YANGON UNIVERSITY OF ECONOMICS
MASTER OF PUBLIC ADMINISTRATION PROGRAMME

A STUDY OF PUBLIC AWARENESS ON EDIBLE OIL CONSUMPTION IN MYANMAR

(Case Study: Insein Township and Mayangon Township)

ZAW KO LAT
EMPA - 79 (15th BATCH)

AUGUST, 2019

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A thesis submitted in partial fulfillment of the requirements for the Master of Public Administration (MPA) Degree

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Abstract

This study is an attempt to analyze public awareness, usage of edible oil and health risks in Myanmar. The study is based on the secondary and primary data from three selected regions as in Insein Township and Mayangone Township. Descriptive method was used to identify public awareness usage of edible oil and health risks in Myanmar. The simple random sampling method was used in drawing the sample of household for the study. The key factors include living standard, awareness, and health risks. The majority of respondents did not have knowledge about usages of edible oil and health risks. This study observed that Majority of the respondents are females, most of the respondents belong to the age group of 31 to 50 years. Most of the respondent uses palm oil or mixed oil. Most of the respondent purchase edible oil from local bazaar and home shop. The majority of respondents did not aware about fat content, FDA registered label and heart and other diseases can cause by consuming reuse cooking oil.

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List of Abbreviations

CEXCs	:	Crop Exchange Centre
COMA	:	Committee on Medical Aspects of Food and Nutrition Policy
CHD	:	Coronary Heart Disease
CPO	:	Crude Palm Oil
CVD	:	Cardio Vascular Diseases
EFAs	:	Essential Fatty Acids
EU	:	European Union
FAO	:	Food and Agriculture Organization
FFA	:	Free Fatty Acids
JOCS	:	Japan Oil Chemists' Society
LA	:	Linoleic Acid
LDL	:	Low-Density Lipoprotein
MAS	:	Myanmar Agricultural Service
MEDA	:	Myanmar Edible Oil Dealer Association
MIS	:	Government Market Information Service
MOCDP	:	Myanmar Oil Crops Development Project
MUFA	:	Monounsaturated Fatty Acid
NCDs	:	Non-Communicable Diseases
NDNS	:	National Diet and Nutrition Survey
PUFA	:	Polyunsaturated Fatty Acid
RBD	:	Refined Bleached Deodorize
UMEH	:	Union of Myanmar Economic Holding
USDA	:	United States Department of Agriculture
WB	:	World Bank

CHAPTER 1
INTRODUCTION

1.1 Rationale of the Study

Edible oil, in accordance with its traditional uses, plays an important role in Myanmar and is considered as the second most important food item after rice. Edible oil is essential ingredient in Myanmar's daily meal, which accounts for 6% of average monthly expenditure on essential foods (CSO, 2006). For domestic consumption, the oil seed crops are generally grown in the different agro-ecological zones in Myanmar. Over 79% of the total oil seed crops production comes from Central Myanmar: Sagaing, Magway and Mandalay Region. Major oil seed crops are groundnut, sesame, sunflower, niger, mustard, coconut and oil palm.

Among them, groundnut is the most important oil seed crop which has been grown both in rain-fed and in irrigated areas and sesame occupied the largest sown area. In Myanmar, total population is about 52 million (2015) and per capita consumption of edible oil is about 9.3 kg annually (10 kg for urban and 8.6 kg for rural). So, the annual edible oil requirement is about 500,000 MT. Restaurants and industry use 250,000 MT, thus total utilization is 750,000 MT. However, 60% of the total oil seed crop production is used for edible oil production, which is about 330,000 MT. Therefore, the country's edible oil production is insufficient for domestic requirements.

To bridge the gap between the demand and supply, cheaper palm oil is imported from neighboring countries, mainly from Malaysia (Thaung, 2011). Myanmar's edible oil in 2015-2016 was found to be only a small fraction (8.6%) of refined oil, bleached and deodorized. The only two locally produced major edible oils directly marketed in large volume in Myanmar are groundnut and sesame oil. Niger and mustard can be found on the market in small volumes. Soybean, sunflower and rice bran oils are rarely found as pure oils in the market. Palm oil is the main edible oil consumed in Myanmar and accounts for an estimated 53% of the total consumption. Palm oil is sold either pure or mixed with groundnut and sesame oil in the market.

Myanmar is experiencing a deficit of edible oil and needs to import 30% of the local consumption each year in order to meet demand, according to sources from Myanmar Edible Oil Dealer's Association (Myanmar business today journal, October 24, 2013). Edible oil import is a major source of supply to meet local edible oil market requirement. Domestic edible oil prices seem to be significantly influenced by the palm oil import quantity and price. The most important thing is to adjust seasonal palm oil imports appropriately and to avoid negative impacts on the productivity of domestic oil and oilseed crops. The current status of inflow of palm oil into Myanmar's oilseed crops sector has several negative impacts for oilseed farmers, consumers and the national economy. These impacts slow down the productivity growth, destabilize market prices, lower rural household incomes and raise consumers' concerns over health due to lack of nutrition.

1.2 Objective of the Study

The objective of this thesis is to analyze the public awareness on consuming the edible oil and health risk in Mayangone and Insein Township..

1.3 Method of Study

The descriptive method is used based on primary and secondary data using questionnaires. The primary data are collected by a survey with individuals as diversity and inclusion of different actors such as retailers and wholesalers, and consumers. The secondary data were collected from related agricultural reports, documents, articles, papers and websites, etc.

The research questionnaires were prepared for customers with randomly selected of 125 respondents in (2) selected different townships in Yangon, and conducted from 21st May – 30th June 2019. Convenient sampling method was used in this study. Data were collected on age, sex, and marital status, highest level of education attained, income status, and awareness on edible oil usage and health risk, kind of edible oil, nutrition and public health, about price factor and consumption quantity.

1.4 Scope and Limitations of the Study

The study of edible oil is a great extent and this study is mainly concerned with the consumption common edible oil (groundnut, sesame, sunflower and palm oil) and health risk in Myanmar.

1.5 Organization of the Study

This thesis is organized into five chapters including this introduction in Chapter One. Chapter Two is Literature Review and policies frame work. Chapter Three covers a study on edible oil production in Myanmar. Chapter Four looks into survey analysis. The analyzed data is presented in tables and percentages where applicable. Chapter Five entails Conclusion which includes findings and recommendation drawn from the findings.

CHAPTER (2)
LITERATURE REVIEW

2.1 Cooking Oils and Usage

Cooking oils are an integral part of a human diet as they are used in almost all types of food preparations including frying, baking, sautéing, dressing, marinades and extrusion cooking. There are various types of cooking oils classified based on their different sources, examples include palm oil, arachis oil (peanut/groundnut oil), coconut oil, avocado oil, fish oil, flax oil, soybean oil, canola oil, sunflower oil, olive oil, corn oil, sesame oil and other vegetable oils. Cooking oils are an indispensable part of our daily diet because they serve as sources of lipid which is an important source of energy, a major part of biomembrane and serve as building blocks for several hormones. Furthermore, the nutritive value and health benefits of these oils are enormous and this can be attributed to their respective constituents such as fatty acid composition (the proportion of saturated to unsaturated fats; and monounsaturated to polyunsaturated fats) and types of natural antioxidants including vitamin A, vitamin E and carotenoids which protect cells and tissues from being damaged by free radicals.

Cooking oils are either consumed fresh or thermally oxidized, but mostly thermally oxidized (Oboh et al., 2014). Thermal oxidation occurs when the fresh form of cooking oils is heated at high temperatures during various food preparations to increase palatability. Thermal oxidation is a usual domestic practice in Africa to improve organoleptic properties of food (Warner, 2004). This practice is not limited to various homes; it is also a regular practice in restaurants and commercial food industry where deep-fat frying and baking occur at very high temperatures. In the commercial food industry, reuse of cooking oils over a period of time is common in order to maximize profit. During cooking, various chemical reactions occur including thermal oxidation, due to oil exposure to high temperatures in the presence of air and moisture. Consequently, cooking oil disintegrates and generates volatile compounds; different monomers and polymers (Andrikopoulos et al., 2002). Some of the major

factors that influence the value of cooking oil in the course of food preparations include temperature, heating period, oil type, level of saturation, and the presence of antioxidant (Gupta, 2005).

Heating cooking oil beyond a particular temperature may change its physicochemical characteristics (Oboh et al., 2014). However, the resistance and stability of different cooking oils to thermal oxidation varies as this is dependent on their fatty acid compositions, wherein oils with higher polyunsaturated fatty acids are more prone to thermal oxidation, those with higher saturated fat such as palm oil are capable of withstanding heat at high temperatures (Matthaus, 2007). The mechanistic operation of thermal oxidation is said to be similar to that of autooxidation. However, the rate of thermal oxidation is faster and occurs through a free radical mechanism of chain reactions which involve initiation, propagation and termination (Choe & Min, 2007). Moreover, studies have revealed that thermal oxidation has a deteriorative effect on cooking oils, but despite these reports the practice seems to persist. Therefore, this review gives an overview of some commonly consumed cooking oils, the effects of thermal oxidation on their nutritional qualities and the possible health implications (Oboh et al., 2014).

2.2 Types of Oil

Palm Oil

Palm oil is an extract from the ripe mesocarp of the oil palm fruits (Elaeis guineensis) with Indonesia, Malaysia, Thailand, Colombia and Nigeria as the leading producers in the world. Palm oil is a notable source of cooking oil in various countries, especially in Africa and Asia and has continued to enjoy increased patronage in recent times as it is reportedly free of trans-fats (Mukherjee and Mitra, 2009). According to Oil World (2013), palm oil is reported to have overtaken soybean oil in the world's market. It is described as the richest source of carotenoids, which is significantly more than that in carrots. Carotenoids play important roles as biological antioxidants, protecting the body cells against reactive oxygen species (ROS) and lipid peroxidation which has been associated with a number of pathology including cancer, cardiovascular disease and type-2-diabetes. The high content of the carotenoids in palm oil seems to compensate for the "so called" high saturated fatty acid composition (50%) which had since stigmatized palm oil as a saturated fat being avoided by potential consumers thereby ignorantly losing the potential health benefits

of palm oil. Besides the antioxidant role of carotenoids in palm oil, they are also precursors of vitamin A, a fat-soluble vitamin with major roles in the regulation of many biological and metabolic functions such as growth, reproduction, regulation of immune system and cell differentiation. In addition to carotenoids and vitamin A, palm oil also contains vitamin E (tocotrienols) which possess powerful antioxidant property and are capable of inhibiting cholesterol synthesis (Chong & Ng, 1991).

Palm oil is unique in its fatty acid composition as it is the only cooking oil with approximately equal composition of saturated (50%) and unsaturated fatty acids (50%) (Chong & Ng, 1991). Its major saturated fatty acid component is palmitic acid (C-16) with its name derived from palm. Other major fatty acid components of palm oil are oleic acid (C-18: monounsaturated), linoleic acid (C-18: polyunsaturated) while the minor ones include myristic acid (C-14) and stearic acid (C-18). However, a WHO report has associated consumption of palmitic acid with an increased risk of cardiovascular diseases (World Health Organization, 2003). In a recent review by Odia et al. (2015), the authors opined that dietary palm oil as part of a healthy balanced diet does not increase the risk of cardiovascular disease. Arachis oil Arachis oil is a kind of cooking oil obtained from groundnuts or peanuts and has been described as one of the most frequently consumed vegetable oils in Nigeria with high smoking point which encourages its use in frying (Falade & Oboh, 2015). Arachis oil is a rich source of mono-unsaturated fatty acids (MUFA) such as oleic acid (18:1) which lowers LDL cholesterol, the so called "bad cholesterol" and increases HDL cholesterol also referred to as "good cholesterol" in the blood. Specifically, its major fatty acid components include oleic acid (46.8% olein), linoleic acid (33.4% linolein), palmitic acid (10% palmitin). It is also made up of the following acids: arachidic, arachidonic, behenic, lignoceric, stearic and some other fatty acids (Falade & Oboh, 2015). Its low saturated fat and high content of essential fatty acids makes it one of the healthiest cooking oils. Nonetheless, its high proportion of unsaturated fats makes it vulnerable to thermal oxidation. Arachis oil contains a significant amount of vitamin E and an insignificant concentration of carotene. Vitamin E is a strong antioxidant. All its isomers (tocopherols and tocotrienols) possess good antioxidant properties in vitro, with tocotrienols being the most potent (Seppanen et al., 2010).

Soybean Oil

Soybean oil is a kind of cooking oil derived from soybean seeds and has been described as one of the most widely and commonly consumed vegetable oils. Its fatty acid composition is its selling point as it contains a high proportion of unsaturated fatty acids, comprising of alpha-linolenic acid, C-18:3 (7–10%), linoleic acid, C-18:2 (51%) and oleic acid, C-18:1 (23%) (Ivanov et al., 2010). It also includes the following saturated fats: 4% stearic acid (C-18:0) and 10% palmitic acid (C-16:0). Although the high level of linolenic acid, a polyunsaturated fatty acid (PUFA), in soybean oil is desirable, it is highly prone to oxidation and therefore unpleasant for some uses such as cooking and frying at high temperatures. To overcome this challenge, hydrogenation has been used to decrease the level of unsaturation in linolenic acid resulting in hydrogenated soybean oil.

Olive Oil

Olive oil is derived from the fruit of olive (Olea europaea). It is composed of oleic, linoleic, palmitic, stearic and α-linolenic acids. However, the proportion varies by cultivars, extraction process and time of harvest. It is abundant in MUFA (oleic acid) representing 70–80% of its total fatty acids (Tripoli et al., 2005). An increased consumption of MUFA has been reported to reduce the risk of atherosclerosis. Olive oil has a high oxidative stability during frying at high temperatures when compared with some other cooking oils such as soybean oil, sunflower oil, arachis oil, corn oil etc., Its oxidative stability and resistance to deterioration at high temperatures can be ascribed to its fatty acid constitution, especially its low amount of PUFA and the presence of biological antioxidants including alpha-tocopherol, delta-5 avenasterol and squalene.

These unique characteristics informed the preference for olive oil in frying process. The beneficial effects of olive oil against cancer, diabetes, inflammatory diseases including rheumatoid arthritis have been established as well (Tripoli et al., 2005). Hypolipidemic activity of olive oil has also been reported (Nakbi et al., 2012). The health benefits of olive oil have been attributed to the antioxidant property of its phenolics (Tripoli et al., 2005). Olive oil contains about 30 phenolic compounds (Attya et al., 2010) which include but are not limited to the following: simple phenolics such as vanillic acid, gallic acid, coumaric acid, caffeic acid, tyrosol and hydroxytyrosol; and some more complex ones (secoiridoids and lignans) (Tripoli et

al., 2005). The antimicrobial, antioxidant and anti-inflammatory activities of olive oil phenolics have been further confirmed in a review by Cicerale et al. (2012) as the consumption of extra virgin olive oil has been linked with a lower incidence of chronic degenerative diseases and higher life expectancy observed within the Mediterranean populations (Cicerale et al., 2012).

Sunflower Oil

Sunflower oil, derived from the seeds of sunflower (Helianthus annuus) is commonly used for frying and other culinary practices. Sunflower oil is a rich source of PUFA (linoleic acid) which constitute about 59% of the oil. Other fatty acid constituents of sunflower oil include oleic acid (MUFA); palmitic and stearic acids (saturated fatty acids). Although the high proportion of PUFA in sunflower compared to other oils in this review is considered an advantage given its health benefits, it enhances its susceptibility to thermal oxidation (Sadoudi et al, 2014). The heating of PUFA in the presence of air has been reported to cause a greater degree of lipid peroxidation [Sadoudi et al., 2014].

