.216	5.019	4.855	4.494	4.192	5.925	5.682	5.571	5.465	5.269	5.092	2.715	2.414
11	8.506	7.887	7.159	6.495	5.958	5.455	5.254	5.029	4.656	4.527	4.055	5.776	5.656	5.544	5.555	5.147	2.752	2.458
12	8.865	8.584	7.556	6.814	6.194	5.660	5.421	5.197	4.795	4.459	4.127	5.851	5.725	5.606	5.587	5.190	2.779	2.456
13	9.594	8.855	7.904	7.105	6.424	5.842	5.585	5.542	4.910	4.555	4.205	5.912	.5.780	5.656	5.427	5.225	2.799	2.468
14	9.899	9.295	8.244	7.567	6.628	6.002	5.724	5.468	5.008	4.611	4.265	5.962	5.824	5.695	5.459	5.249	2.814	2.477
15	10.580	9.712	8.559	7.606	6.811	6.142	5.847	5.575	5.092	4.675	4.515	4.001	5.859	5.726	5.485	5.268	2.825	2.484
16	10.858	10.106	8.851	7.824	6.974	6.265	5.954	5.669	5.162	4.750	4.557	4.055	5.887	5.751	5.505	5.285	2.854	2.489
17	11.274	10.477	9.122	8.022	7.120	6.575	6.047	5.749	5.222	4.775	4.591	4.059	5.910	5.771	5.518	5.295	2.840	2.492
18	11.690	10.828	9.572	8.201	7.250	6.467	6.128	5.818	5.275	4.812	4.419	4.080	5.928	5.786	5.529	5.504	2.844	2.494
19	12.085	11.158	9.604	8.565	7.566	6.550	6.198	5.877	5.516	4.844	4.442	4.097	5.942	5.799	5.559	5.511	2.848	2.496
20	12.462	11.470	9.818	8.514	7.469	6.625	6.259	5.929	5.555	4.870	4.460	4.110	5.954	5.808	5.546	5.516	2.850	2.497
21	12.821	11.764	10.017	8.649	7.562	6.687	6.512	5.975	5.584	4.891	4.476	4.121	5.965	5.816	5.551	5.520	2.852	2.49E
22	15.165	12.042	10.201	8.772	7.645	6.745	6.559	6.011	5.410	4.909	4.488	4.150	5.970	5.822	5.556	5.525	2.855	2.498
25	15.489	12.505	10.571	8.885	7.718	6.792	6.599	6.044	5.452	4.925	4.499	4.157	5.976	5.827	5.559	5.525	2.854	2.499
24	15.799	12.550	10.529	8.985	7.784	6.855	6.454	6.075	5.451	4.957	4.507	4.145	5.981	5.851	5.562	5.527	2.855	2.499
25	14.094	12.785	10.675	9.077	7.845	6.875	6.464	6.097	5.467	4.948	4.514	4.147	5.985	5.854	5.564	5.529	2.856	2.499

Source: UNIDO (2008)

Appendix 10 Food and drug Administration laboratory analysis on edible fats and oils

No.	Foodstuff	Laboratory analysis
1.	**Edible fats, oils and related products**	**Quality characteristics**
	Imported RBD palm oil	a) Colour
	Olive oil	b) Odour and taste
	Shortening	c) Acid value (% mm or mg KOH/g of oil)
	Margarine	d) Peroxide value (meq active oxygen/kg of oil)
	Bakery fat	e) Rancidity
2.	**Local production**	**Chemical and physical characteristics**
	Groundnut oil	a) Relative density
	Sesame oil	b) Refractive index
	Soybean oil	c) Saponification value (mg KOH/g oil)
	Sunflower oil	d) Iodine value (5m/m absorbed iodine)
	Maize oil	e) Unsaponifiable matter (g/kg)
		Identity characteristics
		a) GLC range of fatty acid composition (Expressed as % mm of monthly osters)
		b) Slip point
		Contaminants
		a) Volatile matter at 105 centigrade
		b) Insoluble impurities
		c) Soap content
		d) Mineral oils fats

Source: FDA