ASSESSMENT ON CABBAGE AND CAULIFLOWER SUPPLY CHAIN MANAGEMENT IN KALAW TOWNSHIP, SOUTHERN SHAN STATE

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ASSESSMENT ON CABBAGE AND CAULIFLOWER SUPPLY CHAIN MANAGEMENT IN KALAW TOWNSHIP, SOUTHERN SHAN STATE

SHWE YEE WIN LEI

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

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

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DEDICATED TO MY PARENTS,

U ZAW KHAING AND DAW THU THU NWE

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ABSTRACT

In this study, the socioeconomic characteristics, cost and benefit, factors affecting yield determinants of cabbage and cauliflower production and constraints and challenges of production and marketing were investigated. The primary data were collected by interviewing 100 non-contract farmers in Myinmahti and Heho village tracts, 30 contract farmers in Kyauthtet, Heho and Thekhaung village tracts, and 34 sample market intermediaries in Kalaw Township during October to November, 2015. Descriptive analysis, cost and return analysis, marketing cost, margin and profit, production function analysis and SWOT analysis were used. According to the findings, both non-contract and contract farmers were at the primary education level. Home assets and luxury assets of non-contract and contract farmers were not significant. Regarding, the cost and return analysis, non-contract farmers can get more benefit cost ratio of rain-fed cabbage (3.02) and rain-fed cauliflower (3.55) than winter cabbage production of non-contract farmers (2.64), contract farmers (2.38) and winter cauliflower production of non-contract farmers (3.01). There were seven marketing channels along the cabbage and cauliflower supply chain. Retailers and township wholesalers got the higher profit than village collectors and commission men. Regarding to the winter cabbage production, the significant influencing factors were household head's farming experience, farm size, total family labor cost, total hired labor cost, total material cost and access to credit for contract farmers while total family labor cost, total hired labor cost and access to credit for non-contract farmers. The significant factors of rain-fed cabbage yield were household head's age, household head's farming experience, farm size and total material cost of non-contract farmers. In the cauliflower production, household head's education, amount of seed rate, total hired labor cost and access to credit were influencing on winter cauliflower production while only one influencing factor on rain-fed cauliflower production for non-contract farmers that was the amount of seed rate. In SWOT analysis, the serious factors of strengths, weaknesses, opportunities and threats of sample farmers were price information availability by mobile asset, not resistance pest and diseases, availability of local and export market and summer drought, respectively. SWOT analysis of market participants were price information availability by mobile phone asset, poor crop quality, high demand of product and high transportation cost, respectively. According to the study, farmers who had more experience can produce more products. Therefore, technical knowledge sharing should be promoted for farmers to get higher income.

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LIST OF ABBREVIATIONS

GDP	Gross Domestic Product
SPSS	Statistical Packages for Social Science
HH	Household
HHH	Household Head
FYM	Farm Yard Manure
MMK	Myanmar Kyat
MADB	Myanmar Agricultural Development Bank
UNDP	United Nation Development Program
MOALI	Ministry of Agriculture, Livestock and Irrigation
DoA	Department of Agriculture
SLRD	Settlement and Land Record Department
FAO	Food and Agriculture Organization
NGO	Non-Government Organization
BCR	Benefit Cost Ratio
USD	United States Dollar
SD	Standard Deviation

LIST OF CONVERSION FACTOR

1 hectare	= 2.471 acres
1 metric ton	= 1000 kilograms
1 metric ton	= 1000 liters
1 metric ton	= 3.3 cartloads of farm yard manure
1 tin seed rate	= 100 grams
1 tin seed rate	= 0.1 kilogram

CHAPTER I
INTRODUCTION

1.1 Background of the Study

Myanmar is an agri-based country and agriculture sector remains important to the country's economy. Compared to any other sector within an economy, growth in agriculture productivity, having a direct role in raising real incomes of the rural poor, has been recognized reducing poverty. The agriculture sector will continue to be essential for food production with the growing population as well as for the country to occupy a large part of the exports earnings. Growth in agriculture sector is necessary to increase food availability and sustain the economic development process continuously. Being located between South and South East Asia, Myanmar is considered as a strategic location for trade and growth in the region. Moreover, with its diverse and excellent agro-climate conditions and potentially better resources than many other countries in the region, the future of Myanmar's agricultural sector would be very bright (MSU and MDRI/CESD 2013).

Gross domestic product compositions by sector, 2014-2015 are described in Figure 1.1. The agriculture sector contributes 22.10% of the country's Gross Domestic Product (GDP), 20% of total export earnings, and employs 61% of the labor force (MOALI 2015).

In Myanmar, more than 60 different crops are grown based on the prevalence of different agro-ecological zones. The crops are generally classified into six groups: cereals, pulses, oil-seeds, industrial crops, culinary crops and other crops. Other important crops are sesame, groundnuts and sugarcane. The country's cropping intensity had increased from 157.03% in 2005-2006 to 171.42% in 2010-2011 but in 2012-2013, the cropping intensity decreased 158.39%. In 2013-2014, the cropping intensity increased 161.16% and decreased 159.96% in 2014-2015 (Table 1.1) (MOALI 2015).

In Myanmar's agriculture, cereal crops remain the important crop group with its area constituted around 8,357 (000' ha) of the total crop sown area. Pulses are the second most important crop next to cereal. The total crop sown area of oilseeds is covered with 3,461 (000' ha) in Myanmar. The total sown area of culinary are covered with 350 (000' ha), industrial are covered with 1,269 (000' ha) and other crops are covered with 3,379 (000' ha) (Table 1.2) (MOALI 2015).

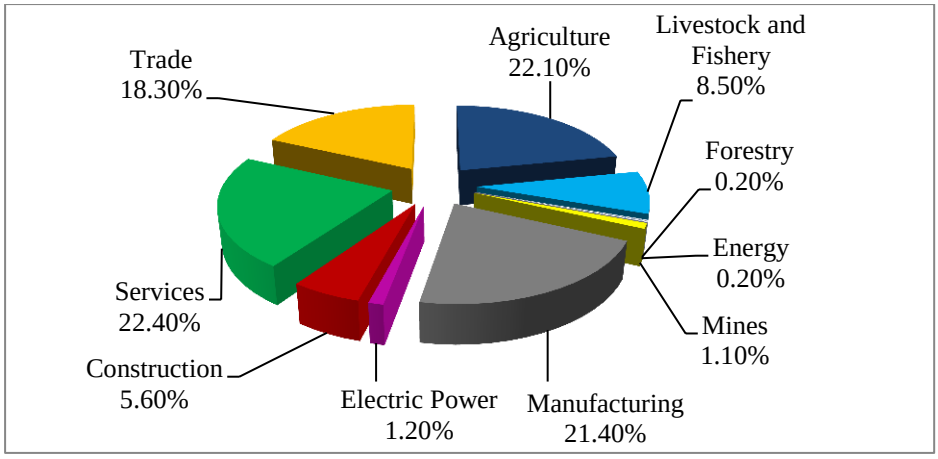

Figure 1.1 Gross domestic product compositions by sector, 2014-2015
Source: MOALI, 2015

Table 1.1 Sown area and cropping intensity of Myanmar

Year	Net Sown Area (mil ha)	Total Sown Area (mil ha)	Cropping Intensity (%)
2005-2006	11.94	18.75	157.03
2006-2007	12.61	20.41	161.85
2007-2008	13.22	22.12	167.23
2008-2009	13.49	22.96	170.20
2009-2010	13.64	23.36	171.26
2010-2011	13.75	23.57	171.42
2011-2012	13.58	22.50	165.68
2012-2013	13.29	21.05	158.39
2013-2014	13.26	21.37	161.16
2014-2015	13.36	21.37	159.96

Source: MOALI, 2015

Table 1.2 Sown area for the major crops in Myanmar (000' ha)

No.	Crop Groups	2011-2012	2012-2013	2013-2014	2014-2015
1.	Cereal Crops	8,686	8,360	8,414	8,357
2.	Pulses	3,487	4,449	4,534	4,554
3.	Oil seed Crops	4,417	3,414	3,479	3,461
4.	Industrial Crops	1,037	1,018	1,228	1,269
5.	Culinary Crops	343	341	333	350
6.	Other Crops	4,525	3,465	3,380	3,379
	Total	**22,497**	**21,047**	**21,368**	**21,370**

Source: MOALI, 2015

1.2 The Role of Vegetable Crops and Production in Myanmar

Vegetables play an important role in solving the problems of food production and providing a balance diet. Vegetables not only meet home requirements but also the important source of income for the farmers and traders. The cole crops reduce the risk of cancer, particularly cancer of alimentary canal and respiratory tract. The cole crop, a very important group of winter season vegetables, includes cauliflower, cabbage, kholrabi, broccoli, brussels, sprouts, and Chinese cabbage (Wadhwani and Bhogal 2003)**.**

Vegetable is one of the most important crop because it has excellent source of minerals, Vitamin A, folic acid and beta-carotene for human health nutrition and useful for raw in salads, such as coleslaw, as a cooked vegetable. A substantial portion of the carbohydrates found in leafy vegetables contribute the dietary fiber. In Myanmar, like the other Asian countries, people enjoy consuming vegetables in their daily diet. Although there are very few exports of leafy vegetables from Myanmar, some organic leafy vegetables have entered the value chain, and postharvest technology is a common practice (MOALI 2007)**.**

Vegetable production is important not only for national economic development but also for rural household income. Vegetable production has one of the potential areas in agriculture to get high profit, employment opportunity, and increase commercialization processing activities which can reduce the economic poverty in rural area. The development of vegetable production is absolutely necessary in the context of modern agriculture. It is one of the quickest ways to increase food and nutrition security through coverage of larger areas with high yielding varieties of vegetables which have a short productive cycle, are grown almost year around and provide sustainable employment to a large number of farm families in both rural and urban areas (MOALI 2012)**.**

Vegetable production is an activity that can play an important role in improving the livelihood conditions of small-scale and resource poor farmers in tropical countries, since vegetable constitute both an opportunity for diet improvement and a source of income (Gioseffi 2008)**.**

Vegetables are widely grown in the whole country but almost all the quantities are for domestic consumption. At present, a limited quantity of cabbage, cauliflower, potato, tomato, broccoli, lime, sweet pepper and asparagus are being exported through border and normal trade by some companies. Only the insignificant amount of fruits and vegetables are exported through across the border trade to China (Aung Hlaing 2009)**.** Although there are excellent opportunities for vegetable production, multiple factors challenge the

adoption of practices which are needed to bring their products in line with consumer requirements and their competitive position on the markets. The new age consumers are becoming more health conscious in terms of hygiene, source of food, ingredients of processed food, calorie content and use of agro-chemicals. Food safety and quality requirements have an increasing importance around the globe (Kalei 2008).