In common with all sources of fat, plant oils contain a range of different fatty acids (both saturated and unsaturated), and their fatty acid composition varies widely, but typically, one type of fatty acid will predominate. For example, the major fatty acid found in olive oil is the monounsaturate oleic acid, and therefore it is classified as ‘monounsaturated oil’, whereas the predominant fatty acid in sunflower oil is linoleic acid (LA), and therefore it is often referred to as a ‘polyunsaturated oil’. Most culinary oils used in the home tend to be predominantly unsaturated and high in either monounsaturates (e.g. rapeseed oil, olive oil, peanut oil) or polyunsaturates (e.g. sunflower oil, corn oil, walnut oil). However, there are some vegetable oils that are high in saturates, particularly coconut oil (86% saturates) and palm kernel oil (82% saturates). Margarines and spreads are produced from a range of vegetable oils and fats and are used in the manufacture of a variety of food products. Margarine was invented in 1869 as a substitute for butter. Today, margarine is defined by EU legislation (along with different criteria for other spreadable fats), as: a product obtained from vegetable and/or animal fats with a fat content of not less than 80%, but less than 90%, and with a milk fat content of not more than 3% . Spreads have a similar composition to margarine but are usually lower in fat. For example, some spreads, especially the low fat spreads (defined as a spread with less than 40 g fat/100

g), cannot be called margarine as they do not meet the minimum fat level requirement. Water is used to bulk out these spreads. The different methods used to produce these different spreads results in the fatty acid composition of margarines and fat spreads varying widely. However, the overall percentage of fat is controlled by strict guidelines. The most commonly used culinary oils for the manufacture of margarines and spreads are rapeseed, sunflower, soybean, palm and palm kernel. Oils are refined to purity and blended. Vitamins, A, D and sometimes E, flavours, salt and milk and/or whey are then added, and the final mixture is emulsified, pasteurised and chilled before being packed.

There are also a number of health products on the market that can help to reduce dietary intake of fat or saturates and products that are based on particular types of fat, for example, polyunsaturates or monounsaturates. Recently a number of 'functional' spreads with additional health benefits have been made available. These include spreads with plant sterols and stanols that bring about cholesterol reduction in individuals with high cholesterol along with spreads with added long-chain n-3 polyunsaturates. There are also a number of premium taste products, which offer a 'buttery' taste with many of the advantages of a vegetable-based spread, such as being low in saturates.

2.3 Effects of Thermal Oxidation on the Quality of Cooking Oils

Thermal oxidation of cooking oils is a normal day-to- -day practice in homes and commercial food industries where edible oils are used for various types of cooking at different temperatures ranging from low to very high. Temperature has been described as one of the major factors that influence the quality of edible oils (Gupta, 2005).

The interest in the subject of thermal oxidation has continued to increase, given the deteriorative effect it might have on the quality of cooking oils. The impact of thermal oxidation on the quality of cooking oils has been studied (Oboh et al., 2014). However, the effect of thermal oxidation on the quality of cooking oils cannot be overemphasized due to the significance of cooking oils in nutrition and health. There is therefore the need to accentuate the potential implications of deterioration of cooking oils on health.

A previous study by Naz et al. (2005) investigated the deterioration of olive, corn and soybean oils caused by exposure to air, light, heat and deep-fat frying. The

oils used in the study were used for deep-frying of potatoes at 180˚C for 30, 60 and 90 mins. The study showed an increase in the oxidative deterioration indicators (peroxide and p-anisidine values) with the highest observed in deep-fat frying, as soybean oil was reported as the most prone to oxidation in the study. Meanwhile the % free fatty acids (% FFA) increased with an increase in time of deep-frying, which was attributed to hydrolysis.

The canola oil in the study was heated at 185˚C and 215^{o}C for 7 h daily for 7 days. The authors concluded that increasing frying temperature above 195^{o}C could cause isomerization of PUFA thereby increasing the amount of trans isomers which have been described as unhealthy. Recently, in a study by Sadoudi et al. (2014), it was reported that thermal oxidation of sunflower oil at 100^{o}C for 52 h caused deterioration of the oil leading to the development of oxidative rancidity. A significant loss in the essential fatty acid (linoleic acid) was also observed in the thermally-oxidized sunflower oil. In one of our recent studies (Oboh et al., 2014), we investigated the effect of thermal oxidation on the physico-chemical properties, malondialdehyde (MDA) and carotenoid contents of palm oil. In the study, fresh palm oil was heated from 0 to 20 mins with the corresponding temperatures ranging from 33oC to 320oC, respectively, and the effect on the physicochemical properties, MDA and carotenoid contents of the oil was evaluated. The study revealed that increase in the duration of thermal oxidation caused appreciable changes in the physico-chemical properties, increased MDA content and decreased the carotenoid content of the oil, thereby altering the nutritive and medicinal value of palm oil. In another study, Falade and Oboh (2015) investigated the effect of thermal oxidation on lipid peroxidation, physico-chemical properties and β-carotene contents of arachis oil. The oil was heated for 20 mins with the temperature reaching 220^{o}C. It was discovered from the study that thermal oxidation induced lipid peroxidation and caused changes in the physico-chemical properties (acid, iodine, and peroxide values) and β-carotene content of arachis oil. The authors discouraged cooking and frying with arachis oil at a high temperature for a long period of time as this might cause a significant loss in the insignificant amount of β-carotene in the oil. Marinova et al. (2012) investigated the high temperature performance of some cooking oils (sunflower oil, grape seed oil, soybean oil, corn oil, and olive oil) subjected to heating at a frying temperature of 180oC by evaluating the oxidative degradation of the oils. The study revealed that olive oil had better thermal oxidation stability which was

attributed to its fatty acid composition. Also soybean and corn oils were reported as the most resistant to oxidation at frying temperatures (Marinova et al., 2012). Furthermore, Adam et al. (2007) investigated the effect of repeated heating on the vitamin E content in palm oil and soy oil. The oils used in the study were heated once and five times with the temperature reaching 180^{o}C while the heating lasted for 10 mins. The study suggested that heating reduced the various fractions of vitamin E in palm oil and soy oil. It is noteworthy that about 98% of the three most abundant vitamin E isomers (α-tocopherol, α-tocotrienol, and γ-tocotrienol) in palm oil were lost to heating while up to 60% of γ-tocopherol (the most abundant form of vitamin E in soy oil) was destroyed by heating. The level of reduction was attributed to the degree of heating as the stability of vitamin E isomers varies during heating. Brenes et al. (2002) in their study on the influence of thermal treatments on the polyphenol content of virgin olive oil using simulated cooking processes assessed the effect of these processes on the phenolic content and physicochemical characteristics of oils. In the study, frying was simulated by heating the oil at 180^{o}C for 1.5, 3, 5, 10, 20 and 25 h. The study revealed that thermal oxidation at 180^{o}C decreased significantly the hydroxytyrosol- and tyrosol-like substances. The concentration of phenolics belonging to the following classes of phenol (simple phenols, complex phenols, lignans, and phenolic acids) was evaluated. The study revealed a decrease in the concentration of hydroxytyrosol, elenolic acid, decarboxymethyl oleuropein aglycon, and oleuropein aglycon with thermal oxidation faster than other phenolics in the oil. However, hydroxytyrosol-acetate and ligstroside aglycone were reported to be quite resistant to heat treatment, while lignans exhibited an interesting behaviour as the family most resistant to thermal oxidation corroborating the previous claim by Brenes et al. (2002).

Katragadda et al. (2010) investigated the emissions of volatile organic compounds such as aldehydes generated by heating of some cooking oils including coconut, safflower, canola and olive oils at 180, 210, 240 and 270^{o}C for 6 h. The study reported that emission of volatile compounds increased with oil temperature. Formation of Acrolein was observed in all the four cooking oils at even the lowest studied temperature (180^{o}C), suggesting domestic cooking as an indoor pollution challenge. This calls for special attention due to the carcinogenicity of acrolein. It is worthy of note that acrolein emission from safflower oil was higher than of the other three oils. Furthermore, Harvorsen & Blomhoff (2011) assessed the concentration of

lipid oxidation products generated in twelve various vegetable oils oxidized by heating at 225^{o}C for 25mins to simulate a typical cooking situation. The concentration of alkenal found in the vegetable oils ranged from 33.24–119.04 nmol/mL. The authors further observed that heating caused a 2.9–11.2 fold increase in the alkenal concentration in the vegetable oils.

2.4 Health Implications of the Consumption of Thermally-Oxidized Cooking Oils

Formation of volatile organic compounds such as aldehyde, ketones, dienes and acids during degradation of edible oil induced by heating has been reported (Katraggada et al., 2010). The oxidative degradation products do not only create unpleasant flavour or reduce the shelf life of cooking oils, they may also cause health challenges (Fullana et al., 2004). Aldehydes are major degradation products with the ability to induce toxicological effects as a result of their reaction with amino groups of proteins (Katraggada et al., 2010). Furthermore, aldehydes are capable of producing other volatile compounds such as MDA when undergone autooxidation. MDA is one of the reactive electrophile species that cause oxidative stress (Farmer & Davoine, 2007).

Oxidative stress has been implicated in the pathogenesis of various degenerative diseases including cancer , Alzheimer disease , myocardial infarction , kidney dysfunction, diabetes mellitus and its complications (Giacco & Brownlee, 2010). Besides alkanals, other more toxic unsaturated aldehydes such as alkenals and alkadienals have been reported (Katragadda et al., 2010). Given the formation of very cytotoxic compounds during thermal oxida tion, the effect of consumption of thermally-oxidized cooking oils on health has long been a concern. This review therefore accentuates the potential health implications of the consumption of thermally-oxidized cooking oils. Several studies have established a link between thermally-oxidized cooking oils and digestibility (Olivero-David et al., 2011). A recent review by Dorbaganes and Márquez-Ruiz (2015) reported that frying oils and oils heated at frying temperatures decreased digestibility which they attributed to poor hydrolysis of triacylglycerol (TAG) polymers by pancreatic lipase. TAG polymers are dimers and oligomers generated by thermal oxidation and are specifically found in thermally-oxidized oils. The effect of repeatedly heated palm oil on serum lipid profile, lipid peroxidation and homocysteine levels was investigated in a post-

menopausal rat model by Adam et al. (2008a). The study reported that repeatedly heated palm oil increases lipid peroxidation and total cholesterol. It was also suggested in the study that repeatedly heated oil is deleterious due to the fact that it causes oxidative damage thereby increasing the risk of atherosclerosis. A related study by Adam et al. (2008b) revealed that consumption of repeatedly heated soy oil increased the serum parameters related to atherosclerosis in ovariectomized rats. In another study, it was suggested that chronic consumption of thermally-oxidized palm oil may cause anaemia and leukocytosis in rat (Mesembe et al., 2004). This finding was further corroborated by Ani et al. (2015a)] who reported that thermally-oxidized palm and groundnut oils may be detrimental to the body's haematological system as it causes alteration in Hb concentration, PCV, WBC count, neutrophil and lymphocyte counts.

Shastry et al. (2011) evaluated the effect of reused edible oils on vital organs of Wistar rats and concluded that reused sunflower and palm oils could be toxic and cause considerable damage to the vital organs of rats. Furthermore, Williams et al. (1999) studied the effect of ingestion of a meal rich in fat that had previously been used for deep-frying in a commercial food restaurant and observed an impairment in the arterial endothelial function in healthy men. Their findings suggested that consumption of deteriorated products of heated dietary oil may contribute to endothelial dysfunction in human. Endothelial dysfunction has been recognized as an early precursor of atherosclerosis. Jaarin et al. (2011) investigated the effects of heated palm and soy oils on blood pressure in rats and observed that repeatedly heated vegetable oils increased blood pressure, enhanced phenylephrine-induced contraction, decreased acetylcholine- and sodium nitroprusside-induced relaxations. The increased blood pressure induced by heated vegetable oils was linked to increased vascular reactivity and reduced nitric oxide (NO) level. The study also suggested that thermal oxidation may promote free radical generation thereby contributing to the pathogenesis of hypertension in rats. Furthermore, Leong et al. (2010) investigated the possible mechanism of elevation in blood pressure as a result of consumption of heated vegetable oil by evaluating the effect of consumption of heated soy oil on blood pressure, plasma NO, heme oxygenase (HO-1) and angiotensin-converting enzyme (ACE).

In a similar study, Leong et al. (2012) investigated the impact of repeatedly heated palm olein on the activity of blood pressure-regulating enzymes and lipid

peroxidation in rats. The study reported that repeatedly heated palm olein induced an increase in the levels of peroxide, ACE and likewise caused a decrease in HO-1, suggesting that consumption of thermally-oxidized palm olein may influence the catalytic functions of the enzymes linked with regulation of blood pressure thereby contributing to the development of hypertension. ACE catalyzes the conversion of the inactive angiotensin-I to angiotensin-II, an active vasoconstrictor. Consumption of thermally-oxidized sunflower oil has also been reported to cause an adverse effect on the liver and adipose tissue of rats, as hypertrophy of cells and cores were also observed in rats fed with the thermally-oxidized oil (Sadoudi et al., 2013). If this finding would be applicable to human, the adverse biochemical and histological consequences of chronic consumption of thermally-oxidized cooking oils calls for a great concern. Ani et al. (2015b) in one of their recent studies investigated the effect of chronic consumption of fresh and thermally oxidized palm oil diet on the serum electrolytes, creatinine and urea as kidney function markers. The study revealed a significant change in the kidney function markers of rabbits fed with thermally-oxidized palm oil thereby suggesting a compromised renal status of the rabbits. In our recent study , Falade et al., (2015) on the effect of consumption of thermally-oxidized palm oil on some biochemical parameters in rats; consumption of thermallyoxidized palm oil diets had deleterious effects on biochemical indices in rats. Specifically, an elevated MDA content was observed in both plasma and liver of rats fed with thermallyoxidized palm oil diet which was suggestive of free radical formation. Furthermore, an elevated total cholesterol and LDL which are risk factors of cardiovascular diseases was also reported in the study. Hence, we suggested that consumption of palm oil subjected to heating for long periods of time should be discouraged as it might have deleterious effects on human health.

2.5 Culinary oils, Nutrition and Health Risks

Nutrient composition of oils and spreads Vegetable oils are mainly composed of triacylglycerides (TAGs, sometimes known as triglycerides) (i.e. three fatty acids on a glycerol backbone), so the main nutrient they provide is fat. The only other nutrient that is present in appreciable amounts is vitamin E, although fat spreads are fortified with vitamins A and D in the UK. The minor components include mono- and diglycerides, free fatty acids, phosphatides, sterols, fatty alcohols and other substances, including a range of phytochemicals (or bioactive compounds).

A large proportion of the vegetable oil on the global market is non-branded. The fatty acid content of non-branded oils is often not known, and the impact of non-branded oils on health remains to be elucidated. The fatty acid profile of vegetable oils influences the risk of non-communicable diseases (NCDs), including diabetes and cardiovascular disease (CVD). A high intake of saturated fatty acids (SFA) has been associated with an increased risk of cardiovascular events. Thus, reducing the dietary content of SFA is emphasized in CVD prevention. The risk of diabetes is inversely associated with a higher intake of polyunsaturated fatty acid (PUFA), but no associations have been found with monounsaturated fatty acid (MUFA) or SFA. Furthermore, a high intake of trans fat is associated with a higher risk of both diabetes and CVD. The type of oil consumed is also related to NCD risk factors. A high intake of palm oil, compared to the intake of vegetable oils low in SFA, has been related to high levels of low-density lipoprotein (LDL). Vegetable oils rich in SFA, especially palmitic, myristic and lauric acid, increase blood cholesterol levels. In terms of fatty acid composition, peanut oil is naturally free from cholesterol and trans fat. Additionally, sesame oil plays a supportive role in hypertensive treatment, and vegetable oils rich in PUFA not only decrease diastolic blood pressure, but also lower fasting plasma glucose levels. Moreover, total body fat, liver fat, and visceral fat accumulation increase with a higher intake of palmitic acid compared with PUFA. NCDs are now the leading cause of death in most places in the world, with CVD being the leading cause, claiming 17.9 million lives each year. The number of adults with diabetes increased from 108 million to 422 million between 1980 and 2014. In 2010, hypertension was one of the top three leading risk factors for the global burden of disease, and the number of people living with hypertension increased from 594 million to 1.13 billion between 1975 and 2015.

2.5.1 Health effects of Trans Fatty Acids

Recognizing the adverse health effects of trans fatty acids, many food manufacturers and retailers have voluntarily chosen to systematically remove them from their products in recent years. For example, they have been absent from major brands of fat spreads for some time, which are now made using a different technique. Also, many companies now have guidelines in place that have resulted in reformulation and the reduction or elimination of trans fatty acids from products where they have been found in the past, such as snack products, fried foods and baked

goods. The FSA has collated data on the current levels of trans fatty acids in processed food categories from up to date information provided by the food industry. As part of the FSA's review of the evidence of the health effects of trans fatty acids, a new estimate of trans fatty acid intake was made in November 2007 using this new data along with the food consumption data from the 2000/01 National Diet and Nutrition Survey (NDNS) of adults (Henderson et al. 2002). A new value for mean trans fatty acid intake for all adults aged 19–64 years was estimated at 1.0% of food energy. This is lower than the original NDNS estimate of mean intake of trans fatty acids in this age group (1.2% food energy). Furthermore, it was not possible to take account of all the reductions in trans fatty acid levels in foods that have taken place, so this figure is likely to be an overestimation of the actual intake, particularly now, one year on, as reductions have continued.

Most fatty acids can be synthesized in the body, but there are two fatty acids required for normal physiological function that are known as essential fatty acids (EFAs) because they cannot be made in the body. These are the omega-6 fatty acid, LA and the omega-3 fatty acid, alpha-linolenic acid . These are both polyunsaturated, and it is from these two EFAs that the n-3 and n-6 fatty acid 'families' are derived.. However, the conversion of ALA to its longer-chain derivatives is not considered to be very efficient. It has been estimated that less than 8% of ALA is metabolised to EPA, and the capacity to synthesize DHA appears to be particularly limited. As well as being inefficient, the conversion of ALA to EPA is also very slow and can be further reduced by the presence of other types of fatty acids in the diet, which can compete for the same enzymes in the metabolic pathway. Plant oils are a good source of EFAs. For example, sunflower oil, safflower oil, corn oil, soybean oil, peanut oil and sesame oil are all rich sources of LA. Flaxseed oil is a rich source of ALA, with rapeseed oil, walnut oil and soybean oil also providing significant amounts.

Margarines and spreading fats (particularly those made from polyunsaturated-rich oils) also provide EFAs, predominantly in the form of LA. Some manufacturers have increased the amounts of n-3 fatty acids present, in the form of ALA, for example, from flaxseed oil. However, increasing the amount of ALA at the expense of LA leads to an increased likelihood of oxidation (as more double bonds are present). Antioxidant compounds (e.g. vitamin E) are often added to counteract this problem (Lunn & Theobald 2006). It is also possible to add the longer-chain n-3 fatty acids to spreads by the addition of fish oils to products. Such products do have a slightly

reduced shelf life (12 weeks) because of the instability of the long-chain, highly unsaturated fatty acids; however, sensory testing panels have revealed that there are no discernable differences in the taste of the products.

Today, we have a good understanding of the nutrients required for normal physiological function; consequently, nutrition research is now focusing on the amounts and types of nutrients required for optimum health and reduced risk of disease. The World Health Organization reviewed the evidence relating dietary fat to the risk of developing a number of chronic diseases in 2003, and another review began in 2008.

The most convincing associations are between diets high in saturates and increased risk of cardiovascular disease (CVD), and the objectives of current dietary advice are to adjust the balance of fatty acids in the diet in order to elicit a more favorable balance of blood concentrations of lipoproteins that transport cholesterol around the body (Frayn & Stanner 2005; Lunn 2007). High levels of low density lipoproteins (LDLs) in the bloodstream are a risk factor for coronary heart disease (CHD). Conversely, high density lipoproteins (HDLs) transport cholesterol from peripheral tissues back to the liver for removal from the system and hence are associated with a reduced risk of CHD. For several decades now, there have been recommendations on fat intake in the UK, originally set by an expert committee [Committee on Medical Aspects of Food and Nutrition Policy (COMA)] and adopted by the government.

These recommendations have been updated from time to time. For example, in 1994, the guidelines on intakes of polyunsaturated were revised to take into account the cardio protective effects afforded by the long-chain n-3 polyunsaturated. The COMA report on CVD advised that there should be no further increase in intakes of n-6 polyunsaturated, as the population target had been achieved, and that the intake of long-chain n-3 polyunsaturated should increase from 0.1 g to 0.2 g/day. However, in light of issues regarding the sustainability of some types of fish, the FSA is currently reviewing the advice on eating fish. The review reflects the growing concern about the sustainability of fish stocks and the wider environmental impact of fishing and fish farming. A consultation process is currently underway, and revised advice is expected in early 2009. In recent years, there has been further research into the specific health effects of individual fatty acids, and the consensus is possibly moving away from the concept that all saturates are bad – indeed, several of the medium chain

saturates in the diet have been shown to have neutral effects on blood lipid levels (Frayn & Stanner 2005). However, as is the case with all fatty acids, foods containing fat provide a mixture of fatty acids, and total saturates will consist of the blood lipid neutral fatty acids, as well as those with adverse health effects. It has been observed that many vegetable oils, notably palm oil, have saturates in the first and third positions along the TAG molecule. This may affect their nutritional properties as saturates in the second position may have a greater cholesterol raising effect (Berry & Sanders 2005). Nevertheless, public health recommendations are still to increase intake of unsaturated and reduce intakes of saturates.

2.5.2 Reusing Cooking Oil and Health Risk

Reusing of edible oil for preparing food, particularly in deep-frying, is a common practice of food benders to enhance the profit. The oxidative degradation of oil lipid accelerates during repeated heating and forms hazardous reactive oxygen species and also diminishing the natural antioxidant contents of the edible oil. Long-term utilization of foods prepared by reusing oil can cause pathologies such as diabetes, hypertension, and vascular inflammation. The injurious effects of reusing of oil consumption extend beyond mere oxidative attack to cellular antioxidant defense. Many research groups examined the experimental and clinical effects associated with the intake of reusing of edible oil on antioxidant contents, endothelial function and membrane lipid peroxidation. The mechanisms holding the pathology related to consumption of repeatedly reuse of oil will help to assess the safety of cooking oil. Finally, considering the potential hazard of reusing of oil, this article aims to increase general public awareness regarding the health risks associated with reuse of edible oil.

2.6 Reviews on Previous Studies

Yasushi Endo (2013) did a research “Analytical Methods to Evaluate the Quality of Edible Fats and Oils: The JOCS Standard Methods for Analysis of Fats, Oils and Related Materials”. Edible fats and oils are used in for pan- and deep-frying, and in salad dressing, mayonnaise and processed foods such as chocolates and cream. The physical and chemical properties of edible fats and oils can affect the quality of oil foods and hence must be evaluated in detail. The physical characteristics of edible fats and oils include color, specific gravity, refractive index, melting point, congeal point, smoke point, flash point, fire point, and viscosity, while the chemical

characteristics include acid value, saponification value, iodine value, fatty acid composition, trans isomers, triacylglycerol composition, unsaponifiable matters) and minor components. This research used the analytical methods to evaluate the quality of edible fats and oils; especially the Standard Methods for Analysis of Fats, Oils and Related Materials edited by Japan Oil Chemists' Society (the JOCS standard methods) and advanced methods. Although different types and quantities of solvents are used in the JOCS standard methods, nondestructive methods using no solvents and harmful chemicals such as NIR and THz spectroscopy and other portable sensors are expected to become more popular.

Another research is by Simone Monteiro E Silva (2013), "On the Physical Refining of Edible Oils for obtaining High Quality Products". Vegetable oils are important compounds of the human diet and they should be refined before consumption. Consumers demand for healthier products and stiff environmental legislation are forcing refining industries towards changes and improvement of processes. In this context, this thesis has as main objective to investigate/improve the physical refining of vegetable oils, emphasizing the bleaching step. Then, bleaching step of palm oil, nowadays the most consumed oil in the world, was studied under different aspects: (1) determining kinetics, equilibrium and thermodynamic parameters of adsorptive removal of carotenes and phosphorus onto acid activated bleaching earth; (2) influence of different procedures on final color of palm oil; (3) influence of bleaching earth kind on final color of palm oil. These studies were important for a better understanding of bleaching process of palm oil, and some conclusions were obtained: adsorptive removal of carotenes and phosphorus onto acid activated bleaching earth occurs by chemisorption and it is endothermic; new procedures in the bleaching step can improve final color of palm oil when using the same amount of bleaching earth and deodorization time; a hypothesis was proposed to explain how the kind of bleaching earth can interfere in the final color of palm oil.

Bhavsar Ganesh Janardhan (2017) did a research "Studies on Extraction, Physico-chemical and Nutritional Chacterization of Oil from Different Oilseeds and it's Utilization in Development of Fat Spread". The investigation had been made with objectives of studies on extraction, physico-chemical and nutritional characterization of oil from different oilseeds and it's utilization in development of fat spread replacement of shortening by fat spread in cookies. The extraction of oil by

mechanical and solvent method from safflower, sesame, linseed and niger were carried out. The extracted oil is subjected for physico-chemical and nutritional analysis. The yield of mechanical extraction was low but oil has high stability and superior quality over solvent extracted oil. The mechanical extracted safflower, sesame, linseed and niger oil at different level with fixed level of palm oil was utilized for fat spread development. The sensory, physico-chemical and microbial and storage study of fat spread were carried out. It can be concluded from the results obtained during this investigation that the good quality of oil was extracted by mechanical method from oilseeds. The fat spread of high quality can be prepared using the blend of various vegetable oils i.e. palm oil, safflower oil, linseed oil. Use of appropriate antioxidants in food system and appropriate packaging may be explored to enhance shelf life of food products containing fat spread.

CHAPTER 3
LOCAL EDIBLE OIL PRODUCTION IN MYANMAR

3.1 Current Edible Oil Supply and Demand in Myanmar

The Myanmar Agricultural Service (MAS) has estimated the total domestic supply of edible oil in 2005/06 at 597 000 tons; 234 000 tons groundnut oil, 183 000 tons sesame oil, 144 000 sunflower oil, 21 000 tons niger oil and 14,017 tons mustard oil. These estimates are 65,000 tons over the 532 000 tons edible oil demand estimated by the CSO. Therefore, official statistics suggests that Myanmar is self-sufficient in edible oil. In addition, during the same fiscal year, 185 000 tons of palm oil was imported into Myanmar, which should have resulted in a stock of 250, 000 tons of edible oil.

Official data do not reflect the reality of the oil crops sub-sector and therefore there is an urgent need to develop a sound database on supply and demand of edible oil in Myanmar, to allow adequate policy formulation and program planning.

At present, the annual production of the vegetable oil is around 0.5million ton, and every year there are still 0.35 million tons mainly the palm oil to be imported from foreign countries. With the increasing growing population in recent years, the domestic demand for the edible oil is becoming large. To solve the long-term severe shortage of the edible oil, how to achieve the self-sufficient is a top priority.

Table (3.1) Supply and Demand of Vegetable oil in Myanmar

1,000 Ton

Element	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Production	356	445	467	516	578	597	710	769	904	983	1,023	873
Import Quantity	266	275	235	282	308	359	379	410	424	373	401	412
Other uses	309	422	389	504	562	623	782	816	924	907	972	827
Food	312	297	310	293	323	332	306	364	399	448	453	458

Source: FAO stat Food Balance Sheet (2012)

3.2 Position of Myanmar in the World of Edible Oil Production

Myanmar is a rather small producer of edible oils 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 oils. Palm, soya and rape oils are the top 3 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 groundnuts 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%). Both products can be seen as oilseed specialties, due its small volumes and the special applications.

Table (3.2) Production of Vegetable Oil in the World and Myanmar

Oil From	World (1,000 tons)	Tons	Myanmar (% in world)
Soya bean	41,538	29,736	0,07
Sunflower	14,947	120,823	0.81
Groundnut	5,170	234,000	4.53
Coconut (Copra)	3,305	28	0
Sesame	1,278	341,000	26.69

Source: Based on FAO stat. (2012)

3.3 Production and Consumption of Oil Crops and Vegetable Oils

Myanmar is not self-sufficient in vegetal oil and is a net importer: in 2000, the self-sufficiency was 57%, increasing to 68% in 2011 and peaking in 2010 at 72%. The total domestic supply doubled in that period. The quantity of vegetal oil used for food consumption grew, but less strongly than for other utilizations. The later grew as fast as the total production. 'Other utilization' in Myanmar is - according to several consulted stakeholders - the use of edible oil in restaurants and in the food (e.g. noodles) industry. This definition differs from the FAO, which defines other utilization as non-food consumption. The vegetal oil supply for food consumption increased from 6.4 in 2000 to 8.7 kg/capita/year in 2011. Keeping in mind that a large share of other utilization is, in the end, also consumed as (processed) food, the

vegetable oil consumption might be double the statistics of the FAO: between 12 and 18 kg/capita.

3.3.1 Production and Utilization of Groundnut Seeds and Oils

Myanmar increased its production of groundnuts at a rather constant pace since 2003, becoming the sixth largest producer in the world. The production increased from 0.9m tons in 2003 to 1.4m tons in 2003. It outpaced the growth of the total world production of 45.3m tons in 2013. Myanmar's share in the world increased from 2.4% in 2003 to 3.0% in 2013. The leading producers are China, which produced 17m tons or 37% of the world total in 2013 and India (producing 9.5mn tons and a share of 21%). In contrast to Myanmar, the production fluctuated strongly in India, Nigeria, USA and Sudan (before 2012 former Sudan). Asia accounts for around two-thirds of the groundnuts production, Africa for one-quarter and the Americas for the remaining 8%. These shares were more or less stable in the last decade. Besides the increasing production, also the yields per ha increased: 1,340 kg/ha in 2003 to 1,545 kg/ha in 2013. Nevertheless, the yields in Myanmar are 10 to 20% below world average, 50 to 60% below the level of China and two-thirds below the level of the USA. Increasing yields seems achievable and therefore constitutes a real opportunity.

Table (3.3) Leading Countries in Groundnut Production and their Yields

Description	Production (1,000 tons)			Yield (kg/ha)		
Country / Year	2003	2008	2013	2003	2008	2013
World				1521	1525	1721
China	13550	14500	16575	2632	3358	3610
India	8015	6650	9821	1355	1142	1754
Nigeria	2500	2412	2514	1500	1250	1332
USA	1918	2115	1910	3509	3780	4501
Sudan	858	750	1821	750	744	820
Myanmar	915	1211	1412	1395	1490	1512
Indonesia	1350	1310	920	1996	2150	2350
Argentina	155	451	853	1445	2721	2521

Source: Based on FAO stat. (2013)

Myanmar used 12 to 13% of groundnut production for direct food consumption and another 10 to 12% as seed. Imports and exports of groundnuts are very small and negligible (below 0.3% of total production) and for oil even smaller. A major part of the groundnuts (40 to 60%) is processed and the groundnut oil is fully used for food. The edible oil yield is around 30% of 1 tons of groundnuts in shell. This supply of groundnut oil for domestic consumption is the third in volume after imported palm oil and domestic sesame oil. Waste of groundnuts is around 5%, reducing this level might be an option to improve the income in the supply chain. The remaining oil cake is used as animal feed; just 1% is exported and no imports are indicated by the FAO.