Vegetable demand at present is strong, unsatisfied, and expected to continue expanding in the future as there will be more urbanization and increased income leading to an increase in the consumption of vegetables. Myanmar is relatively rich in natural resources and has a rich agriculture, livestock and fishery biodiversity. Although rice is grown as it is the staple food of the Myanmar people, other cereal crops such as corn, wheat, as well as numerous vegetables crops and crops useful for consumer goods and industrial use present a potential in agriculture diversification which could lead to the development of the nation in a sustainable manner (Mandal 2008).

In Myanmar, vegetables can be grouped into two namely lowland and highland produce according to the origin of produce. Based on the agro-ecological zone, tomato, cauliflower, cabbage and carrot can be produced as rainy season crop in highland area Vegetable are perishable crop and cultivated mainly for domestic consumption. These crops can be grown as cool season crop in lowland area. The prominent lowland vegetables are ladyfinger, eggplant, cucumber, green chili, snake guard, baby corn and bottle gourd etc. (Nyein Nyein Thaung 2011)**.**

More than hundred kinds of vegetables are growing agro-ecological regions of Myanmar. Myanmar is home of the numerous horticulture crops, due to its various tropical, sub-tropical and temperate climate conditions. Besides, vegetables are rich in sources of vitamins and play an important role and ensuring nutritional food security. Vegetables constitute an important segment of the agricultural economy (Tin Htut Oo and Nwe Ni Win 2008)**.**

Enana and Gebremedhin (2007) studied that vegetable cultivation in Myanmar is mainly dominated by smallholder farmers. Factors such as inadequate markets, low prices, a lot of intermediaries and inadequate marketing institutions and interaction among farmers make it impossible for small- scale farmers to take part in formal markets. With growing market demands and limited land requirements, smallholder farming system offer good potential for pro-poor growth and the reduction of rural poverty in Myanmar.

Table 1.3 indicates some vegetables grown area in Myanmar from 2011-2012 to

2014-2015. Vegetables crops include cabbage, cauliflower, lettuce, mustard, tomato, beet root, radish, water melon, bottle gourd, asparagus and others crops. The total sown area of vegetable in Myanmar has increased from 538.01 (000' ha) in 2011-2012 to 564.83 (000' ha) in 2014-2015 (SLRD 2014).

Vegetable production in Myanmar and neighboring countries is shown in Table 1.4. In the world, Indonesia occupied the highest sown area which was 1,049 (000' ha) sown areas and Vietnam was occupied 836 (000' ha). Myanmar occupied the fifth largest vegetable sown area among the Asian countries. World's vegetable production was 1,090,425 (000' MT) and Asia's vegetable production was 182,931 (000' MT) and yield was 124.50 (MT/ha) in 2010. Among the Asian countries, Myanmar occupied the fourth highest vegetable production 5,332 (000' MT) and vegetable yield was 139.70 (MT/ha). Myanmar was followed by Vietnam, Indonesia and Philippines in the vegetable production (FAO 2014).

1.3 Production of Cabbage and Cauliflower in Myanmar

Nyein Nyein Thaung (2011) stated that in Myanmar, cabbage is one of the popular vegetables. It is used as a dish or use as an ingredient of a dish or a salad. Based on the agro-ecological zone, cauliflower and cabbage can be produced in both highland and lowland area. In highlands area, they are produced during the rainy season whereas they can be grown as cool season crops in low land area.

The production of cabbage increased significantly from 2011-2012 to 2014-2015. The sown area of cabbage slightly increased from 2012-2013 to 2014-2015. In 2014-2015, the total sown area of cabbage was 31.47 (000' ha) and the production of cabbage was 476.98 (000' MT) (Figure 1.2). The sown area and production of cauliflower increased from 2011-2012 to 2012-2013 and slightly decreased in 2013-2014 and increased in 2014-2015. In 2014-2015, the total sown area of cauliflower was 27.23 (000' ha) and the production of cauliflower was 387.66 (000' MT) (Figure 1.3) (DoA 2015).

1.4 Production of Vegetable in Myanmar Belle Dehydrated Vegetable Factory

Myanmar Belle Manufacturing Company is established Myanmar Belle Dehydrated Vegetable Factory since 2011, October 20. Then, Myanmar Belle Dehydrated Vegetable Factory is opened in 2012, September 28. Myanmar Belle Dehydrated Vegetable Factory is located at Wayonepin Village, Heho Township, Southern Shan State. Area of the factory is 9.48 acre wide and the wide of factory construction area is

3,564 square meter. The establishment of the dehydrated vegetables factory is a strategic step in preparation for distribution of dehydrated vegetables in Asian countries. In order to better serve the customers, Myanmar Belle Dehydrated Vegetable Factory had relentlessly improved quality of the products through innovation, use of the latest technologies from Japan and Korea. Dehydrating vegetables preserves them with a nutritional content that far surpasses that canned vegetables. Additionally, the process of dehydrating vegetables is often more cost-effective than freezing and it didn't need electricity in the long-term storage of the items.

The final product is daily produced from 1.5 Tons to 2.5 Tons in 2013-2014 by 8 hours power full rotate system. To obtain raw material in time for factory and without difficulty for operating cost for farmers by using contract farming system and pre-support all of the inputs such as seed, fertilizer, pesticides and insecticides, etc. To qualify the evocative raw materials are weekly tested and guided by buying raw material with bond**.** As the buyers due to adopt the quality of the product for selling about 500 Tons/year to Korea and about 300 Tons/year to Japan from 2013 to 2014. The vegetables such as cabbage, ginger, onion, onion hair, carrot, radish, chili and mustard are produced from the factory.

As factory, for more contribute the require basic agricultural expense of farmers by 200,000 MMK per one acre and supporting allowance 12,000,000 MMK at one month for 60 acres. The total allowance 144,000,000 MMK was supported at one year for 720 acres with made to good quality of raw materials. Support buying from guarantee input company at domestic for farmers. Also neighbor’s country such as China, Thailand due to produce the dry vegetable also the product produces from in our Myanmar country factory selling the product with competition by abroad price and quality standard. The types of machines for quality inspection are; (1) Incubator, (2) Stomacher, (3) Steamer, (4) Moisture machine, (5) Dryer machine.

The main objectives of the factory are; (1) certain firm to improve income previously the small income farmers, (2) to no losses due to logistic difficult expertly sowing vegetables, (3) to schooling children education with fulfillment from certain income enjoy family life, (4) to obtain employment opportunities not only local farmers but also local civil, (5) to more act creed affect and monastic affect with improve income, (6) observation foreign income for country by produce marketing value added with uses domestic raw materials, (7) Facilitating for reduce the rural development and poorly.

Table 1.3 Sown area of vegetables in Myanmar (000' ha)

No.	Vegetable Names	2011-2012	2012-2013	2013-2014	2014-2015
1	Cabbage	32.34	31.09	30.76	31.47
2	Cauliflower	26.61	27.15	26.32	27.23
3	Lettuce	10.66	11.89	11.16	10.49
4	Mustard	37.96	36.94	36.79	34.26
5	Tomato	107.46	110.39	112.73	110.20
6	Beet root	2.76	2.79	2.64	2.29
7	Radish	22.73	22.29	20.92	21.97
8	Water melon	16.57	15.27	18.40	20.61
9	Bottle gourd	22.77	23.30	22.77	23.19
10	Asparagus	0.50	0.51	0.82	0.57
11	Others	257.65	259.65	269.43	282.55
	Total	**538.01**	**541.27**	**552.74**	**564.83**

Source: SLRD, 2015

Table 1.4 Vegetable production in Myanmar and neighboring countries (2010)

Country	Area (000' ha)	Yield (MT/ha)	Production (000'MT)
Cambodia	96	64.9	622
Indonesia	1,049	96.3	10,096
Lao PDR	147	92.8	1,368
Malaysia	58	208.3	1,213
Myanmar	382	139.7	5,332
Philippines	714	86.9	6,204
Thailand	513	73.2	3,760
Timor-Leste	12	26.4	31
Vietnam	836	123.5	10,321
South-East Asia	3,807	102.3	38,947
South and South West Asia	9,815	146.7	143,984
Developed Countries	508	254.1	12,897
World	56,734	192.2	1,090,425