In brief account of groundnut, groundnut oil is a minor commodity around worldwide; the production is around 3% of the vegetal oil production. Groundnuts are around 30% of Myanmar's vegetal oil production. Myanmar is the sixth world producer of groundnuts: its international trade is negligible. Seeds have many applications: oil, snack, food ingredient, peanut butter. Health risks are aflatoxins and some people are allergic for groundnuts. For that reason, groundnut oil is not suited for margarine production in the EU. Crude oil has a slightly sweet, green, and nutty flavour and deteriorates slowly. The yields in Myanmar are 10 to 20% below world average, 50 to 60% China's level and one third of the level in the USA. The EU is the main importer of groundnuts in shell (70% of the world trade) and processed groundnuts (around 40%) paying above average prices. The EU has a share of about 50% in oil imports and pays averages prices. Processed groundnuts in shell have a premium price of 80% above those of raw groundnuts. India and China are small importers of groundnuts. Chinese import of oil increased last decade with a market share of one third in 2013.

3.3.2 Production and Utilization of Sesame Seeds and Oil

Myanmar became the largest producer of sesame seeds in the world during last decade: almost 19% of the world production in 2013, surpassing India and China. Myanmar showed a strong growth in production as the third largest producer in 2003. Other strong growers are African countries, especially Tanzania. The world production grew from 3.2m tons in 2003 to 4.8m tons in 2013: a growth of 48%. The production in Myanmar outperformed this growth: a growth of 78%. Nevertheless, almost all African countries showed a stronger growth in that decade. India and

Ethiopia reached their production peaks in 2010 and their production declined after that year. The African continent produced 45% of the world sesame seeds in 2013 (in 2003 28%). As a result, Asian share declined from 68% in 2003 to 52% in 2013, despite the strong growth in Myanmar. Sesame yield in Myanmar is above world average and the levels of India (ranked 2 as producer) and Sudan (rank 4 as producer). The yield is less than half of the level of China and below the level of Tanzania and Ethiopia. This indicates some possibilities of increasing the yields.

Table (3.4) Sesame Seed Production and Yields in the Main Producing Countries

Description	Production (1,000 tons)			Yield (kg/ha)		
Country / Year	2003	2008	2013	2003	2008	2013
World				425	445	448
Myanmar	500	832	890	395	590	571
India	785	650	632	436	341	330
China	591	581	588	820	1250	1332
Sudan	330	345	582	219	225	251
Tanzania	41	49	435	387	319	670
Ethiopia	62	185	182	680	997	668
Uganda	116	175	181	495	599	621
Nigeria	81	125	168	460	375	470
Mozambique	15	35	110	418	344	551

Source: Based on FAOstat (2013)

In Myanmar 80 to 90% of the sesame-seed is processed in other products mainly vegetal oil. The exports share is on average 7% of the total seed production: peaking at 13% in 2008. The export volume does not follow the production, despite the rather strong production growth. The direct consumption as food is rather stable at 10% and the last 6 years 1% is used as sowing seed. The consumption of sesame oil did not change much. In the period 2001 to 2011, the average consumption of seeds was on average 1.2 kg/capita /year and for sesame oil 1.6. Remarkable is the high use of sesame oil for other purposes; this is mainly used in restaurants or the food industry. Hence, the direct and indirect consumption of sesame oil almost doubled.

Furthermore, the FAO statistics did not provide data on waste or feed purposes of seeds or oils.

Sesame oil is a minor commodity around worldwide; the production is less than 1% of the vegetal oil production. Sesame constitutes around 45% of Myanmar's vegetal oil production. Myanmar is the largest sesame seed and oil producer in the world. Almost all is consumed domestically. Myanmar produces red, white and black sesame seed. Seeds have many applications: oil, hulled as bread toppings, snacks, and tahini. Crude oil has a special flavor and is valued as cooking oil and for dressings. The yields in Myanmar are 10% above world average but only 43% of the level of China and 84- 90% of Ethiopia, Uganda and Tanzania. Myanmar exports less than 2% of the production mainly to China and Japan (demanding a high quality standard). Myanmar exports at a price below world average. USA, EU and Japan pay consistently above world average prices for imported seeds. The average import price of oil is 2.2 higher than the import price of seeds.

3.3.3 Production and Utilization of Sunflower Seeds and Oil

The share of Myanmar in the world production (45m tons in 2013) of sunflower seed is negligible: less than 1%. The production peaked in 2010 at 780,000 tons and declined after those years to a mere 360.000 tons in 2013.The neighboring countries are also relatively small to very small producers. Of these countries, China has rather high yields levels; all other countries in the region including Myanmar have low yields levels. Achieving higher yield levels might be an opportunity. Export is not identified as a major opportunity due to Myanmar's small share in the world production. Other crops have greater opportunities on the world market. Around 5% of the production of sunflower seeds is used for direct consumption, 2 to 3% for seeds and the remaining is processed into edible oil. Myanmar's international trade in sunflower seeds is almost negligible, only in some years, very small quantities are imported.

Sunflower oil is the fourth largest commodity around worldwide; the production is 15m tons or 9% of the vegetal oil production. Sunflower oil is about 16% of Myanmar's vegetal oil production. Myanmar is a very small producer of sunflower seeds in the world (less than 1%). The yields levels in Myanmar are far below world average. Two types of seeds exist: for oil and snacks. Application of

sunflower oil is comparable to that of groundnut oil, but the composition and tastes are different. The oil is used as cooking oil, salad oil or in margarine.

Table 3.5 Production and Yields of Sunflower Seeds in the Main Producing Areas

Description	Production (1,000 tons)			Yield (kg/ha)		
Country / Year	2003	2008	2013	2003	2008	2013
World				1210	1485	1748
Ukraine	4.2	6.5	11	1195	1550	2271
Russia	4.9	7.2	10.6	1009	1295	1515
EU	6.4	7.1	9.5	1495	1885	2105
Argentina	3.8	4.8	3.2	1550	1785	1854
China	1.8	1.9	2.2	1500	1801	2550
India	1.1	1.5	0.8	480	657	868
Myanmar	0.4	0.9	0.7	505	799	621
Thailand	0.1	0.05	168	660	675	770

Source: Based on FAOstat. (2013)

3.3.4 Palm Oil Production

Also for palm oil, no information for Myanmar production is available in the FAO statistics. The report of Favre et al. (2009) indicated a production of 172,000 tons of palm oil fruits in 2006/2007 that are all crushed. This resulted in 24,000 tons of palm oil: a higher amount than for niger or mustard seed. Two types of oil are extracted from the fruits of the palm tree 'Elaeis guineensis' (Ataga and van der Vossen, 2007):

1. Palm oil from the fruit flesh and from the kernel have a volume ratio of approximately 9:1. Palm oil is used for a large variety of edible products, such as cooking oils, margarine, vegetable ghee, shortenings, frying and bakery fats, and for preparing potato crisps, pastry, confectionery, ice cream and creamers.
2. Palm-kernel oil is similar in composition and properties to coconut oil. It may be used as cooking oil, in margarine, edible fats, filled milk, ice cream and confectioneries. For industrial purposes, it is either an alternative to coconut oil in

making high-quality soaps, or a source of short-chain and medium-chain fatty acids. The press cake or palm-kernel meal is a valuable protein-rich livestock feed.

Imported palm oil provides 30% of the domestic supply. Most stakeholders mentioned palm oil as a major threat for the oilseed production and processing sector: rather cheap oil. However, this is mainly based on the view that only the domestic market is their playing field.

Palm oil is the most important commodity around worldwide; the production is 53m tons or one-third of the vegetal oil production. In Myanmar, the production is not significant. Imported palm oil provides 30% of the domestic supply, as is shown afore. In 2006/2007, around 24,000 tons were produced. Actual information on palm oil production is not retrieved. Palm oil is used for a large variety of edible products, such as cooking oils, margarine, vegetable ghee, shortenings, frying and bakery fats, for preparing pastry, confectionery, ice cream and creamers.

3.4 Oil crop Sub-sector's Policies and Legal Framework

Until the early 1990s, the production of crops was heavily influenced by state controls and regulations. These controls dictated which crops could be grown and, in many cases, included compulsory procurement of output for sale at prices below market levels. This system started to change in the 1990s and one crop group, pulses, was effectively liberalized leading to a dramatic jump in yields, sown area and production, as well as in exports.

However, not all market policies have been liberalized. Although no compulsory purchasing exists for oil crops, the oil crops and edible oil sub-sectors are among those for which state controls are still in place. These include outright bans or controls of export and import of oil crops, oil meals and edible oils.

The most important restrictions in international trade include the following commodities:

1. Palm oil import: more liberalized since 2003, but the volume of import and price are still controlled. Besides, the import of crude oils, such as crude palm oil (CPO), is prohibited.
2. Oil crops seeds import (e.g. soybean) is prohibited.
3. Export of groundnuts is prohibited.
4. Export or import of oilcakes is prohibited.

5. Export of sesame: In October 1998, an export ban for private traders was imposed until 2006, when export was authorized. The effects on export volumes were immediate, reflecting both the competitive advantage Myanmar holds on the international market and the dynamism of the private sector.

The apparent logic of these bans is that Myanmar is currently a deficit producer of edible oil and oilcake, and significant quantities of palm oil are imported to partially meet domestic demand. Outright bans on imports or exports cannot be fully enforced. Informal imports allow the country to meet domestic demand of oil and oilcake, while informal exports of groundnuts for the snacks market allowed groundnut prices to be sustained on the domestic market.

3.4.1 Oil Crop Subsector Policies

Overall, there are essentially two major government policy objectives for the oil crops subsector:

1. Achieve self-sufficiency in edible oil.
2. Maintain edible oil price control to avoid fluctuations.

These two policies are self-defeating. Through the implementation of these policies, Myanmar has adopted restrictive measures on imports and exports of oil seeds 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, market prices of oil crops products in Myanmar are heavily distorted resulting in stagnant production. Myanmar is increasingly dependent on palm oil imports, while domestic production is stagnating.

3.4.2 Edible Oil Self-Sufficiency Policy

This policy is a remnant of the socialist period in Myanmar and has been in existence in the country since the 1980s. Because of the central role edible oil plays in the Myanmar diet, the government attaches great importance to supplying the population's requirements directly from home production, as opposed to generating foreign exchange from home production through other means, and also securing required edible oil through imports. The Myanmar Oil Crops Development Project (MOCDP) funded by Organization of Petroleum Exporting Countries (OPEC) aims at supporting the government to achieve its self-sufficiency objective.

The limitation or outright prohibition of exports of a number of agricultural commodities is justified on the basis that there is insufficient production of these crops to meet domestic needs. As a result, exports are only permitted when domestic demand has been filled. The result of such export controls has been to limit prices on the domestic market, as only informal export markets can be accessed. Although this may bring short-term benefits to urban consumers, it is damaging for both producers and consumers in the long term. With depressed returns on domestic markets, producers reduce input usage and cropping intensity, resulting in stagnant/reducing yields and low uptake of new technologies.

In addition, farmers will often shift to alternative crops, reducing supplies further. As a result, the long term trend will be towards declining supplies and increased prices – even while exports are prohibited. Much of the strong growth in the relatively low value beans and pulses, for example, has occurred as a result of a shift in production from higher value oilseeds. As exports for oilseeds have been banned, the increased import volumes of cheap palm oil have pressured downwards domestic markets.

It is to be noted that Myanmar's policy to achieve self-sufficiency in edible oil is of doubtful practical effect, in the sense that no Asian country enjoys edible oil self-sufficiency besides the two main palm oil producing nations: Malaysia and Indonesia.

3.4.3 Oilseed and Oilcake Imports

Oilseed and oilcake imports are prohibited and the reasons for this ban are unclear. Probably the measure is an attempt to stimulate local production in a policy context of self-sufficiency.

Of particular interest is the import of soybean or soybean cake in Myanmar. The existing processing capacity in Yangon for soybean is 250 ton/day, mainly from two privately owned plants: Yuzana and Batamya. Authorizing soybean import would supply much needed feed meal for the fast growing livestock and fish/shrimp industry, as well as supplement the oil deficit.

Continuing the current ban will result in a substantial slow- down of the livestock industry and continued stagnant soybean production. Other countries in Asia, such as Thailand and Viet Nam, have successfully developed their chicken and fishery industry through imports of soybean.

3.4.4 Edible Oil Price Control

This policy is of strategic importance, as social stability is believed to depend on prices of rice and edible oil. Oil crops are indeed the second most important crop after rice in the household budget expenditure. The country's edible oil production is insufficient for domestic requirements.

To bridge the gap between the demand and supply, cheaper palm oil is imported, mainly from Malaysia.

3.4.5 Palm Oil Import and Price Control: The End of the 65/35 Rule

Until March 2007, the government fixed a quota on palm oil imports at 30,000 tons/month; 20,000 tons by the private sector and 10 000 tons by the Union of Myanmar Economic Holding (UMEH). In April 2007, the quota was revised at 40,000 tons per month; 20,000 tons by the private sector and 20,000 tons by the UMEH. This raises the maximum import capacity from 360,000 to 480,000 tons/year. However, the maximum import capacity is not utilized, as imports reached their highest level in 2006/07 with 274,440 tons.

Until recently, the Myanmar Edible Oil Dealer Association (MEDA) retained 65 percent of any palm oil imported in the country and paid the importers at 'cost recovery' price. However, price adjustments are slow to respond to international market prices. Imported palm oil is stored in large capacity tanks in Kye Myin Daing and Thilawa Yangon port. Sixty-five percent of the total imported palm oil is sold to MEDA's members or municipalities at a fixed price (Kyats 1700/viss in May 2007). If municipalities are receiving palm oil from MEDA, the oil is sold to members at Kyats 100 below open market price (e.g. Mandalay). The proceedings are reportedly used for social welfare activities organized by the municipality.

Sixty five percent of palm oil retained by MEDA is distributed to the association members (approximately 2300 members) who are instructed to sell palm oil to consumers at fixed price (1715 Kyats/viss in May 2007 in Yangon). However, restaurants and factories buying in large quantities have to pay the open market price at Kyats 2180/viss (May 2007). The importers can dispose of the remaining 35 percent of palm oil not retained by MEDA and sell it to wholesalers at open market prices.

As with most direct price control mechanisms, enforcement remains loose and as a result, the prices negotiated on the open market for the 35 percent share, set market price for all palm oils. As importers can only make profit on the 35 percent of the volume imported, they have to compensate for losses or absence of profit incurred on the 65 percent, through higher price negotiation on the open market. Therefore the 65/35 price control mechanism pushes the open market price up.

At the end of June 2007, perhaps related to the inefficient nature of the 65/35 price control mechanism, the government banned the private sector to import palm oil in Myanmar and all imports were to be handled solely by UMEH. If UMEH is able to import palm oil in a timely and sufficient amount, the price of palm oil decreases on the local market. Otherwise, oil shortages will result in an oil price increase.

3.4.6 Crude Palm Oil (CPO) Import

CPO import is prohibited. The reasons for this ban is surprising, as authorizing import of CPO could add value and create jobs in Myanmar while the policy of supplying cheap palm oil to the market could still be achieved. The current refining capacity of CPO exceeds 120,000 tons per year considering the existing private and state operated refineries. Yuzana Ltd. has invested in a world class large capacity CPO refinery in Yangon, using physical refining processes.

3.4.7 Ability of the Government to formulate and Carry out Policies

The GoUM has the required institutions in place to carry out policies in the oil crops sector. However, along border areas, the government faces serious constraints to enforce policies related to trade, and this allows a parallel informal economy to prosper.

Policy decision mechanisms on the oil crops sector seem scattered between a variety of bodies and interest groups. As a result, there is an absence of a forum in which to discuss and build consensus on individual policies related to the sub-sector. Hence, policies are often changing, depending on perceptions and interest group pressures, which create an unstable operating environment for the private sector.

There have been three policy changes affecting the import of palm oil: increase of import volume for UMEH in April, increase of minimum oil price in May and ban of private sector import of palm oil in June which marked the end of the 65/35 rule.

On the other hand, some policies appeared to be inflexible for decades. As an illustration, the self-sufficiency policy for oil crops dates back to the socialist government in the 1970s. It is to fulfill the self-sufficiency requirement, rather than a positive trade balance in the oil crops sector that the export of oil crops commodities was and continues to be restricted.

The mechanisms in which policies are decided in various aspects of the oil crops subsector in Myanmar remain unclear. However, policy changes such as opening/closing borders, imposing/lifting of export bans, introduction of export taxes and levies all have large repercussions on the farmers, millers and traders in Myanmar. It appears that generally private actors involved in the oil crops businesses have little say on policy issues, and insufficient considerations on the impacts of policy decisions on the various actors of the oil crops chain is made.

The creation of a coordinating body representing all of the various interests in the oil crops sector, to debate and formulate policies would substantially benefit the sector as a whole.

3.5 Domestic Market Condition (Demand/Supply and Mixed oil)

The world edible oil market consists of many closely substitutable commodities, such as soybean, oil-palm, rapeseed, sunflower, cottonseed and tropical oils (palm oil or its liquid fraction palm olein). Through technological means such as RBD (Refined Bleached Deodorized), all oils have been rendered practically colorless, odorless and tasteless and, therefore, have become easily interchangeable in the kitchen. The situation in Myanmar is very different, as only a small fraction (8.6 percent) of the oil is RBD.

Exporting countries can either export the oilseeds or process them domestically and ship the resulting protein meal/cake and vegetable oils to foreign buyers. Foreign import demand depends on the deficit between countries' domestic oilseed output and consumption. Divergent requirements for protein meal and vegetable oil, as well as limits on domestic processing capacity, determine the ratio of oilseeds to oilseed products that countries will import.

The volume and source of foreign imports depend on seasonal availability and relative prices, credit and delivery terms, local preferences, and quality. Country policies, such as tariffs and domestic subsidies, also can affect prices and the availability of competing products.

3.5.1 International Trade Policies

Compared with trade in other agricultural commodities, trade in whole oilseeds, particularly soybeans, is relatively unrestricted by tariffs and other border measures. But oilseed meals, and particularly vegetable oils, typically have higher tariffs. Applied tariffs on soybean oil, for example, average about 20 percent for the world's top importers of the commodity, compared with rates generally at or below 10 percent for soybeans.

In addition to tariffs, both exporters and importers have used other trade-distorting policies, such as differential export taxes in Argentina and in Brazil (prior to 1996), production subsidies such as those in the European Union (EU), and "Phytosanitary" barriers in India. These policies create incentives to boost domestic oilseed production or encourage exports of processed products. India imposes prohibitive barriers on oilseed imports, so its domestic crushing is limited to the oilseeds that can be produced within the country. Domestically produced oilseeds are highly valued as vegetable oil, and India is now among the world's largest vegetable oil importers.

Myanmar restricts imports and exports of oilseeds and oilseeds products, but authorizes the imports of large quantities of palm oil and attempts to maintain palm oil prices at the lowest level on the domestic retail market. As a result, Myanmar is increasingly dependent on palm oil import while domestic production is stagnating. Furthermore, as a result of an outright ban to import oilseeds or CPO, the domestic processing industry remains largely undeveloped, compared to neighboring countries.

3.6 Distribution of Oil Crops, Edible Oils and Oil Cakes

The domestic agricultural marketing system of oil crops covered in this study is general. Farmers have choices of traders for selling their produce as many traders are competing on the market. CEXCs (Crop Exchange Centre) and private information services are effectively facilitating oil crops trade. Nevertheless, inefficiencies exist with respect to marketing policies and access to timely market information by farmers. These include access to international markets, lack of quality standards, trade standards and measures, poor infrastructures and utilities, energy price structure, as well as macroeconomic policies related to finance and trade policies which are severely distorting the market. Most of the oil crops, edible oil and

oil cakes trading centers are located near production areas in the CDZ (Central Dry Zone). There are 7 main trading centers in the oil crops sub-sector (see Map 1):

1. Yangon
2. Mandalay
3. Myingyan
4. Monywa
5. Pakkoku
6. Magway
7. Pyay

3.6.1 Crop Exchange Centers (CEXCs). (Map 1)

The first CEXC established in Myanmar is the 'Brokers, Merchants and Millers Maha Kahtaintaw Association' and was founded in Mandalay during the colonial period in 1935. The association has operated as a CEXC as well as a voluntary organization supporting Buddhist institutions for the past 72 years. Membership is open to any Myanmar citizen who is 18 years old and who lives in the municipal area of Mandalay City. The association does not allow nonmembers to do business in the association compound. However they can visit and observe the marketing activities in the association compound and have to pay an entrance fee.

The primary role of the CEXC is to facilitate business transaction for its members. Members bring grain samples for display in the CEXC and buyers negotiate prices. Time for negotiation is restricted within the working hours of the CEXC. Once in agreement, both parties are checking the grains in warehouse. The CEXC association staffs record the agreed transaction prices on a black board or print some 400 copies of transaction prices daily.

These copies are sold Kyats 20/per copy within the premises of the CEXC as the crop exchange closes. Market information is dispatched to other marketing centers in Myanmar amongst traders using mobile phone or through private marketing information services (E-Trade). Mandalay market is the main grain exchange market in Myanmar, including oil crops. Mandalay CEXC is the first market to operate daily and therefore it is a price setter for oil crops in Myanmar. Apart from the Mandalay association, other CEXCs exist in Yangon, Monywa, Pakokku, Magway, Myingyan and Taunggyi and refer to the price and demand situation of the Mandalay market. Map 1 shows the location of CEXCs in Myanmar. The main commodities traded in all

CEXC are pulses, followed by oil crops. In Yangon, oil crops are rarely traded. The CEXC offers dispute resolution mechanisms for its members for transactions that occurred within the CEXC premises. A working group of dispute resolution calls both buyer and seller to the association to investigate. Then, this working group can make a judgment, which is submitted to the executive committee. The executive committee has to confirm or can make amendment on the judgment of the working group. Buyer and seller have to comply with the final judgment of the executive committee. If a member is dishonest, he or she shall be removed from this association.

3.6.2 Market Information

Timely market intelligence is essential for both domestic and international markets. Market information is required by farmers, traders, millers and exporters along the supply chain. All participants make decisions based on market information such as up-to-date information and historical trends analysis. The main information required by stakeholders in the oil crops sector is on the following:

• Traders and millers interviewed require daily price information in main regional market centers in Myanmar to assist daily decisions on procurements. These actors are aware of transport costs from procurement location to main markets and can therefore effectively utilize regional market price information. Weekly trends analyses are also appreciated, as it provides pertinent information assisting business strategies.

• In addition to daily price information, exporters require market intelligence on international market trends to decide on exports. For actual transaction, daily price information is essential and weekly average price and monthly price trends can assist exporters.

• Farmers need daily price information from neighboring markets to assist decisions on selling their agricultural produce. Timely trends analysis in main market centres could also assist farmers in their decisions.

There are two main sources of market information on agriculture produces in Myanmar; MIS and E-Trade.

3.6.3 Government Market Information Service (MIS)

The MIS was established in the year 2000 with technical and financial support from FAO. It is currently implemented by the DAP (Department of Agricultural Planning) in the MOAI (Ministry of Agriculture and Irrigation). Market prices are collected by MAS (Myanmar Agricultural Service) staffs on rice, paddy, oilseeds crop, edible oil, pulses, vegetables and fruits. Daily market prices are collected only in Yangon and Mandalay and weekly prices in other cities (Pyay, Myigyan, Monywa, Pakkoku, Taunggi, Augban and Mawlamyine). MIS print and distribute 15,000 copies of weekly market prices to over 300 MAS township offices. The weekly market prices can be procured by the private sector at MoAI library in Yangon. Delays in distribution of daily and weekly market prices reduce the value of the information system for farmers and traders. To increase its role in facilitating trade, MIS services need to expand from just providing market information on prices to a limited audience, to include information specifically required by farmers, commercial agriculture and agro-industry on a much wider scale. Radio broadcasting of marketing information, databases of price, trade and production data that can be accessed via internet and enhanced capacity to collect and interpret data are also desirable. The MIS has not been authorized to broadcast marketing information on radio as disseminating prices of rice and edible oils are perceived as a potential risk to social stability.

3.6.4 E-Trade

In Myanmar, the private sector has come in to fill some gaps in MISs for agricultural commodities. E-Trade was established in April 2003 with the objective of providing trade and business intelligence to Myanmar traders and exporters. E-Trade service has adapted to the specific demands from traders and exporters. Daily prices in CEXC (Yangon, Pyay, Myigyan, Mandalay, Monywa, Pakkoku, Magway, Taunggi, Auglan and Hintada) are collected and ETrade customers are updated on price news several times a day through Short Message Service (SMS) on mobile phone and internet facilities www. e-trade. Myanmar. com. Commodities covered by E-Trade include oil crops, edible oils, palm oil from Malaysia and oilcakes, but the main focus is on pulses market intelligence in Myanmar and on the Mumbai market in India. Weekly price trends analysis are made available to E-Trade customers. Printed versions of the weekly price analysis are distributed in trading centers where electronic communication is not available. The company has more than 2,000

customers registered and using their services, mainly located in Yangon, Mandalay, Monywa and Magway. Monthly SMS service charge ranges between Kyats 5,000 to 25,000 depending on different market information selected by users.

3.6.5 Limitations of Market Information Systems

None of the existing market information is made available to farmers in rural areas. The MIS is not in a position to broadcast market data through radio and E-Trade uses communication means (SMS and internet) which are expensive in urban areas (mobile phone) and simply not available in rural areas. It appears that many villages in the CDZ are connected with phones. If not directly connected to a phone line, cordless phones mounted with an antenna that can receive signals up to 5 or 10 miles (depending on the phone model) are available in many villages. As a result, villagers in the CDZ can make phone calls to any part of Myanmar. Market information could be disseminated through automated phone services. Discussions with farmers were encouraging and showed that a market for such services does exist. Other limitations of the current market information system are that international market intelligence remains limited to a few commodities for which export is well established. Prospecting market intelligence on other promising commodities such as processed sesame seed, sesame oil, and edible/snack groundnut would provide useful information to traders and support business development.

3.7 Market Integration and Trade Flow

Market integration analysis could not be conducted within the framework of this study. The function of CEXCs in the main producing areas and timely market information updates provided to traders by E-Trade results in immediate market reactions to signals from any CEXC in the country. The main price setters are Mandalay CEXC for oil crops, Yangon for palm oil and Taunggi for soybean. Price differences exist between markets but these mostly reflect transport costs to end markets.

Oil crops, edible oils and oilcakes flow from production and processing to consumption areas.

3.7.1 Domestic Edible Oils

Domestic edible oil flows from main production areas in the CDZ to Yangon and other states and divisions which have a deficit in edible oil production. There are small volumes of groundnut oil informally exported to the People's Republic of China.

3.7.2 Sesame (Map 2)

Sesame flows from main production areas in the CDZ to Yangon and the Chinese border in Muse for export. In 2006/07, the total sesame exports have reached a new record and exceeded 100,000 tons. There are informal exports reported on Myawadi border to Thailand. Sesame for oil consumption remains mainly located in central and upper Myanmar where consumers prefer the aromatic and slightly bitter taste of sesame oil.

3.7.3 Groundnut (Map 3)

Groundnut flows from main production areas in the CDZ and Shan states to processing areas mainly in Mandalay, Magway, Pyay and Yangon. Main consumption areas for groundnut oil are in lower Myanmar. It is estimated that overall 40 percent of marketed groundnut are used for snack/table purpose out of which an estimated 20 percent is informally traded to Thailand mainly via Myawadi border. The rate of groundnut use for snack/table purpose has significantly increased over the past three to five years.

3.7.4 Sunflower (Map 4)

Sunflower trade flow is very limited as most of the production is consumed locally by farmers or villagers mixed with sesame oil. Trade of roasted sunflower from Shan states is not presented on the map.

3.7.5 Oil Palm (Map 5)

Domestic production of CPO from Tanintharyi division is shipped by boat to Yangon and refined at Yuzana refinery. Unprocessed CPO is used by the soap industry or locally as biofuel. Imported palm oil, mainly from Malaysia is shipped in bulk to Yangon. Palm oil is dispatched to all parts of Myanmar from Yangon through the Myanmar Edible Oil Dealers Association and municipalities administrations. Palm

oil is shipped in drums by boat to Rakhine state from Yangon. Informal palm oil imports from Thailand enter the country mainly via Myawadi and Kaya state border points and are estimated to account for 20 percent of all palm oil imports in the country. This proportion varies depending on government palm oil price and import policies. Informally imported palm oil is redistributed to all parts of the country through traders and wholesalers. Informal exports of palm olein and sterin to India takes place in Tamu border, stimulated from price differences between India and Myanmar.

3.7.6 Oilcakes (Map 6)

Sesame and groundnut cakes flow from main processing areas in the CDZ and Yangon to main livestock and fishery production areas in Ayeyarwaddy, Yangon and Shan states. Feed millers are processing and enriching oilcakes in Mandalay, Yangon and Shan states (northern and southern). Soybean cake flows from Yangon and Mandalay to fishery and chicken production areas in Ayeyardaddy and Shan states. Caused by the shortage of oilcakes which became apparent in the past two to three years, palm oilcakes, although of poor quality, are increasingly used as animal feed.

CHAPTER 4
SURVEY ANALYSIS

4.1 Survey Profile

The survey method was used to analyze public awareness of edible oil usage and health risk in Myanmar in this study. The study areas were In Sein Township and Mayagone Township and respondents were households from those townships.

The majority of vegetable oils used in food preparation in Myanmar are imported and sold non-branded. Little is known about their fatty acid (FA) content. This study aimed to investigate the FA composition of commonly used vegetable oils in the Yangon region, and the association between the use of palm oil vs. peanut oil and risk factors for non-communicable disease (NCD).

A large proportion of the vegetable oil on the global market is non-branded. The fatty acid content of non-branded oils is often not known, and the impact of non-branded oils on health remains to be elucidated. In the Yangon region of Myanmar, the age-standardized prevalence of diabetes was 12.1% in urban areas and 7.1% in rural areas in 2014. The corresponding prevalence of hypertension was 34.5% in urban areas and 34.2% in rural areas, while those of hypercholesterolemia were 50.7% in urban areas and 41.6% in rural areas. Vegetable oils are essential in the Myanmar diet (‘Rice, oil, salt and medicine are a man’s basic needs’ is a saying in Myanmar).

The annual consumption of edible oil per person in Myanmar is approximately 9.3 kg. The results from previous and future studies on the association between the types of oils used and health-related outcomes could be better interpreted if the FA contents of different types of oil were known. Therefore, the aim of this study was to identify the FA composition of vegetable oils consumed in households in the Yangon region of Myanmar, and to investigate the association between the two most commonly used types of cooking oil (palm oil and peanut oil) and NCD risk factors in study participants between the ages of 25 and 74.

4.2 Survey Design

To accomplish the objectives, a questionnaires survey was conducted as face to face interview from 21st May - 30th June 2019 by using qualitative and quantitative approach. The research questionnaires were prepared for customers with randomly selected of 125 respondents in (2) selected different townships in Yangon. Convenient sampling method was used in this study. Data were collected on age, sex, and marital status, highest level of education attained, income status, and awareness on edible oil usage and health risk, kind of edible oil, nutrition and public health, about price factor and consumption quantity. (Sample questionnaires are shown in (Appendix-B).

4.3 Survey Results

According to the survey, it is observed the important survey results for this study such as demographic characteristics of respondents, public awareness of edible oil usage and health, kind of edible oil, nutrition and public health, about price factor, quality and purchased quantity in Myanmar.