Source: FAO, 2014

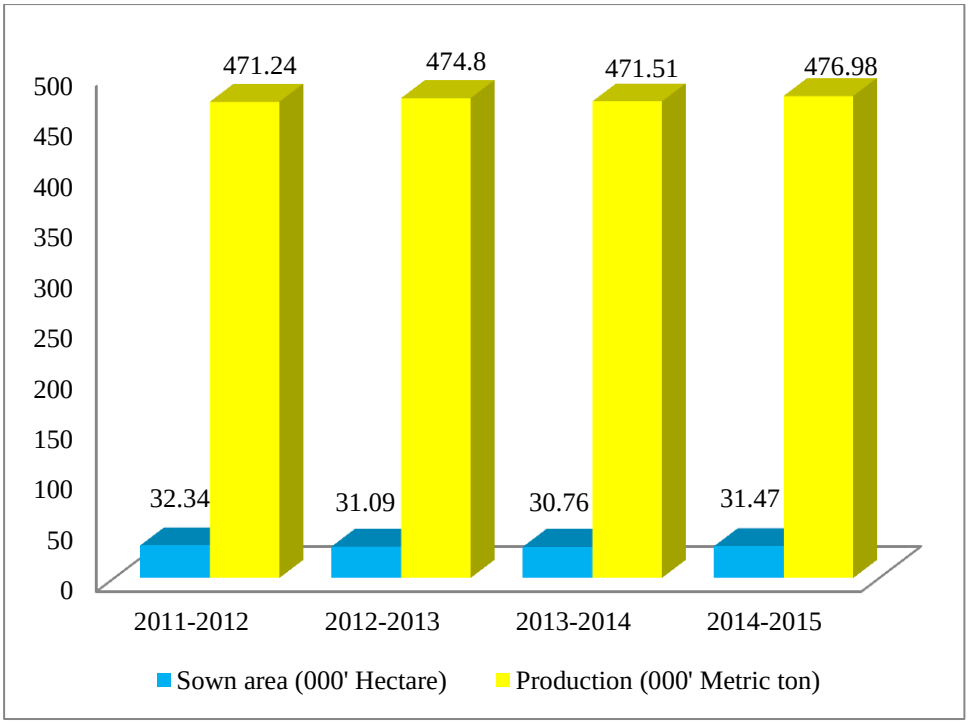

Figure 1.2 Sown area and production of cabbage in Myanmar

Source: DoA, Kalaw, 2015

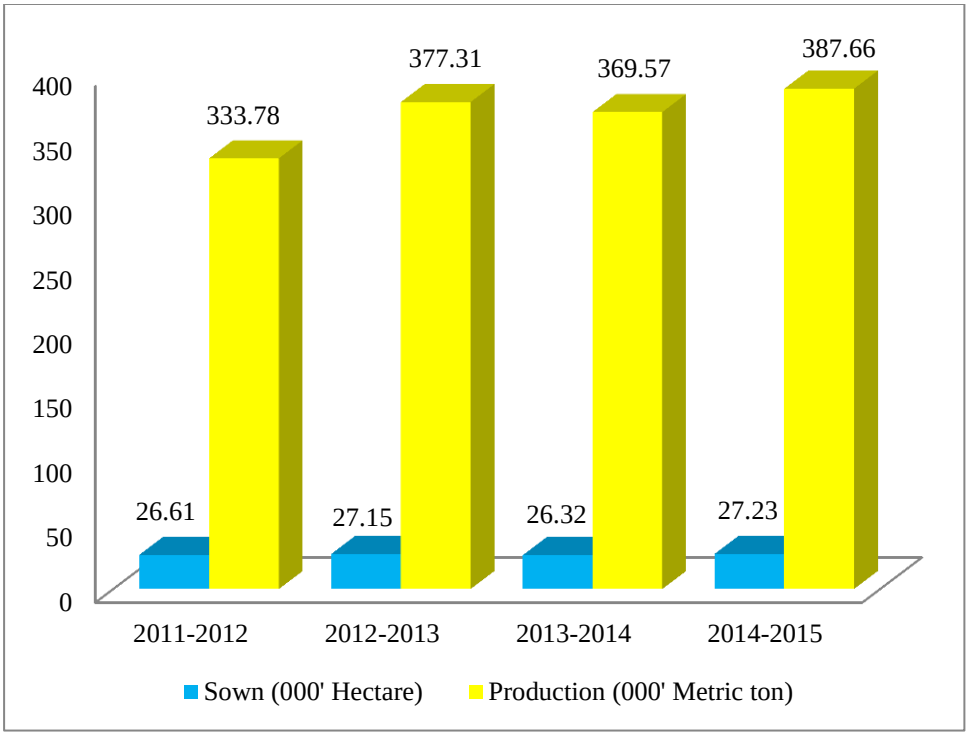

Figure 1.3 Sown area and production of cauliflower in Myanmar

Source: DoA, Kalaw, 2015

1.5 Problem Statement

Vegetable production is important not only for national economic development but also for rural household income. The province of Kalaw Township, Southern Shan State has a topography and climate that is suitable for vegetables production and hence grows a wide range of vegetables for local consumption and trading. Also lack of information with regard to productivity and supply chain of vegetable sector in Kalaw Township. Benefit sharing distribution among actors is also not clearly known. The degree of vulnerable farmers integrated in the supply chain of cabbage and cauliflower production in Kalaw Township is unclear, i.e. to what extent small holder farmers take any state in the supply chain is not well understood. Moreover, there is a lack of information on how actors of the cabbage and cauliflower supply chain coordinate and interact with each other within the horizontals and vertical chains. There may be constraints along the supply chain from production to consumption of vegetables.

Small holder farmers act on their own decision to supply for household consumption and are not yet integrated to modern market, where there are opportunities to improve income of small holder farmers and reduce poverty of these poor small holder farmer. In the agricultural sector, a supply chain analysis can help to improve process and especially help farmers to raise their income.

Knowing well about each step of the chain for vegetables is very important aspects to increase income of small holder farmers. This study might generate important information useful to formulate vegetable sector development programs and guidelines for interventions that would improve efficiency of the vegetables supply chain. In addition, the information generated from this study will also help a number of organizations, research and development organizations, traders, producers, policy makers, extension service providers, NGOs, to access their activities, redesign their mode of operation and ultimately influence the design, implementation of policies and strategies. In Myanmar, problems in the vegetable supply chain hinder the potential gains that could have been attained from existing opportunities. Shan State is located the Northern part of Myanmar and there are many small-scale growers engaged in vegetable cultivation for their livelihood. Due to the limited access of knowledge and improved technology, vegetables growers cannot perform for year around production.

During off-season, vegetables are imported from various parts of Myanmar. According to this situation of vegetable sector of Shan State, various actors along the vegetable supply chain were vulnerable to market competition. However, no research has

been done on this sector to highlight problems and opportunities to upgrade the vegetable supply chain. Therefore, this study will be carried out to analyze the supply chain of vegetables for improving this supply chain in each segment in Kalaw Township, Southern Shan State. Vegetable supply chain and its characteristics have not yet been studied in this area. Therefore, this study attempts to fulfill in these gaps.

1.6 Objectives of the Study

The main objective of the study is to analyze the cabbage and cauliflower supply chain in Kalaw Township. The specific objectives are

1. To explore the socioeconomic characteristics of cabbage and cauliflower market participants in Kalaw Township
2. To observe the cost, benefit and marketing margin of the specific market participants along the cabbage and cauliflower supply chain
3. To identify the supply chain of cabbage and cauliflower production comprising non-contract and contract farmers in the study area
4. To find out the yield determinants of cabbage and cauliflower production and
5. To investigate the constraints and challenges encountered by the specific market participants along the cabbage and cauliflower supply chain.

CHAPTER II
LITERATURE REVIEW

2.1 The Concept of Supply Chain

A supply chain consists of all parties involved, directly or indirectly, in fulfilling a customer request. The supply chain not only includes the manufacturer and suppliers, but also transporters, warehouses, retailers, and customers themselves. Within each organization, such as manufacturer, the supply chain includes all functions involved in receiving and filling a customer request. These functions include, but were not limited to, new product development, marketing, operations, distribution, finance, and customer serve (Chopra and Peter 2004).

Tolani and Hussain (2013) mentioned on the main problem of supply chain is the transaction cost was too high due to more number of intermediaries in the value chain. Only 30-35% of the end price reaches to the fruit growers and other part goes to the different intermediaries. Since supply chain is long and scattered, wastage of fruit and vegetables was around 10-12% of the total quantity which increases the possibility of cost rise for the consumers.

Gonzales et al. (2014) conducted to map the supply chain and determine losses from the farm to wet markets and to supermarket of cabbages produced in Cebu, Philippines. They conducted that wholesalers in the traditional chain brought the cabbages to the biggest wholesale-retail markets in Cebu City. Postharvest loss did not differ much between the two chains (26-27%) but the modern chain had more stringent quality requirements and about two times higher retail price than in the traditional chain. In the modern chain, wholesalers brought the cabbages directly to supermarkets in the city. Retailers in the traditional chain incurred higher losses (10%) than in supermarkets (7.2%). Wholesalers in both chains had losses ranging from 6-7%.

The fruit and vegetable markets in India had improved from short and linear supply chains controlled tightly by the state, to a highly complex and increasingly diverse. The vegetable supply chains include a very large number of farmers growing different vegetable varieties on their individual lands. They sold their vegetables directly to businessmen, food processing industries, wholesale markets, cooperatives, retail shops and supermarkets. The basis of negotiations in these unorganized sectors was limited to price, quality and quantity (Lumsden and Mirzabeiki 2008).

Chuan-li et al. (2003) studied vegetable supply chain in China and they revealed that compared with common agricultural products supply chain, vegetable supply chain had its particular structure and special demanding. As a whole, vegetable industry had made an important progress and had been taking more and more influence on Chinese agriculture-country-farmers issue. Moreover, Green and clean vegetable supply chain was more important for the strategy of sustainable development for China. Being closely bound up to respective civilians' diet and health, it was never overemphasized to pay attention to such topic.