4.3.1 Demographic Characteristics of the Respondents

Demographics are characteristics of a population. Characteristics such as race, ethnicity, gender, age, education, profession, occupation, income level, and marital status, are all typical examples of demographics that are used in surveys. When designing a survey, the research needs to assess who to survey and how to breakdown overall survey response data into meaningful groups of respondents. Both assessments are based on demographic considerations.

Table (4.1) Age, Gender, Educational and Occupational Status of Respondents

Age Composition (Year)	Number	Percentage (%)	Mean
20-30	23	18.4	31.25
31-50	86	68.8	
51-60	12	9.6	
61and above	4	3.2	
Gender	Number	Percentage (%)	Mean
Male	45	36	62.5
Female	80	64	
Education Level	Number	Percentage (%)	Mean
Primary	6	5	25

Secondary	38	30	
Certificate College	62	50	
University and above	13	10	
None Formal Education	6	5	
Daily Income	Number	Percentage (%)	Mean
5000 Kyat/Day	62	50	41.66
5000-8000 Kyat/Day	40	32	
9000 Kyat and above	23	18	
Total	125	100	

Source: Survey data (2019)

Respondent's Characteristics are also given in terms of age. The age composition of the respondents is shown in table (4.1), Out of 125 respondents, a total of 18.4% respondents belong to the age group between 20 – 30 years, 68.8% respondents belong to the age group between 31 – 50 years and 9.6 % respondents belong to 51-60 years and the rest are 61 and above. From 125 selected respondents the Gender identical is a total of 36 % respondents are male and 64% respondents out of 125 respondents are female.

According to the table (4.1), 5% of respondents are primary level, 30% of respondents are secondary level, 50% of respondents studied certificate college level and 10% are university and above and only 5% of respondents had none formal education. The survey data are collected an account of 125 respondents. The finding of present study mainly focus on level of respondent's education, age and daily income status. According to table (4.1), 50% respondents get at least 5000 kyats per day, 32.% of respondents get 5000-8000 kyats per day and only 18% get daily income as 9000 kyats and above.

4.3.2 Analysis on the Customers' Awareness on Edible Oil

The usage of repeatedly heated cooking oil is a common practice amongst Malaysians. When oil is heated repeatedly, oxidation and hydrolysis occur due to thermal decomposition. Several studies have suggested that consumption of repeatedly heated oil can be detrimental to health. Therefore, this study was conducted in order to assess the level of awareness amongst the general public regarding the usage of repeatedly heated cooking oil.

Table (4.2) Customers' Awareness on Edible Oil

Do you aware Fat contents in each oil	Number	Percentage (%)	Mean
Yes	25	20	62.5
No	100	80	
Do you found fat content ratio label in domestic oil	Number	Percentage (%)	Mean
Yes found	19	15	62.5
No read	106	85	
Do you found fat content ratio label in import oil	Number	Percentage (%)	Mean
Yes found	25	20	62.5
No read	100	80	
Do you found FDA register number when you buy the cooking oil from local market?	Number	Percentage (%)	Mean
Yes found	10	8	62.5
No read	115	92	
Do you found FDA register number when you buy the cooking oil from super market?	Number	Percentage (%)	Mean
Yes found	37	30	62.5
No read	88	70	

Source: Survey data (2019)

According to the table (4.2), from 125 selected of customer respondents, 80% of respondents did not aware about fat and fatty acid content in edible oil and only 20 % of customer respondents know about this. Over 80 % of respondents did not read fat content ratio label on edible packing of both domestic and import products and less than 20% found and aware about fat content label. The total 92 % of respondents did not found and look the FDA registered number on edible oil packing when purchase at local market and home shop and only 8% take care this FDA registered number. And 30% of respondents found and read FDA registered number when they bought from supermarket and the rest did not read the registered number. Total 75 % of respondents did not aware heart disease and other health problem if consuming of reusing cooking oil and only the rest 25% know about this and they did not reuse cooking oil

4.3.3 Customer's usage of edible oil for cooking

High consumption of fried foods might increase the risk of these disorders. However, it is not clear whether the use of vegetables oils for cooking increases the risk of chronic diseases. The myth that frying foods is generally associated with a higher risk of CVD is not supported by the available evidence, virgin olive oil significantly reduces the risk of CVD clinical events, based on the results of a large randomized trial that included as part of the intervention the recommendation to use high amounts of virgin olive oil, also for frying foods and high consumption of fried foods is probably related to a higher risk of weight gain.

Table (4.3) Customer's Usage of Edible Oil for Cooking

How do you manage lunch and dinner of family?	Number	Percentage (%)	Mean
Cook at home	115	92	41.66
Eat at restaurant	6	5	
By food catering services	4	3	
Which kind of edible oil use in cooking at home?	Number	Percentage (%)	Mean
Groundnut oil	25	20	31.25
Sesame oil	25	20	
Soybean oil / Sunflower oil	12	10	
Palm oil or mix oil	63	50	
Where did you buy?	Number	Percentage (%)	Mean
From local bazaar	78	63	41.66
From super market	44	35	
Direct from oil factory	3	2	
How much use in a month?	Number	Percentage (%)	Mean
1-2 viss	91	73	41.66
3-4 viss	32	26	
5 vis and above	2	1	
Total	**125**	**100**	

Source: Survey data (2019)

According to the table (4.3), from 125 selected of customer respondents, majority 92% of respondents cooked at home and only 5% eat at restaurants some

times and the rest 3% order food from catering services. Majority of the respondents, 50% of respondents use pure palm oil and mixed oil for cooking, 20% use groundnut oil and the other 20% use sesame oil for cooking at home and only 10% use sunflower oil or soybean oil for cooking. About the usage of edible oil, total 73% of respondent use 1 to 2 viss per month and 26% of respondents use 3-4 viss, only 1 % use 5 viss and above per month according to large family and their lifestyle.

Table 4.4 Most Preferred Brands and Product

Description	Number	Percentage (%)	Mean
Ayeyarwaddy Peanut Oil	12	10	17.86
Shwe Peanut Oil	7	5	
Yangon Peanut	7	5	
Meizan Soybean Oil	12	10	
Yangon Pure Sesame Oil	12	10	
Bayin Sesame Oil	12	10	
Palm Oil and Mix Oil	63	50	
Total	**125**	**100**	

Source: Survey data (2019)

According to the table (4.4), from 125 selected of customer respondents, majority 50% of respondents used palm oil or mix oil because of reasonable price and each 10% of respondents use Ayeyarwaddy peanut oil, Yangon sesame oil and Bayin sesame oil. The other 10% of respondents use Meizan soybean oil and the rest of each 5% use Shwe peanut oil and Yangon peanut oil. Majority of the respondents, 50% of respondents use pure palm oil and mixed oil for cooking.

4.3.4 Health Risk

Edible oils extracted from plants are commonly known as vegetable oils. The consumption of vegetable oils has increased dramatically in the past century. Most mainstream health professionals consider them healthy, but vegetable oils may cause health problems. Their health effects vary depending on what fatty acids they contain, what plants they are extracted from and how they are processed.

Table 4.5 Health Risk

Heart disease and other health problem of reusing cooking oil	Number	Percentage (%)	Mean
Yes	115	75	62.5
No	6	25	
High consumption of fried food might increase risk of overweight/ obesity, CVD, hypertension and Diabetes	Number	Percentage (%)	Mean
Yes	115	60	62.5
No	6	40	
High trans-fat intake increases the risk of death	Number	Percentage (%)	Mean
Yes	115	30	62.5
No	6	70	
Deep fried foods are link to serious health problems	Number	Percentage (%)	Mean
Yes	115	60	62.5
No	6	40	
Cooking with vegetable oil can release toxic chemical linked to cancer and other diseases	Number	Percentage (%)	Mean
Yes	115	35	62.5
No	6	65	
Total	**125**	**100**	

Source: Survey data (2019)

According to the table (4.5), from 125 selected of customer respondents, majority 75% of respondents accepted about reusing cooking oil can cause heart disease and other health problems. And 60% of respondents accepted about High consumption of fried food might increase risk of overweight/ obesity, CVD, hypertension and Diabetes. But only 30% of respondents aware about high trans-fat intake increase the risk of death. And 60% of respondents accepted about deep fried food are link to serious health problems. Only 30% of respondents understand about cooking with vegetable oil can release the chemical toxic linked to the cancer and others.

CHAPTER 5
CONCLUSION

This chapter contains two main parts as Findings and Recommendations which may support for further study. The Conceptual framework of demographic characteristics of respondents, public awareness of edible oil usage and health, kind of edible oil, nutrition and public health, about price factor, quality and purchased quantity in Myanmar.

5.1 Findings

The survey was conducted in (2) selected townships and those are Insein and Mayangone townships in Yangon. The Respondent's Characteristics are also given in terms of age, education level, daily income status and their awareness about edible oil and usage of customers. The living status is decided from survey data based on occupational and educational standards. The finding of present study is mainly focus on level of respondent's education, daily income and their awareness of edible oil usages.

The annual consumption of edible oil per person in Myanmar is approximately 9.3 kg (10 kg in urban areas and 8.6 kg in rural areas). However, information on consumption patterns of vegetable oils, and the fatty acid content of the oils, is scarce in Myanmar. Peanut oil and sesame oil are the two major oils produced in Myanmar, while palm oil is the most commonly used oil in the country. However, in Lower Myanmar, including the Yangon region, peanut oil is the most frequently consumed oil. Most of the palm oil is imported at a low price from Malaysia. In Myanmar, palm oil is available in the market as pure palm oil, or else is mixed with peanut oil or sesame oil, and can be branded or non-branded.

Choice of oil depends on educational level, income, consumer's preference, health knowledge. Palm oil - the cheapest oil and often the choice of low income people, was most commonly used by the participants with low educational level and income, among rural dwellers and among women. In Myanmar, men are commonly breadwinners working outside the house and may be less exposed

to foods cooked at home. However, in our study, amount of oil consumed did not vary with socio-economic position, location or gender.

The survey interview is completed with 36% of male and 64% of female, a majority of age between 31 and 50 as presented. According to survey result, it is observed that only 5% of respondents have primary level of education and the other 5% have none formal education. And most of respondents get daily income as 5000 kyats per day. And 18 % of respondents get daily income 9000 kyats and above.

From 125 selected of customer respondents, 80% of respondents did not aware about fat and fatty acid content in edible oil. Over 80 % of respondents did not read fat content ratio label on edible packing of both domestic and import products and less than 20% found and aware about fat content label. The total 92 % of respondents did not found and look the FDA registered number on edible oil packing Total 75 % of respondents did not aware heart disease and other health problem if consuming of reusing cooking oil.

From 125 selected of customer respondents, majority 92% of respondents cooked at home and only 5% eat at restaurants some times and the rest 3% order food from catering services. Majority of the respondents, 50% of respondents use pure palm oil and mixed oil for cooking, 20% use groundnut oil and the other 20% use sesame oil for cooking at home and only 10% use sunflower oil or soybean oil for cooking. About the usage of edible oil, total 73% of respondent use 1 to 2 viss per month and 26% of respondents use 3-4 viss, only 1 % use 5 viss and above per month according to large family and their lifestyle.

This study observed that Majority of the respondents are females, most of the respondents belong to the age group of 31 to 50 years. Most of the respondent uses palm oil or mixed oil. Most of the respondent purchase edible oil from local bazaar and home shop. The majority of respondents did not aware about fat content, FDA registered label and heart and other diseases can cause by consuming reuse cooking oil.

Majority 50% of respondents used palm oil or mix oil because of reasonable price and each 10% of respondents use Ayeyarwaddy peanut oil, Yangon sesame oil and Bayin sesame oil. The other 10% of respondents use Meizan soybean oil and the rest of each 5% use Shwe peanut oil and Yangon peanut oil.

From 125 selected of customer respondents, majority 75% of respondents accepted about reusing cooking oil can cause heart disease and other health problems.

And 60% of respondents accepted about High consumption of fried food might increase risk of overweight/ obesity, CVD, hypertension and Diabetes. But only 30% of respondents aware about high trans-fat intake increase the risk of death. And 60% of respondents accepted about deep fried food are link to serious health problems. Only 30% of respondents understand about cooking with vegetable oil can release the chemical toxic linked to the cancer and others.

5.2 Recommendations

A cheaper price of palm oil and limited information for how to choose healthy oils could be barriers to change to more healthy alternatives. Appropriate intervention, such as information on how to choose healthy oils could help reducing the intake of oils rich to prevent health problem. Further research into the quantity of vegetable oil consumption and food preparation, with a focus on sex differences is warranted. Non-branded oils were most commonly used in food preparation, and non-branded palm oil had a less favorable fatty acid composition compared to branded palm oil. The lower price of non-branded oils and limited information about how to make healthy choices could be barriers to changing to healthier alternatives. The adulteration of original oils with low-quality oils, and low-quality production techniques, could contribute to substandard quality in vegetable oils. Appropriate interventions, such as the enforced labeling of content on oil bottles, encouraging the regulation of non-branded oils, and providing information on how to choose healthy oils, could help to reduce the intake of oils rich and help to reduce the risk of NCD in Myanmar.

FDA should be collaborated with local authorities such as General Administrative Department and Township YCDC office to improve public awareness about consumption of edible oil among the people and law and regulation should be improvement with reusing cooking at teashop, household and selling in local markets.