Man et al. (2009) observed that an overview of the supply chain management (SCM) of Malaysian vegetable and fruit industries focusing on the channel of distribution in Peninsular Malaysia. Results showed that the players in the fresh vegetable supply chain consisted of growers, collectors or transporters, wholesalers, retailers and hypermarkets or supermarkets. At the first marketing level, a major portion of the growers' produce which was 64% went to the wholesalers. Another 26% went to the collectors/transporters, 7% to the retailers, 2% to the direct marketers and 1% to the hypermarkets. At the collectors' level, 59% of the collectors worked with the wholesalers while the remaining 41% dealt with the retailers. From the main wholesalers, 46% trickled down to the other wholesalers, 27% went to the institutional buyers and 24% went to retailers. The remaining 3% went to the hypermarkets. At the other wholesale level, 55% went to the retailers, 25% went to the hypermarkets while the remaining 20% went to the institutional buyers.

Chan (2009) studied integration of small farmers into horticultural chain in Asia and the Pacific region. The results showed that vegetable supply chains start from farm-gate collection of harvested produce, then process or prepare, distribute, and finally display for retailing to consumers. Supply chains vary considerably in length and complexity, depending on the distance between the producer and the target market.

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2.2 Supply Chain Management

Simchi-levi et al. (2008) defined supply chain management (SCM) may be defined as a set of approaches utilized to efficiently integrate suppliers, manufacturers, warehouses, and stores, so that merchandise was produced and distributed at the right quantities, to the right locations, and at the right time, in order to minimize system-wide costs while satisfying service level requirements stated that SCM as a set of approaches utilized to efficiently integrate suppliers, manufacturers, warehouses, and stores, so that

merchandise was produced and distributed at the right quantities, to the right locations, and at the right time, in order to minimize system-wide costs while satisfying service level requirements.

Supply chain management is the integrated planning, implementation, coordination and control of all business processes and activities necessary to produce and deliver as efficiently as possible products that satisfy market requirements (Jack et al. 2007).

According to Tolani and Hussain (2013), SCM plays an integral role in keeping business costs minimum and profitability as high as possible. There are many factors involved in SCM. There are three main types of flow, such as the product flow, the information flow and the finances flow. The product flow includes the movement of goods from a supplier to a customer, as well as any customer returns or service needs. The information flow involves transmitting orders and updating the status of delivery. The challenge for us in SCM was to maintain all three flows and all three unique in an efficient manner, resulting in optimal results for farmers, growers, wholesalers and customers.

Deliya et al. (2007) stated that SCM not only helps in cutting costs, but also adds to maintain and improve the quality of fruits and vegetables marketed. In marketing fruits and vegetables, which are perishable in nature, supply chain plays a crucial role. In India, SCM is at its growing stage in marketing of fruits and vegetables. Marketing of fruits and vegetables are challenging because of the perishability, seasonality and bulkiness and consumption habits of the Indian consumers. SCM plays an important role in marketing of goods and services.

Reardon et al. (2003) showed that small farmers were not able to meet the strict quality requirement of these retail chains. For instance, in Malaysia the Giant Supermarket Chains had 200 vegetable suppliers in 2001, but by 2003 this was down to 30. Likewise, in Thailand, the number of vegetable suppliers to the Top Supermarket fell from 250 to 60.The new SCM system focuses on the consumers' preferences and needs, high quality packaging and branding system, efficient logistics and procurement, high value-added products and lower operating costs. One possible mechanism for improving the livelihood of rural smallholders was to link the farmers to the market and to provide them with the benefits of economic liberalization via the contract farming.

Man et al. (2009) studied SCM of Malaysian vegetable and fruit industries focusing on the channel of distribution in Peninsular Malaysia. They concluded that the

present movement and distribution of fresh fruits and vegetables from the farm to the retailers was dominated by wholesalers. More than half of the fresh fruits and vegetables produced flows through the wholesalers. The second level wholesalers also play a major role in collecting and distributing fresh fruits and vegetables. The role of collectors and transporters were equally important for remote and smaller farms where it was not economically viable for growers to carry their produce to the market using their own means of transport. Sometimes, it was deemed more efficient.

2.3 Review of Supply Chain of Vegetables

Lapide (2006) stated that the customer demands in a vegetable supply chain typically include orders from supermarkets, wholesalers, and retailers to sell the fruits and vegetables to the end customers. Lately the emphasis of this chain is on supplier owned inventory programmed, where the supermarkets require that the contract farmers and cooperatives.

Cadilhon et al. (2003) developed a conceptual framework for the analysis of vegetable supply chains in a South East Asian context by highlighting the particular role of trust and collaboration among stakeholders in the Ho Chi Minh City vegetable marketing system. The critical factor in the development of improved fresh food marketing system were domestic legal and policy factors, international trade policies and food markets, history, geography, and cultural and social norms.

Negi and Anand (2014) investigated the status of supply chain efficiency in fruits and vegetables sector in India and suggested that the supply chain was highly inefficient which was leading to huge losses and wastages and less income to the stakeholders. Fruits and vegetables sector in India is rapidly increasing and presents a huge opportunity to the stakeholders and entrepreneurs through setting up the cold chain infrastructure and food processing units. Negi and Anand conducted supply chain of fruits and vegetables in India and suggest that there is an improper SCM, lack of cold chain infrastructure and Food Processing units which were leading to maximum inefficiencies and resulting to losses and wastage of fruits and vegetables in 2015. They revealed that highly inefficient supply chain and cold chain infrastructure was the major impediment in the path of speedy growth of agriculture sector in India.

Buurma and Saranark (2006) mentioned that two supply chain development projects in Thailand. Firstly, they introduced certification system for food safety in order to improve their competitive position and to consolidate their image of a quality

supermarket. And they managed and integrated quality chain in order to comply with the increasing food safety requirements in the European Union and Japan.

Singh and Mishra (2013) observed to assess the challenges and problems of supply chain of vegetables. Farmers were not getting requisite realization of price commensurate to their efforts due to lack of storage facilities, poor market information and unorganized faulty supply chain. A better solution can be the Public Private Partnership for the supply chain development.

2.4 The Concept of Marketing

Kohls and Uhi (2002) defined food marketing can be defined as the performance of all business activities involved in the flow of goods and services from the point of initial agricultural production until they are in the hands of the consumers. The food production process does not stop at the farm gate. The food marketing activities complement the agricultural production process. Although it is true that there would be no food without farmers, it is also true that consumers rely on the food marketing system to complete the food production process begun on the farm. The relationship between farmers and food marketing firms is at the same time competitive and complementary.

Kotler (2003) mentioned that marketing as a societal process by which individuals and groups obtain what they need and want through creating, offering, and freely exchanging products and services of value with others. He also defined marketing as a managerial definition; marketing has often been described as the art of selling products. Marketing is widely known as “the 21 century definition of marketing” which runs as follows a social and managerial process by which individuals and groups obtain what they need and want through creating and exchanging products and values with others.

Cadilhon et al. (2003) mentioned that vegetable marketing system of Vietnam, the role of traditional fresh produce supply chains is assured for the medium-term, despite the challenge of their modern competitors. The complementary satisfaction of different consumer segments and of the various stakeholders interviewed also supports the call for city authority policies that might bring a harmonized development of both modern and traditional marketing channels. On the one hand, the traditional marketing sector should be modernized in order to improve trading conditions in respect of hygiene, congestion and waste management.

2.5 Review of Empirical Study of Determinants Factor that Effects on Crops Productivity

Abdelaziz et al. (2010) studied that factors affecting crop production in North Darfur State and found that the crops produced in season 2006 were significantly affected by some factors. Millet production was affected by labor, period of cropping and amount of rainfall. They revealed that significant factors affecting groundnuts production were the total cultivated area of groundnuts, crop rotation and period of cropping. In order to improve the agricultural production in the study area, the study recommended that the supply of the farmers with agricultural inputs especially seeds through repayment in kind after harvesting and support agricultural extension to be more efficient and effective in transferring the recommended improved technologies.

Govereh and Jayne (2002) stated that the determinants of cotton production in Gokwe North district and concluded that cotton production was positively associated with farm size, education of the household head, the value of farm capital, and the number of cotton sprayers from the village in question. This study brought about the importance of education as one of the factors affecting cotton production, but there was also needed to look at other factors which affect cotton production from a historical perspective for policy evaluation purposes.

Gahaifi and Svetlik (2011) studied that in the chosen statistical data about the development in production and consumption of vegetables in Republic of Yemen. They conducted that vegetables production concentrated in governorates which produce about three-quarters of total production in the country. The trend was positive in cultivated area, production, and consumption, and negative for productivity. Production of main vegetables crops which include potatoes, tomatoes, and onion increased, but the annual increase rate of onion production was the highest amongst the mentioned crops due to the increasing in its cultivated area.

2.6 Marketing Channel, Marketing Cost and Marketing Margin

2.6.1 Marketing channel

Kohls and Uhi (2002) defined marketing channels as alternative routes of product flows from producers to consumers. Their marketing channel starts at the farm's gate and ends at the consumer's front door. The marketing channel approach focuses on firm's selling strategies to satisfy consumer preferences. Market performance is a function of the number of scale and role of market intermediaries who provide services involving the

transfer of producer to end user. The marketing channel showed the flow of pulses from the production site (producer) to intermediaries and on to the exporters.

Kotler (2003) conducted that a marketing channel is a business structure of interdependent organizations that reach from the point of product or origin to the consumer with the purpose of moving products to their final consumption or destination.

Eric and Kerin (2000) revealed that most producers did not sell their goods directly to the final users; between them stands a set of intermediaries performing a variety of functions. These intermediaries constitute a marketing channel also called a trader channel or distribution channel. The channel system creates time, place, possession and form utilities. The channel may be direct or indirect. In the direct channel a producer and ultimate consumer deal directly with each other. In the indirect channel intermediaries were involved between the producers and final consumers and perform numerous channel functions.

Matin et al. (2014) identified that cabbage and cauliflower marketing in Bangladesh. They revealed that seven major marketing chains were identified of vegetables marketing. The chain Farmer → Local traders (Faria) → Bepari→ Arathdar (urban) → Retailer (urban) →Consumer was ranked at first position. About 39.60% product runs through this chain. Marketing cost of cauliflower was higher than that of cabbage because it was more perishable than cabbage. A good amount of marketing margin was added by all kinds of intermediaries involved in the cabbage and cauliflower marketing. The net marketing was the highest for retailer (urban) and the lowest for Arathdar.

Rajkumar and Jacob (2010) showed that the farmers themselves sold their products directly to the end consumers in local markets or they sold to intermediaries' agents and organized retailers. Farmers selling vegetables directly to the customer amount to very small fraction by volume. Farmers sold bulk of their produces to agents and auctioneers. The agents buy small quantities of produces from farmers and transfer it to wholesalers directly. The auctioneers were people who enter into buying contract with farmers for whole or partial quantity of the produce and sold the produce to an agent or a wholesaler.

Singh and Mishra (2013) revealed that tomato, green chili and the cauliflower were the high value and high market demanded commodity in Palpa district. Out of total agricultural land, only 7.45% area was under vegetable cultivation. There were seven marketing channels prevailing in the study area. More than 50% vegetable flows through

third channel (farmers – collection center– wholesalers (Butwal) – retailers – consumers). Marketing Planning Committee at local level and apex body in district level facilitate for linking the retailers and farmers. Such constraints can be managed through the improvement of production technology, management, extending linkage improving networking between service receiver and providers.

Dastagiri and B. Ganesh Kumar (2013) found that area under total vegetables cultivation was grown at the rate of 4.12% and production growth rates was 6.48%. Indian vegetables production depicted glorious past and expected promising future. The most common marketing channel for majority of the crops is that Producer - Wholesaler - Retailer-Consumer. The highest marketing efficiency found to be producer to consumer channel. The results showed that in most of the commodity cases marketing cost, marketing margin, transport cost, labor charges were adversely affecting marketing efficiency and open market price, volume of the produce handled and net price received were increasing marketing efficiency.

2.6.2 Marketing cost and marketing margin

FAO (2007) conducted that the harvesting of the crop and movement of that produce to the farm gate was part of the production cost. The first marketing cost was produce preparation including cleaning, sorting and grading. The second cost usually faced by the farmers or traders was packaging. Types of the packaging may be different depending on the product types and market condition. Transportation cost would be different with distance between the farmers and depend on the quality of roads and mode of transport.

Akter et al. (2011) studied that econometric analysis of winter vegetable production in Narsingdi district. They concluded that all the selected vegetables were found to be profitable but cabbage was relatively more profitable than those of tomato and cauliflower. Per hectare yield and gross returns of cabbage were higher than those of tomato and cauliflower. Moreover, gross margin as well as net return of cabbage was higher than those of tomato and cauliflower. Most of the farmers did not follow the recommended doses of input used except human labor, tillage, fertilizer and manure.

Matin et al. (2014) conducted in two chili growing districts Jamalpur and Bogra to examine the financial profitability, marketing cost and margin, post-harvest loss and seasonal price variation of green chili. They observed that green chili cultivation was profitable and per hectare net return was Tk.92,250 and BCR is 1.64. Seven dominant

marketing chains were identified in green chili marketing. The farm level net marketing margin per quintal of green chili was Tk.1105.25 after post-harvest losses. At intermediaries' level highest net margin was Tk.333 for retailer (Dhaka) and lowest was Tk.120.50 for Arathdar.

Gardner and Rausser (2001) mentioned that the concept of marketing margin, or farm-to-retail price spread, was developed to measure the costs of providing a bundle of marketing services. Although there were many ways to characterize the marketing margin, it was best viewed like price as an equilibrium entity, defined as some function of the difference between equilibrium retail price and equilibrium farm price of a given arm product. The relationship between retail and farm price can be influenced by a myriad of factors, not just from changes in marketing input prices. Since the nature and cause of many of these changes were not easy to identify, there was clearly room for additional empirical analysis of margins.

Singh and Chauhan (2004) studied marketing of vegetables in Himachal Pradesh. The result showed that margin of wholesaler/commission agent was highest in case of tomato (17.00%) followed by brinjal (13.68%). Marketing costs on loading/unloading, transportation, losses and storage incurred by the wholesaler/commission agents were found to be highest in case of brinjal (4.18%) followed by tomato (4.00%). Margin of retailer was found to be highest in case of peas (2.21%) followed by cauliflower (19.07%) and marketing costs on loading/ unloading, storage and transportation and losses incurred by retailer were found to be maximum in case of brinjal (6.44%) followed by tomato (6.00).

2.7 Review of Market Performance of Vegetables

Hau and Oppen (2004) studied that the efficiency of the vegetable market in Northern Thailand. The result showed that cabbage, carrot and onion market were similar in structure and the same factors influence the market efficiency of the latter two markets. They revealed that factors influencing market efficiency differ by commodity and that market structures differed significantly among the vegetables. Correlation coefficients are expressed as a function of a set of marketing costs, operational costs, margins and qualitative characteristics of the markets.

Haji (2008) mentioned on economic efficiency and marketing performance of vegetable production in the Eastern and Central Parts of Ethiopia. He found that the existence of considerable economic inefficiency in production, poor contract

enforcement, and imperfect competition in the marketing of vegetables. Trades capture a significant portion of the marketing surplus due to market power and audacity to absorb risk with this share varying along the degree of perishability and across cities. Limited access to capital markets, high consumer spending and large family size attributed to low economic efficiency.

Mogaji et al. (2013) conducted marketing performance and efficiency of evaporative preservation cooling system of fresh tomato marketing in Ondo State, Nigeria. It was found that profit margin for users of traditional mode of preservation. Disaggregated wholesaler's profit margin for users of traditional preservation method implies that they were not efficient compared with users of evaporative cooling system and it was economic importance towards commodity marketing development in Ondo State, Nigeria.

Pandey et al. (2013) estimated the price spread producers and market intermediaries in potato marketing at Shimal. The result showed that the producer realized around 73% share in consumer's price. The retailer and commission agent earned profit of about 3.5 and 8% of the consumer's rupee, respectively. The price spread and marketing efficiency was found to be about 27% and 3% respectively.

2.8 Review of Contract Farming

Baumann (2000) defined contract farming refers to a system where a central processing or exporting unit purchases the harvests of independent farmers and the terms of the purchase are arranged in advance through contracts. The terms of the contract vary and usually specify how much produce the contractor will buy and what price they will pay for it. The contractor frequently provides credit inputs and technical advice. Contracting is fundamentally a way of allocating risk between producer and contractor; the former takes the risk of production and the latter the risk of marketing. The allocation of risk was specified in the contract which can vary widely.

Eaton and Shepherd (2001) conducted a comparative study regarding difficulties concerned with contract farming from both party's businessmen and the Lao farmers. It found that the former party faced social and culture limitations that probably affected the ability of the farmers to produce standard products as specified by buyers or entrepreneurs. In addition, improper management and incomplete discussion with the farmers can result in dissatisfaction of the farmers, as well as the farmers may distribute of products by the farmer to outsiders resulting in the contract counterpart being unable to

fully supply products to the factory.

Boonbrahm et al. (2011) found that Laos farmers have only primary educations and do not understand the way to apply updated technology to agro-products. The agreement and the contract farming itself are different. Sometimes, it was made in written language making it hard for the farmers to understand all of the details mentioned in the contract and that may cause a loss in benefits or lead to the misconceptions regarding either the farming and marketing requirements. As mentioned, this could cause accidental breaks in the contract and could result in contractor risks of uncertainty regarding.

Supawadee (2013) studied that benefit and efficiency of cabbage production of Laos farmers under Thai-Laos contract farming. The results found that two highly flexible forms of contract farming under the Thai-Laos contract farming agreement: one was the official written agreement that needed the signatures of both parties and the other was the unofficial oral agreement. The annual revenues for cabbage production were 2,859.30 USD/ha, the capital costs were 2,139.07 USD/ha, and the net profit was 720.23 USD/ha. The production efficiency of cabbage was concentrated at the lowest level between 0.00-0.50 (86.44%), which was risky for Lao agriculturists.

Zhu (2007) revealed that small-scale farmers were likely to be excluded out of the contract farming program in China. Further a linear pricing method employed by contracting firms was one of the primary factors contributing to the exclusion of small farms. The resulting policy implication was that the government should encourage contracting firms to employ a differentiating pricing strategy offering contracts with price and quantity provisions. Possible policy instruments include contract pricing regulations and the redesign of the government's grant distribution mechanisms.

Tripathi et al. (2005) stated that the cost of potato cultivation had been found 17% to 24% higher under contract farming over various costs than under non-contract system, mainly due to high investments on seeds, fertilizers and machine power. Yield had been found 255.78 quintals/ha in the contract farms, which was 8.84% higher over the potato yield obtained from the non-contract farms. The sale price of potato has been found much higher (Rs 390/q) for contract than non-contract farms (Rs 177 /q). Benefit-cost ratio on various costs has been found to vary from 1.40 to 1.02 for without contract and from 2.71 and 2.08 for contract farming. The impact of contract farming had been quite visible and remarkably favorable on yield and profitability of potato production at the existing pattern of resource use and production technology prevalent in the Haryana farming system.