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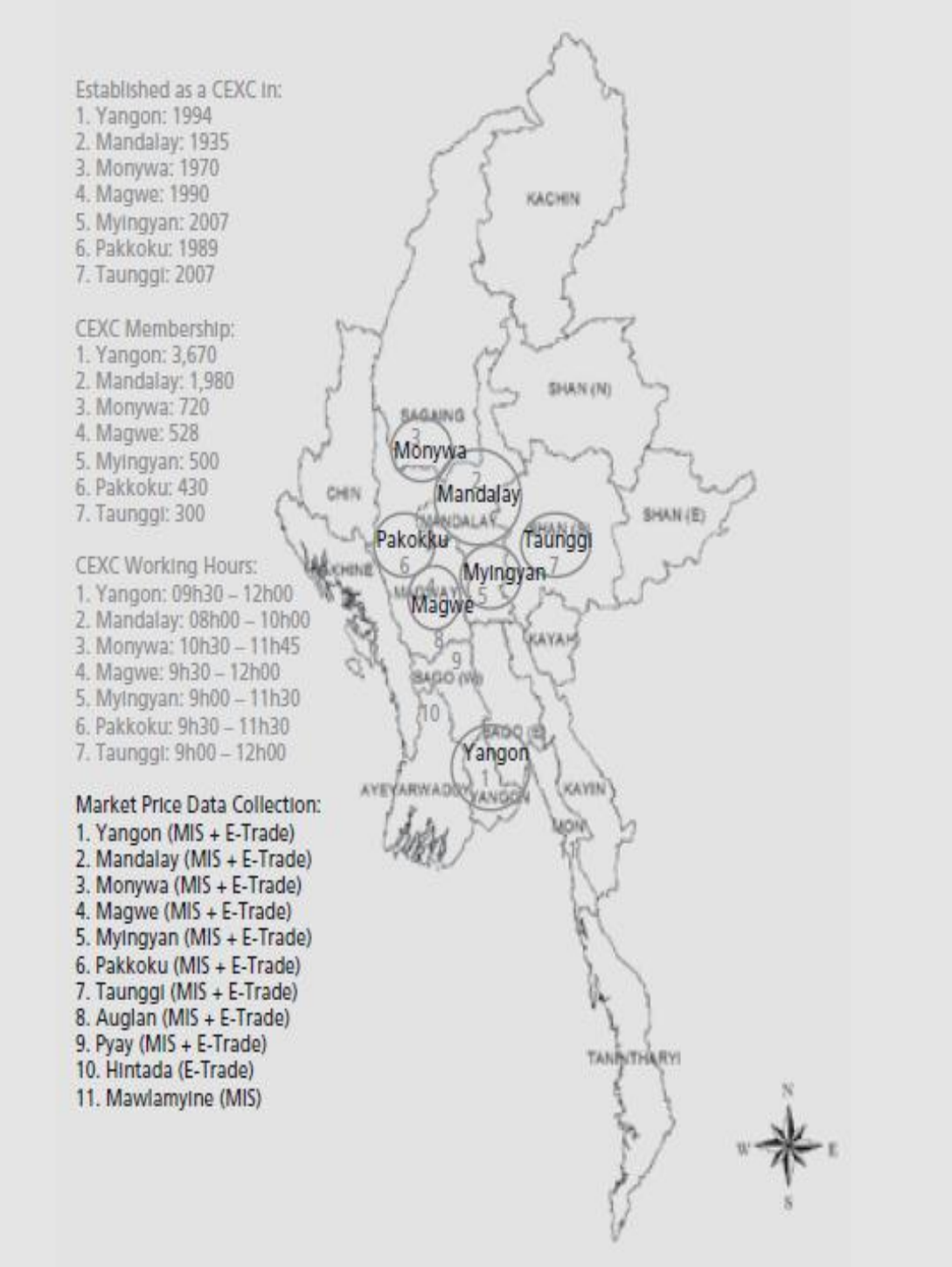
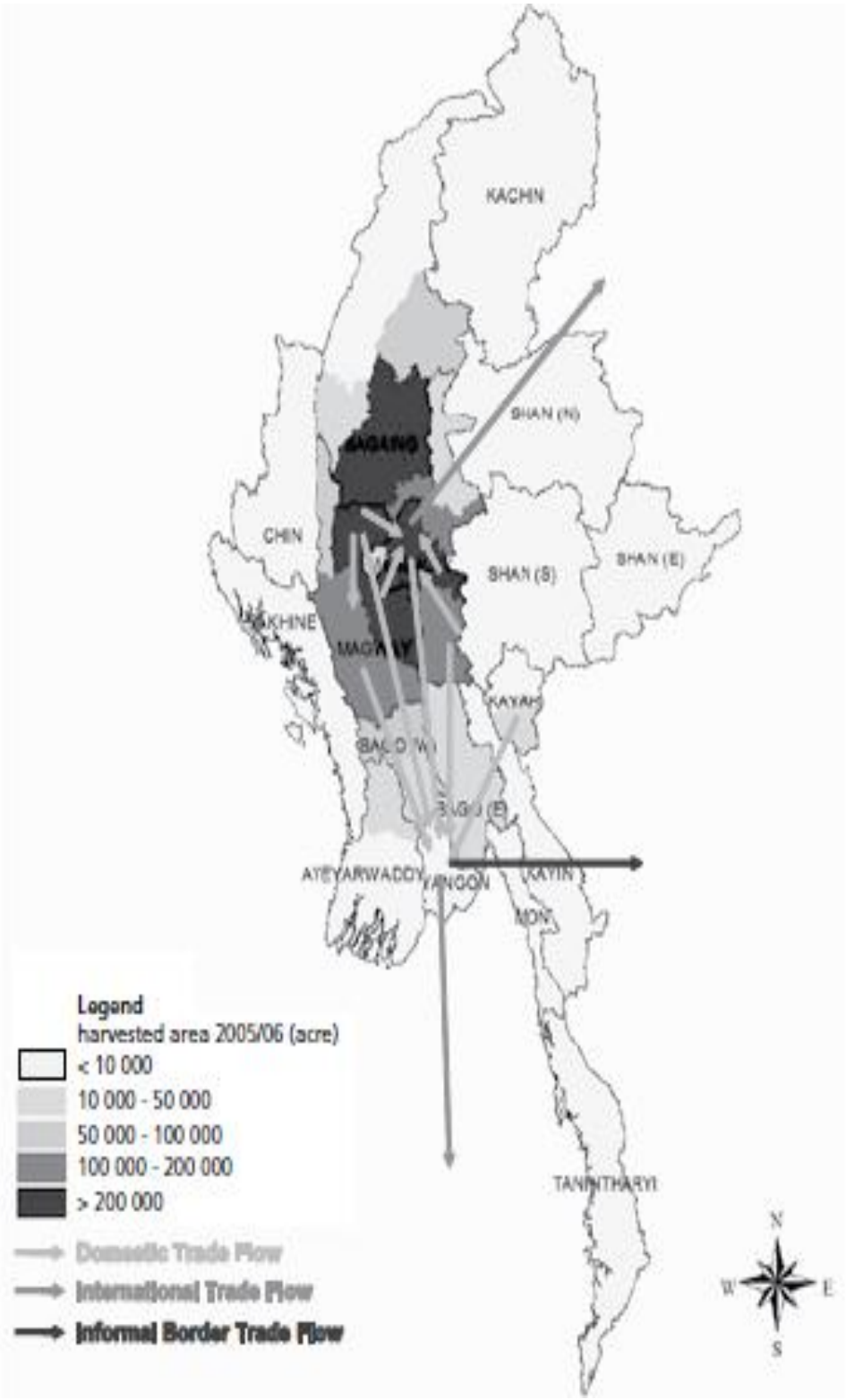
Appendix (A)

Map 1: Location of the Crop Exchange Centres and market price data collection by the Myanmar Agricultural Service and E-Trade



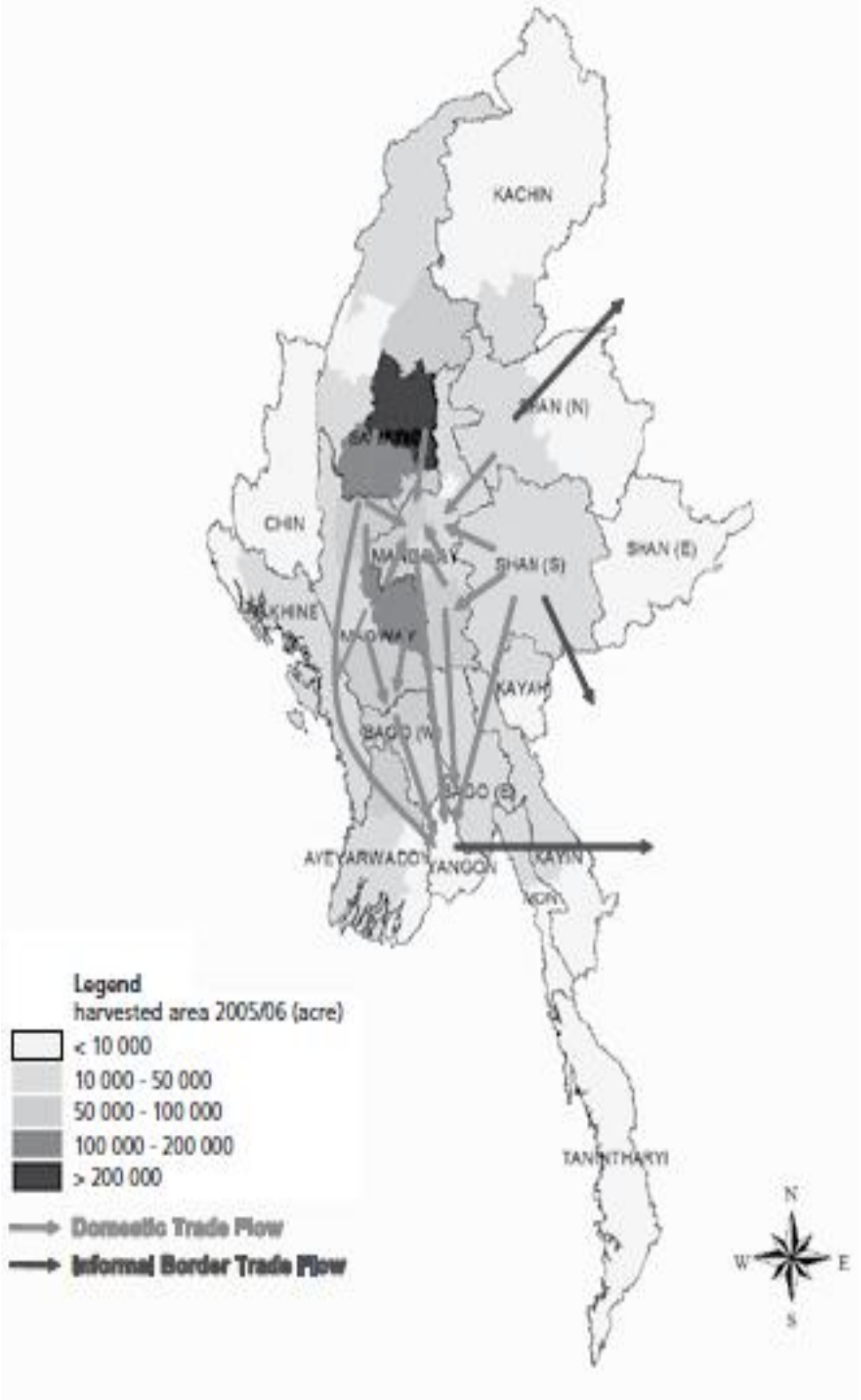
Source: FAO. 2005. Agricultural Atlas of the Union of Myanmar. Agricultural Year 2001-2002

Map 2 - Sesame harvested area 2005/06 and trade flow



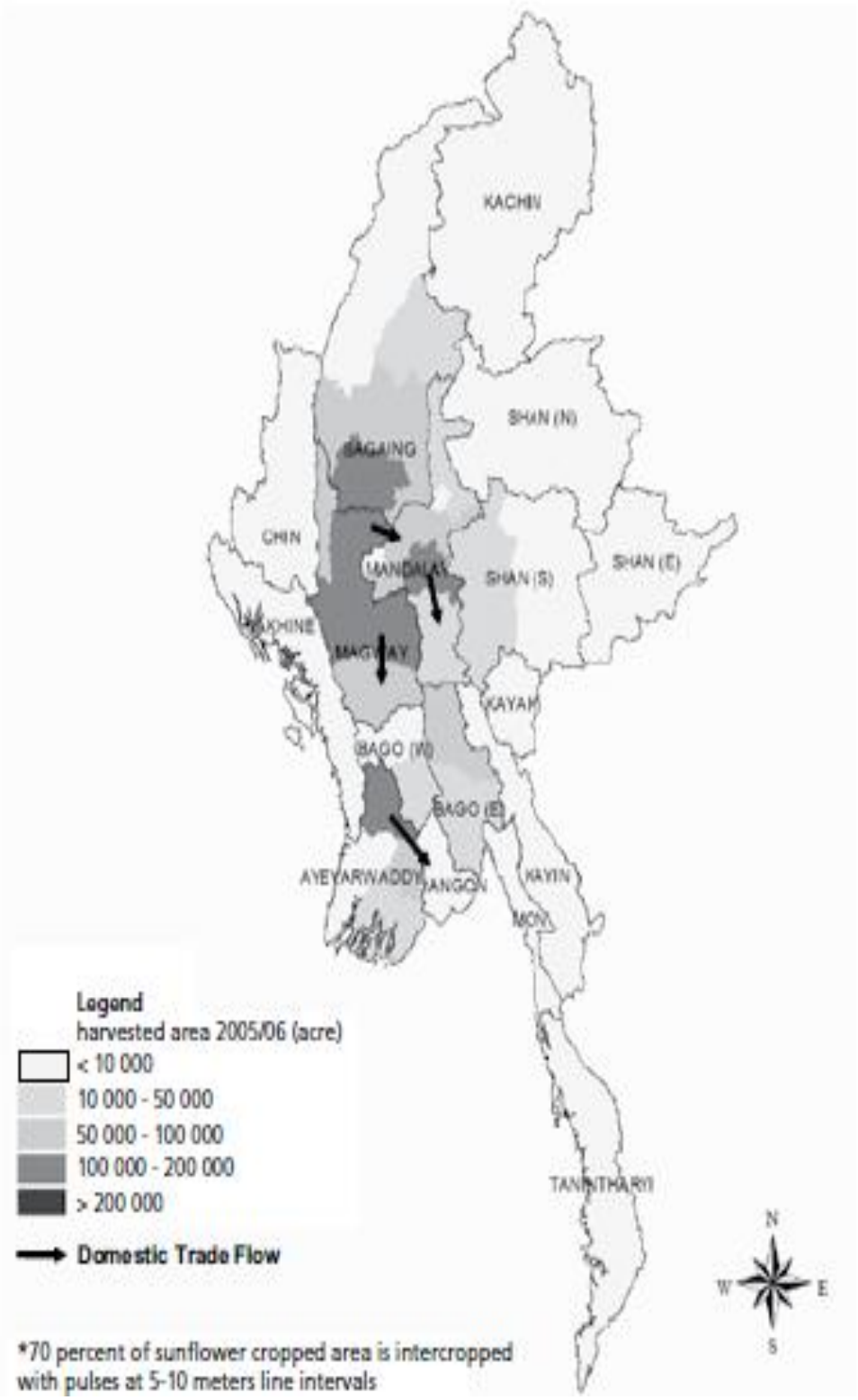
Sources: MAS (Myanmar Agricultural Service)

Map 3 - Groundnut harvested area 2005/06 and trade flow



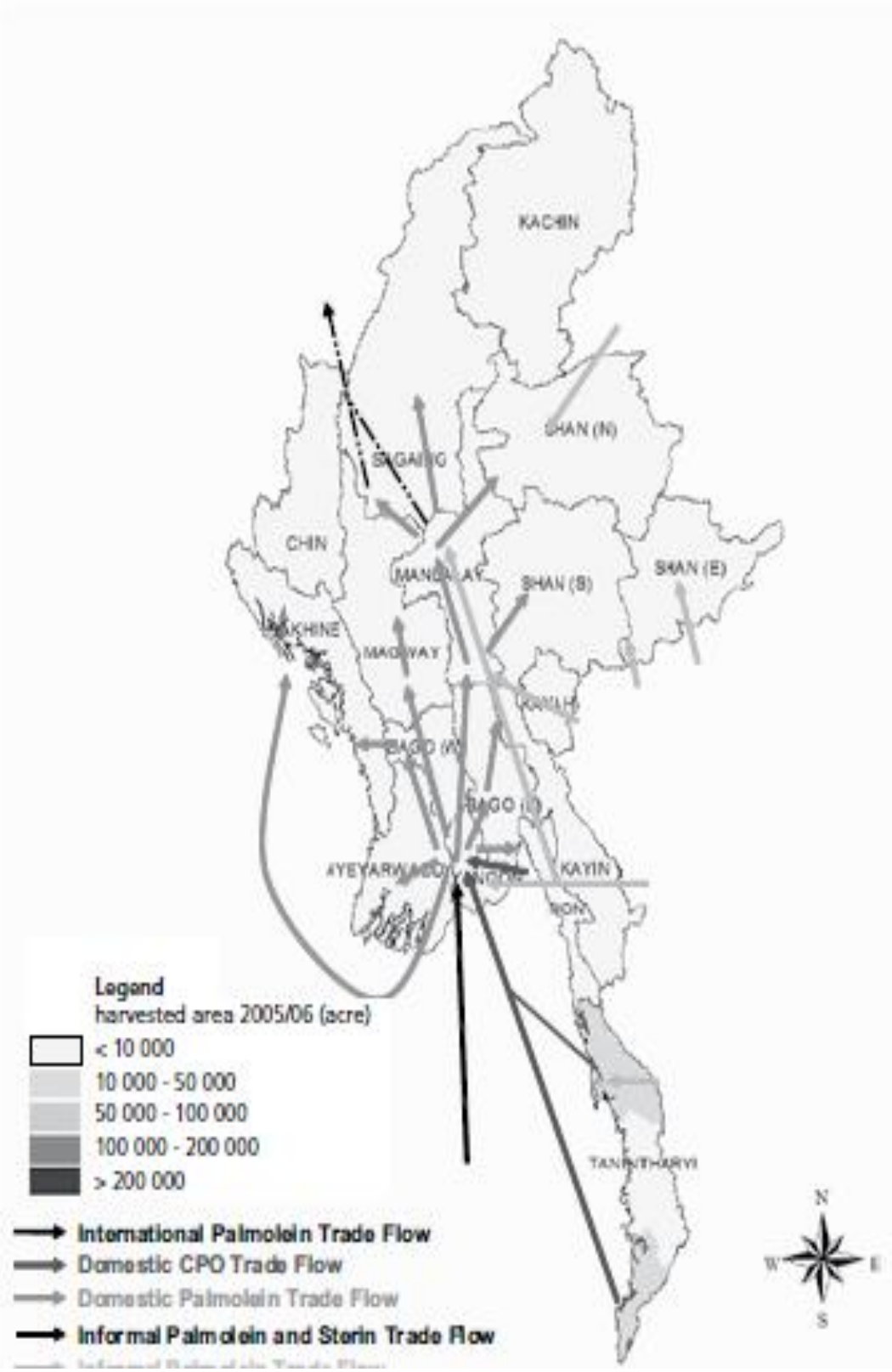
Sources: MAS (Myanmar Agricultural Service)