Simmons et al. (2005) studied contract growers of poultry, maize seed, and rice

seed in Indonesia. Using a Heckman selection model, they found out that poultry contracts and maize seed contracts resulted in improved returns to capital, while no significant impact was found in the case of rice seed. They expressed that contract seed growers were generally larger than the independent growers. They conclude that the contracts increased income and welfare, reducing absolute poverty.

2.9 Concept of SWOT Analysis

SWOT is an acronym that stands for strengths, weaknesses, opportunities and threats. SWOT provides a framework for analysis of the internal and external business environment. SWOT analysis is easy to use and a combination of quantitative and qualitative analysis. A SWOT analysis is a strategic tool but it is generally not used in a formal way. However, there are now several pieces of SWOT analysis software available to help formalize the process and give the analysis structure. This software can help companies brainstorm and create a SWOT analysis and then present it as a report or presentation. SWOT is a frame work for analyzing strengths, weakness, opportunities and threats. It has been developed as a simple yet effective method for analyzing within the strategic marketing planning processes. It has been based on a sound knowledge about the present environment and trends, as well as internal resources.

A SWOT analysis is a term used to describe a tool that is effective in identifying your Strengths and Weaknesses, and for examining the Opportunities and Threats you face. While it is a basic, straightforward model, it has been a popular business practice for many years because it helps provide direction and serves as a basis for the development of business plans. It accomplishes this by examining the strengths and weaknesses in addition to opportunities and threats (Bennett et al. 2003).

CHAPTER III
METHODOLOGY

3.1 General Description of the Study Area

Kalaw Township is located on the road of Meiktila-Taunggyi. It is situated between latitude 20° 20' 42s north and 96° 26' 23s east longitudes. Kalaw Township is bordered by east of Taunggyi, south of Pinlaung, west of Pyawbwe, Thazi and Yatsauth and north of Pindaya. Its total land area was 582.13 sq. miles. The cultivated land area was 29,709.83 hectares. The population is about 158,927. Kalaw Township is situated at 4,315 feet elevation above the sea level. The criteria for selecting the study area based on cabbage and cauliflower growing area. Then, Kalaw Township was selected for site study area because it has situating Myanmar Belle Dehydrated Vegetable Factory for contract vegetable supply chain and then this area has one of the largest vegetable growing areas than the other Township. A map of study area is showed in Appendix 1.

3.2 Climate of the Study Area

According to the latitude location except the northern sectors, other sectors of the Kalaw Township have a tropical climate with low temperature as they are hilly regions. In the coldest months of January and February, the average temperature of the region is 14.5°C to 15.7°C (Figure 3.1). Generally, rainfalls are highest in month of July and lowest in month of February (Figure 3.2). Agriculture is the main economic activity of Kalaw Township, principal crops being paddy, wheat, chili, cotton, potatoes, groundnut, sesame, pulses, tea and Virginia tobacco. Kalaw' cold climate also allows cultivation of oranges, peaches, pears, damsons, apples, grapes, onions, pineapples, vegetables and thanatphet trees. Kalaw Township is famous for its garden produce of all sorts of fresh fruit and vegetables.

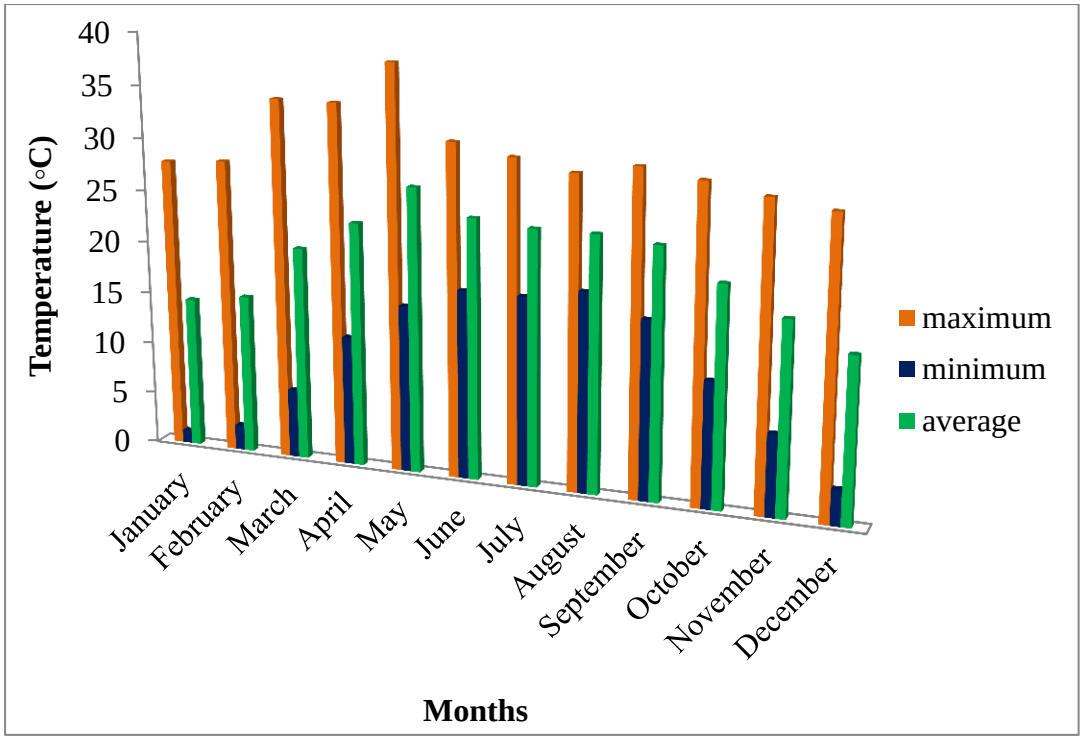


Figure 3.1 Temperature (°C) in Kalaw Township (2015)

Source: DoA, Kalaw, 2015

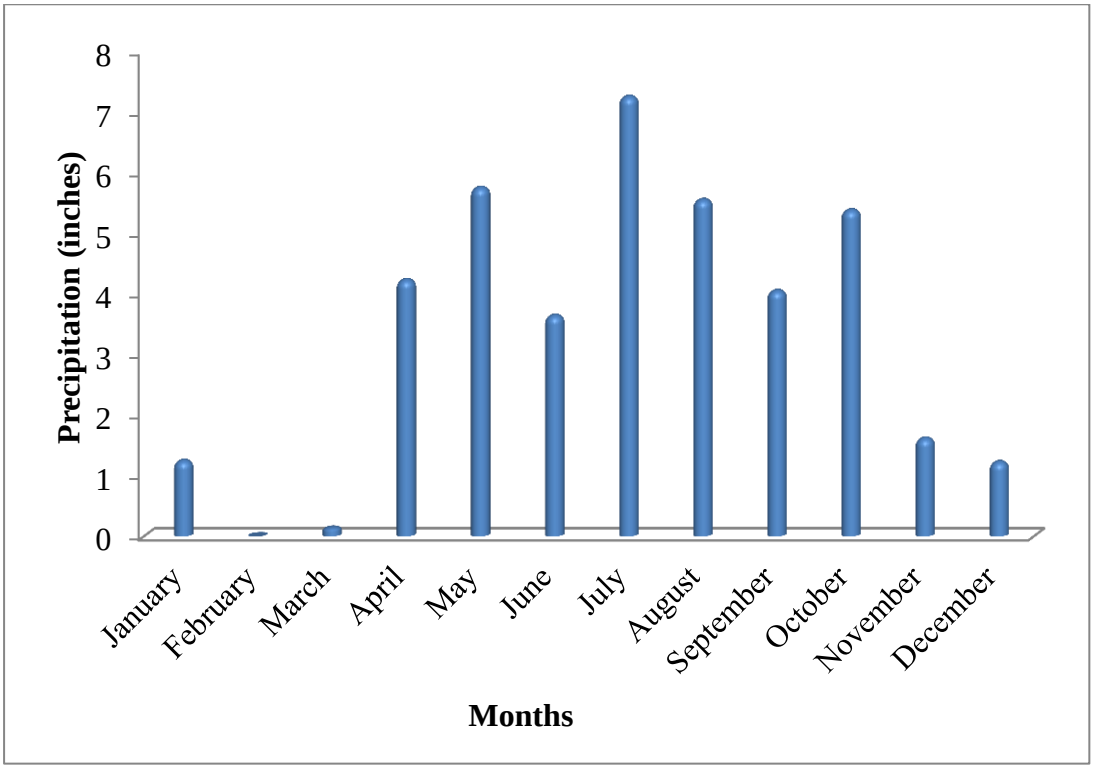


Figure 3.2 Precipitations (inches) of Kalaw Township in 2015

Source: DoA, Kalaw, 2015

3.3 Sown Area and Crop Production in the Study Area

Kalaw Township occupied a land area of about 154.08 thousand hectares in which the cultivable area covered 31.21 (000' ha), wild land covered 6.32 (000' ha), reserved and other forests covered hectares 32.12 (000' ha) and others occupied 53.22 (000' ha). Total cultivable area was divided into 4.23 (000' ha) of upland, 24.43 (000' ha) of lowland and 2.55 (000' ha) of orchard. Land utilization in Kalaw Township (2014-2015) is shown in Table 3.1.

Vegetables such as cabbage and cauliflower are mostly grown in Southern Shan State. In the Southern Shan State, Kalaw Township is mostly grown vegetables than the other townships. In Kalaw Township, the total sown area of cabbage was 1,190.21 ha and total sown area of cauliflower was 238.37 ha (Table 3.2) (DoA 2015).

The sown area of rain-fed cabbage significantly increased from 0.77 (000' ha) in 2009-2010 to 1.19 (000' ha) in 2013-2014 and significantly decreased 0.77 (000' ha) in 2014-2015. The production of rain-fed cabbage significantly increased from 18,505,202 heads in 2009-2010 to 24,946,097 heads in 2013-2014 and significantly decreased 16,864,583 heads in 2014-2015 (Table 3.3). The sown area of winter cabbage increased from 0.31 (000' ha) 2009-2010 to 0.42 (000' ha) in 2014-2015. The production of winter cabbage increased from 6,556,697 heads in 2009-2010 to 8,550,648 heads in 2014-2015 (Table 3.4).

Table 3.5 indicates sown area, harvested area, yield and production of rain-fed cauliflower in Kalaw Township from 2009-2010 to 2014-2015. The sown area of rain-fed cauliflower significantly increased from 0.22 (000' ha) in 2009-2010 to 0.24 (000' ha) in 2013-2014 and significantly decreased 0.16 (000' ha) in 2014-2015. The production of rain-fed cauliflower significantly increased from 4,451,638 curds in 2009-2010 to 4,755,852 curds in 2013-2014 and significantly decreased 3,239,506 curds in 2014-2015.

Table 3.6 mentions sown area, harvested area, yield and production of winter cauliflower in Kalaw Township from 2009-2010 to 2014-2015**.** The sown area of winter cauliflower significantly increased from 0.06 (000' ha) in 2009-2010 to 0.07 (000' ha) in 2014-2015. The production of winter cauliflower significantly increased from 1,153,580 curds in 2009-2010 to 1,314,815 curds in 2014-2015.

Table 3.1 Land utilization in Kalaw Township (2014-2015)

No.	Type of Land	Area ('000 ha)	Percent in total sown area
(1)	Net sown	31.21	20.26
	(a) Low land	4.23	(2.75)
	(b) Up land	24.43	(15.87)
	(c) Orchard	2.55	(1.66)
(2)	Wild land	6.32	4.05
(3)	Reserved and other forest	32.12	20.86
(4)	Others	53.22	34.55
	Total	**154.08**	**100**

Note: Figures in the parentheses represent percentage in total net sown area.
Source: DoA, Kalaw, 2015

Table 3.2 Sown area of vegetables in Kalaw Township

No.	Vegetable Names	Sown area (ha)	No.	Vegetable Names	Sown area (ha)
1.	Cabbage	1,190.21	7.	Maize	1,268.72
2.	Cauliflower	238.37	8.	Chili	282.07
3.	Potato	4,813.44	9.	Groundnut	1,186.56
4.	Tomato	431.81	10.	Soybean	1,001.62
5.	Wheat	1,104.82	11.	Garlic	787.13
6.	Niger	3,731.28	12.	Other	22,340.35

Source: DoA, Kalaw, 2015

Table 3.3 Rain-fed cabbage sown area, harvested area, yield and production in Kalaw Township from 2009-2010 to 2014- 2015

Year	Sown area ('000 ha)	Harvested area ('000 ha)	Yield (Heads/ha)	Production (Heads)
2009-2010	0.77	0.77	23,909	18,505,202
2010-2011	0.77	0.77	23,907	18,527,871
2011-2012	1.19	1.19	22,623	26,921,358
2012-2013	0.77	0.78	23,907	18,647,405
2013-2014	1.18	1.18	21,141	24,946,097
2014-2015	0.77	0.77	21,621	16,864,583

Source: DoA, Kalaw, 2015

Table 3.4 Winter cabbage sown area, harvested area, yield and production in Kalaw Township from 2009-2010 to 2014- 2015

Year	Sown area ('000 ha)	Harvested area ('000 ha)	Yield (Heads/ha)	Production (Heads)
2009-2010	0.31	0.31	20,881	6,556,697
2010-2011	0.31	0.31	20,881	6,556,697
2011-2012	0.42	0.42	20,262	8,550,648
2012-2013	0.42	0.42	20,262	8,550,648
2013-2014	0.42	0.42	20,262	8,570,911
2014-2015	0.42	0.42	20,262	8,550,648

Source: DoA, Kalaw, 2015

Table 3.5 Rain-fed cauliflower sown area, harvested area, yield and production in Kalaw Township from 2009-2010 to 2014-2015

Year	Sown area ('000 ha)	Harvested area ('000 ha)	Yield (Curds/ha)	Production (Curds)
2009-2010	0.22	0.22	20,235	4,451,638
2010-2011	0.22	0.22	20,247	4,454,320
2011-2012	0.20	0.20	19,815	3,963,086
2012-2013	0.21	0.21	20,247	4,251,851
2013-2014	0.24	0.24	19,816	4,755,852
2014-2015	0.16	0.16	20,247	3,239,506

Source: DoA, Kalaw, 2015

Table 3.6 Winter cauliflower sown area, harvested area, yield and production in Kalaw Township from 2009-2010 to 2014-2015

Year	Sown area ('000 ha)	Harvested area ('000 ha)	Yield (Curds/ha)	Production (Curds)
2009-2010	0.06	0.06	18,025	1,153,580
2010-2011	0.06	0.06	19,259	1,232,593
2011-2012	0.07	0.07	19,765	1,344,049
2012-2013	0.07	0.07	19,259	1,386,667
2013-2014	0.07	0.07	18,519	1,333,334
2014-2015	0.07	0.07	18,519	1,314,815

Source: DoA, Kalaw, 2015

3.4 Information of Surveyed Villages

Kalaw Township is made up of 25 village tracts and 256 villages. To represent the cabbage and cauliflower growers, Myinmahti and Heho village tracts were selected for non-contract farming system and Kyauthtet, Heho and Thekhaung village tracts were selected for contract farming system in this study. Non-contract farmers in Myinmahti village tract (Alalywar and Talalpyar villages) and Heho village tracts (Heho and Poneinn villages) were selected (Table 3.7), and contract farmers in Kyauthtet (Kyauthtet and Tayarpin villages), Heho (Wayonpin village) and Thekhaung village tracts (Innkhaung village) were collected (Table 3.8). In survey village tract, Myinmahti is 8 miles far from Kalaw Township, Heho is 22 miles far from Kalaw Township, Kyauthtet is 33 miles far from Kalaw Township, Thekhaung is 18 miles far from Kalaw Township.

Table 3.9 and Table 3.10 indicate **c**abbage and cauliflower sown area, harvested area, yield and production of sample village tracts. In Myinmahti village tract, there were 76.49 ha of cabbage and 21.45 ha of cauliflower sown area. Cabbage and cauliflower production was 1,652,562 heads and 434,296 curds, respectively. In Heho village tract, farmer grew 162.28 ha of cabbage and 22.56 ha of cauliflower. Production of cabbage and cauliflower was 3,486,015 heads and 439,701 curds, respectively. In Kyauthtet village tract, farmer grew 6.10 ha of cabbage and 1.20 ha of cauliflower. Cabbage and cauliflower production was 134,049 heads and 25,185 curds respectively. In Thekhaung village tract, farmer grew 20.23 ha of cabbage and 3.64 ha of cauliflower in 2015-2016. Production of cabbage and cauliflower was 442,063 heads and 73,699 curds, respectively.

Sample village tracts Myinmahti and Heho occupied a land area of about 12,533 ha and 8,541 ha in which the cultivable area covered 2,643 ha and 4,100 ha, reserved and other forests covered 6,747 ha and 4,140 ha and others occupied 3,143 ha and 301 ha. Kyauthtet and Thekhaung village tracts occupied a land area of about 23,863 ha and 14,073 ha in which the cultivable area covered 4,972 ha and 7,707 ha, reserved and other forests covered 8,000 ha and 1,423 ha and others occupied 10,891 ha and 4,943 ha. Land utilization in sample village tract is shown in Table 3.11.

Table 3.7 General information of surveyed villages of non-contract farmers in Kalaw Township

Item	Unit	Myinmahti Village Tract		Heho Village Tract	
		Alalywar	Talalpyar	Heho	Poneinn
Population	No.	395	464	10,191	602
Households	No.	87	77	2,234	165
Male	No.	191	240	5,102	255
Female	No.	204	224	5,089	347

Source: DoA, Kalaw, 2015

Table 3.8 General information of surveyed villages of contract farmers in Kalaw Township

Item	Unit	Kyauthtet Village Tract		Heho Village Tract	Thekhaung Village Tract
		Kyauthtet	Tayarpin	Wayonpin	Innkhaung
Population	No.	1,308	478	1,413	933
Households	No.	280	112	370	255
Male	No.	692	233	763	471
Female	No.	606	245	650	462

Source: DoA, Kalaw, 2015

Table 3.9 Cabbage sown area, yield and production of sample village tracts in Kalaw Township

Village tract	Cultivated land area (ha)	Yield (heads/ha)	Production (heads)
Myinmahti	76.49	21,605	1,652,562
Heho	162.28	21,482	3,486,015
Kyauthtet	6.10	21,975	134,049
Thekhaung	20.23	21,852	442,063

Source: DoA, Kalaw, 2015

Table 3.10 Cauliflower sown area, yield and production of sample village tracts in Kalaw Township

Village tract	Cultivated land area (ha)	Yield (Curds/ha)	Production (Curds)
Myinmahti	21.45	20,247	434,296
Heho	22.26	19,753	439,701
Kyauthtet	1.20	20,988	25,185
Thekhaung	3.64	20,247	73,699

Source: DoA, Kalaw, 2015

Table 3.11 Land utilization in sample village tract (ha)

Item	Myinmahti	Heho	Kyauthtet	Thekhaung
(1) Net Sown area	2,643	4,100	4,972	7,707
(a) Low land	389	2,459	-	242
(b) Up land	1,881	1,626	4,796	7,195
(c) Orchard	373	15	176	270
(2) Reserved and other forest	6,747	4,140	8,000	1,423
(3) Others	3,143	301	10,891	4,943
Total	**12,533**	**8,541**	**23,863**	**14,073**

Source: DoA, Kalaw, 2015

3.5 Data Collection and Sampling Methods

Both primary and secondary data were collected based on cabbage and cauliflower growing season. The data were collected during the crop season of 2014-2015.