Map 4 - Sunflower harvested area 2005/06 and trade flow



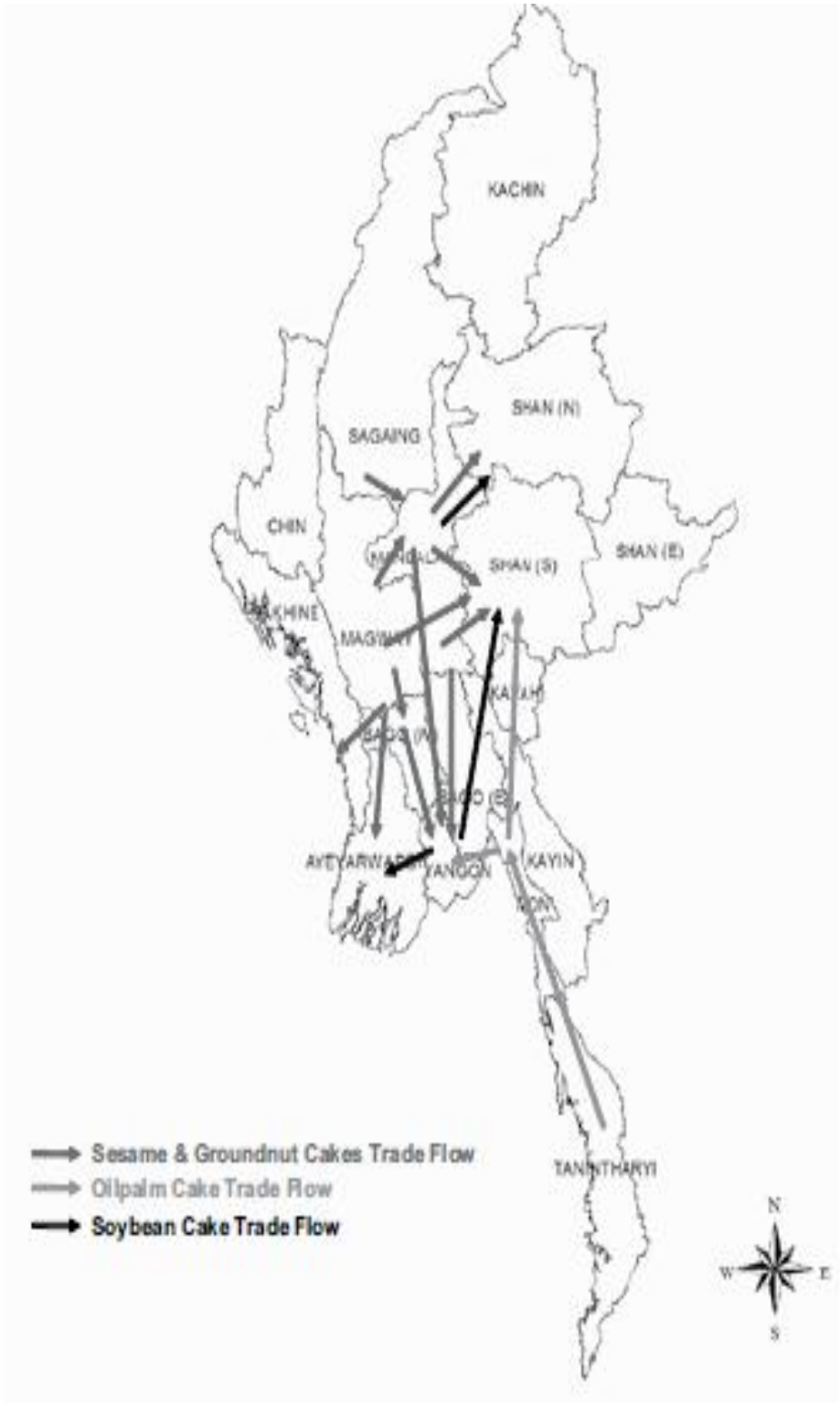
Sources: MAS (Myanmar Agricultural Service)

Map 5 – Oil palm harvested area 2005/06 and trade flow



Sources: MAS (Myanmar Agricultural Service)

Map 6 - Main oilcakes trade flow 2006/07



Source: MAS (Myanmar Agricultural Service)

APPENDIX (B)

မြန်မာနိုင်ငံ စားသုံးဆီထုတ်လုပ်မှုအခြေအနေကောက်စစ်တမ်း

(Survey of edible oil production in Myanmar)

- ဤမေးခွန်းလွှာသည် ရန်ကုန်စီးပွါးရေးတက္ကသိုလ်၊ အသုံးချဘောဂဗေဒဌာနမှ ကြီးမှူးဖွင့်လှစ်သော ပြည်သူ့ရေးရာ စီမံခန့်ခွဲမှု မဟာဘွဲ့(EMPA) အတွက်လိုအပ်သော ကျမ်းကို ပြုစုတင်ပြရန်အတွက်သာ မေးမြန်းခြင်းဖြစ်ပါ၍ ကျေးဇူးပြု၍ ကူညီဖြေကြားပေးပါရန် မေတ္တာရပ်ခံအပ်ပါသည်။ (This question is just only purpose for thesis of EMPA, conducted from Yangon Institutes of Economic and it is requested to answer please.)
- ဤဖြေကြားချက်များကို အခြားမည်သည့်နေရာတွင်မှ အသုံးပြုမည်မဟုတ်ကြောင်းနှင့် အချက်အလက်များ အားလုံးကို လေးစားစွာဖြင့် လျို့ဝှက်ထိန်းသိမ်းထားပါမည်။ (Theses answers are confirmed to use in nowhere and kept as personally secret with fully regards, apart from using in thesis for EMPA.)
- ဤလေ့လာမှုအတွက် စိတ်ပါဝင်စားစွာ ပါဝင်ပေးမှုအတွက် အလွန် ကျေးဇူးတင်ပါသည်။ (Truly thanks for interestingly involving in this study.)

အပိုင်း(က) ဖြေဆိုသူ၏ ပုဂ္ဂိုလ်ရေးဆိုင်ရာ အချက်အလက်များ

Part (A) (Personal information of answerer).

၁။ ကျား (Male) ☐ မ (Female) ☐

၂။ သင်သည် အောက်ပါတို့မှ မည်သည့် အသက် အုပ်စုဝင် ဖြစ်သနည်း။ (Which group of aged are you in?)

၁၈- ၃၀☐ ၃၁-၄၀ ☐ ၄၁-၅၀☐ ၅၁အထက် ☐

(18~30) (31~40) (41~50) (51 Above)

၃။ ဖြေဆိုသူ၏ ပညာရေး (အမှန်ခြစ်ရန်သာ) (Educational back ground. Just to tick for answer)

1. မူလတန်း ☐ 2. အလယ်တန်း ☐ 3. အထက်တန်း ☐

(Primary) (Intermediate) (Matriculation)

5. ဘွဲ့လွန် ☐ 4. တက္ကသိုလ် ☐ 6. အခြား (ဖော်ပြရန်) _____

(Post graduate) (University) (Other)

၄။ လက်ရှိနေထိုင်လျက်ရှိသောမြို့နယ် _____ (Location township of current resident)

၅။ လက်ရှိအတူနေမိသားစုဝင် (သို့မဟုတ်) အတူနေသူ လူဦးရေ - ( ) ဦး

(Family members or persons stay together) ( ) person

အပိုင်း(ခ) ချက်ပြုတ်ရာတွင် စားသုံးဆီအသုံးပြုခြင်း

Part (B) (Edible oil usage in cooking).

၆။ အိမ်တွင် ကိုယ်တိုင်ချက်ပြုတ်စားသောက်ပါသလား (အမှန်ခြစ်ရန်သာ) (Self cooking? Just to tick for answer)

1. အမြဲချက်စားသည် ☐ 2. တခါတရံမှချက်စားသည် ☐ 3. ထွင်းချိုင့်ဆွဲစားသည် ☐

(Mostly) (Sometimes) (Order from food shops)

၇။ အိမ်တွင် မည်သည့်ဆီအမျိုးအစားကို အသုံးပြု၍ ဟင်းချက်ပါသနည်း။ (Which kind of edible oil use in cooking at home?)

1. မြေပဲဆီ ☐ 2. နေကြာဆီ ☐ 3. ပဲပိစပ်ဆီ ☐ 4. ရောနှောဆီ ☐

(Groundnut oil) (Sunflower oil) (Soyabean oil) (Mixed oil)

၈။ အိမ်တွင်သုံးသည့် စားသုံးမည့်ဆီကို မည်သည့်နေရာမှ ဝယ်ယူပါသနည်း။ (From where do you buy edible oil use in cooking at home?)

1. ဈေးထဲမှ ☐ 2. Super market မှ ☐ 3. ကြိတ်စက်မှ ☐

(From bazaar) (From Supermarket) (Direct from mills)

အပိုင်း(ဂ) စားသုံးဆီအကြောင်း သိနားလည်မှုအခြေအနေ

Part (C) (Awareness about edible oil).

၉။ စားအုံးဆီတွင် ပါဝင်နေသော ဆီပါဝင်မှုနှုန်းထားများကို သိပါသလား။ (Do you know Fat level that contain in Palm oil ?)

သိပါသည်။ ☐ မသိပါ။ ☐

၁၀။ မြေပဲဆီတွင် ပါဝင်နေသော ဆီပါဝင်မှုနှုန်းထားများကို သိပါသလား။ (Do you know Fat level that contain in Groundnut oil ?)

သိပါသည်။ ☐ မသိပါ။ ☐

၁၁။ နှမ်းဆီတွင် ပါဝင်နေသော ဆီပါဝင်မှုနှုန်းထားများကို သိပါသလား။ (Do you know Fat level that contain in Sesame oil ?)

သိပါသည်။ ☐ မသိပါ။ ☐

၁၂။ နေကြာဆီတွင် ပါဝင်နေသော ဆီပါဝင်မှုနှုန်းထားများကို သိပါသလား။ (Do you know Fat level that contain in Sunflower oil ?)

သိပါသည်။ ☐ မသိပါ။ ☐

၁၃။ ဈေးမှဝယ်ယူလိုက်သော စားသုံးဆီပုလင်း/ဗူးတို့တွင် ဆီပါဝင်မှုနှုန်းထားများကို ဖော်ပြထားသည်ကို တွေ့မြင်မိပါသလား။ (Do you see Fat level specification label that stuck on cooking oil you bought from shop ?)

မြင်မိသည်။ ☐ မမြင်မိပါ။ ☐

၁၄။ ပြည်ပမှတင်သွင်းလာသည့် စားသုံးဆီပုလင်း/ဗူးများတွင် ဆီပါဝင်မှုနှုန်းထားများ ဖော်ပြထားသည်ကို တွေ့မြင်မိပါသလား။ (Do you notice ingredient specification label that contain in imported cooking oil bottles?)

မြင်မိသည်။ ☐ မမြင်မိပါ။ ☐

၁၅။ Supermarket တွင်တင်ပြရောင်းချထားသော ပြည်ပမှတင်သွင်းလာသည့် စားသုံးဆီဗူး/ပုလင်းများတွင် မြန်မာနိုင်ငံ Food & Drug Control (FDA) ၏ခွင့်ပြုချက်အမှတ်တံဆိပ်ကို သတိထား တွေ့မြင်မိပါသလား။ (Do you notice government's FDA approval serial on imported cooking oil bottles which are selling in Super/Hiper markets?)

မြင်မိသည်။ ☐ မမြင်မိပါ။ ☐

အပိုင်း (ဃ) စားသုံးဆီအမှတ်တံဆိပ်ပေါ်ရွေးချယ်နှစ်သက်မှု

Part (D) Most Preferred Brands and Product

၁၆။ အောက်ပါ ကုန်အမှန်တံဆိပ်နှင့်အမျိုးအစားများမှ နှစ်သက်ရာကိုရွေးချယ်ပါ။ (Please choose your most preferred band and product in below mentioned.)

(က) Ayeyarwaddy Peanut Oil

(ခ) Shwe Peanut Oil

(ဂ) Yangon Peanut

(ဃ) Meizan Soybean Oil

(င) Yangon Pure Sesame Oil

(စ) Bayin Sesame Oil

(ဆ) Palm Oil and Mix Oil

အပိုင်း(ဇ) ကျန်းမာရေးကိုအန္တရာယ်ပြုနိုင်သည့်အချက်များ

Part (E) Health Risk

၁၇။ ချက်ပြီးသားဆီကို ပြန်လည်အသုံးပြုခြင်းကြောင့် နှလုံးရောဂါနှင့် အခြားသော ကျမ်းမာရေးဆိုင်ရာ ပြဿနာများဖြစ်ပွားနိုင်သည်ကို သင်သိရှိပါသလား။ (Do you aware that heart disease and other health problem if consuming of reusing cooking oil?)

၁၈။ ဆီကြော်အစားအစာများကို အလွန်အကျွံစားသုံးခြင်းကြောင့် အဝလွန်ခြင်း၊ နှလုံးကြွက်သားဆိုင်ရာရောဂါများ၊ သွေးတိုးနှင့် ဆီးချိုရောဂါများဖြစ်ပွားနိုင်သည်ကို သိရှိပါသလား။ (Do you know that high consumption of fried food might increase the risk of overweight/ obesity, CVD, hypertension and Diabetes?)

၁၉။ ပြည့်ဝလွန်ဆီများကို စားသုံးခြင်းကြောင့် နာတာရှည်ရောဂါများနှင့် အခြားဆင့်ပွားရောဂါများဖြစ်ပွားနိုင်သည်ကို သိရှိပါသလား။ (Do you aware that high trans-fat (Fatty Acid) intake increases the risk of death by coronary heath disease and other diseases?)

၂၀။ ဆီးချိုနှင့်နှလုံးရောဂါကဲ့သို့သော ကျမ်းမာရေးပြဿနာများသည် ဆီနှစ်ကြော်အစားအစာများနှင့် ဆက်နွယ်နေသည်ကို သင်လက်ခံပါသလား။ (Do you accept that deep fried foods are link to serious health problems like diabetes and heart disease?)

၂၁။ သီးနှံထွက်ဆီများဖြင့်ချက်ပြုတ်ခြင်းသည် ဓါတုအဆိပ်အတောက်များကြောင့် ကင်ဆာကဲ့သို့သောရောဂါများ ဖြစ်ပွားခြင်းကို လျော့ချပေးနိုင်ကြောင်း သင်သိပါသလား။ (Do you know about cooking with vegetable oils can release toxic chemicals linked to cancer and other diseases?)