3.5.1 Primary data collection

The primary data were collected as personal interview by using structured questionnaire. The household survey for primary data collection was done from October to November 2015. The number of sample respondents is shown in Table 3.12. In this study, simple random sampling and purposive sampling were used. In the Southern Shan State, the most growing four villages of cabbage and cauliflower were purposively selected.

The household level survey for non- contract farmers in Kalaw Township was carried out covering 100 non-contract farmers in Myinmahti village tract and Heho village tract. The diagrams of the study area for non-contract farmers are described in Figure 3.3. The household level survey for contract farmers in Kalaw Township was carried out covering 30 cabbage growers from Kyaukhtet village tract, Heho village tract and Thekhaung village tract (Figure 3.4).

The questionnaire was structured in details on winter and rain-fed cabbage and cauliflower production at the farm level. Demographic characteristics of cabbage and cauliflower farmers such as age, education, household's experience in cabbage and cauliflower production, family size, family labor were also collected. Cultural practices of cabbage and cauliflower production such as farm ownership, farm size, cabbage and cauliflower sown area, harvested area, crop production, varieties used, seed rate per hectare, utilization of fertilizer, seed, insecticides, foliar and fungicide were collected. Detail costs (hired labor cost, non-labor input cost, transportation costs and marketing costs), extension service, credit taken, loan from agricultural development bank and amount of marketed surplus and returns of cabbage and cauliflower production, constraints and perspective of cabbage and cauliflower farmers were also composed in data collection. The market related questionnaire was used to collect the market performance of market intermediaries of cabbage and cauliflower market such as village collectors, township wholesalers, commission men and retailers for their marketing activities, cost and margin of purchasing channels, sold system, transport facilities and other socioeconomic data etc.

Table 3.12 Number of sample respondents in the study area

Items	Number of sample respondents
Non-contract farmers	100
Contract farmers	30
Village collectors	10
Commission men	6
Township wholesalers	8
Retailers	10
Total	**164**

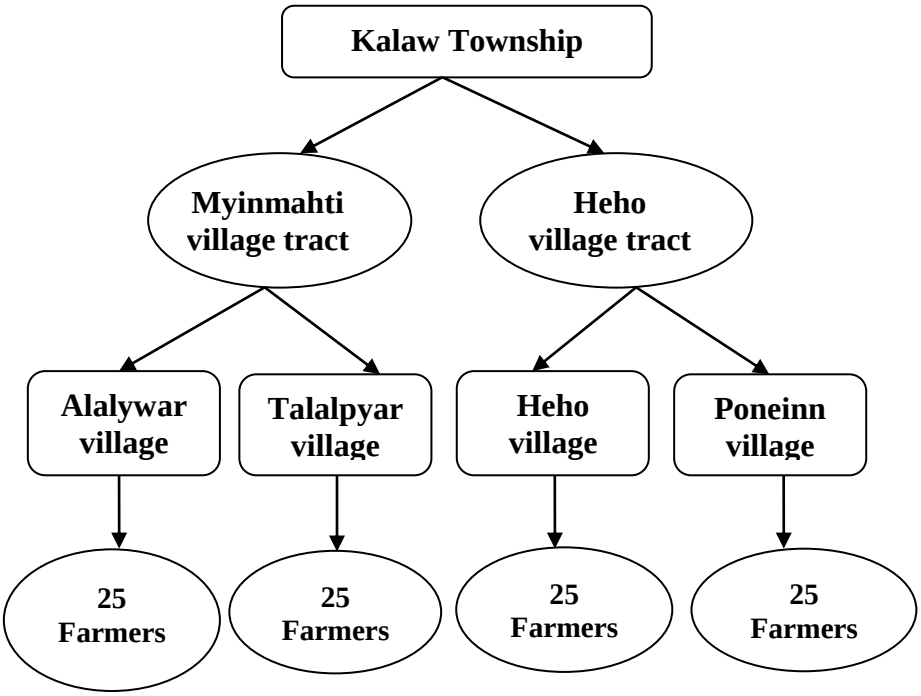


Figure 3.3 Diagram of study areas and sample non-contract farmers

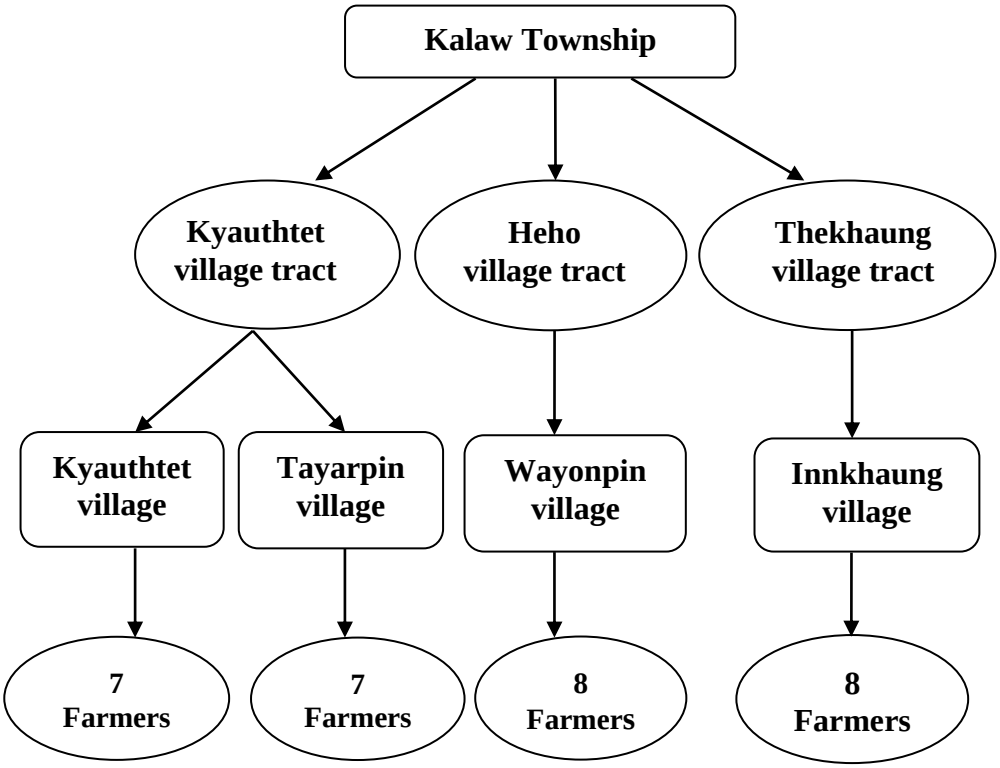


Figure 3.4 Diagram of study areas and sample contract farmers

3.5.2 Secondary data collection

Secondary data were gathered from published and official records of Ministry of Agriculture, Livestock and Irrigation (MOALI), Department of Agriculture (DoA), Township Office (Kalaw), Food and Agriculture Organization (FAO), YAU library and the other related publication.

3.6 Data Analysis Methods

Both quantitative and qualitative data were firstly compiled in the Microsoft Excel program. The study was employed with descriptive method, and econometric models were applied by the help of Statistical Packages for Social Science (SPSS) version 17.0. This method included descriptive analysis, cost and return analysis, marketing cost and margin analysis and regression analysis on determinants of cabbage and cauliflower yield.

3.6.1 Descriptive analysis

Descriptive analysis as a part of the numerical methodology such as mean, standard deviation, frequency and percentages were used to describe and compare the demographic and socioeconomic characteristics, cropping patterns, yields, inputs used, and general constraint and challenges in cabbage and cauliflower production.

3.6.2 Cost and return analysis

The cost and return analysis was applied to determine the profitability of the cabbage and cauliflower in the study area. Variable costs were taken into account; (1) Material input cost, (2) Hired labor cost, (3) Family labor cost and (4) Interest on cash cost. Both cash and non-cash items were included in the estimation of material cost and labor cost. Non-cash items for material cost included seeds, family labor, owned working animals, farm yard manure and cost of inputs. Cash payment for labor included hired labor and payment for land preparation.

The first measurement was the difference between total gross benefits or total returns and total variable cash costs, excluding opportunity costs. This value was referred to as “return above variable cash cost”. The second measurement was the deduction of the opportunity cost and total variable cash costs from gross benefit. This return was referred to as “return above variable costs” or “gross margin”. The return per unit of capital invested could be calculated by gross benefits per total variable costs. The return per unit of cash cost could be calculated by gross benefits per total cash costs. Benefit

cost ratio was used as profitability measures for each crop enterprise computing total gross margin or return above variable cost and return above cash costs (Olson 2009).

The following measurements could be expressed with equations as:

Measurement (1)

Return above variable cash cost = Total gross benefit - Total variable cash cost

Measurement (2)

Return above variable cost = Total gross benefit - Total variable cost

Measurement (3)

Return per unit of capital invested = Total gross benefit/Total variable cost

Measurement (4)

Return per unit cash cost = Total gross benefit/Total cash cost

Measurement (5)

Break-even yield = Total variable cost/Average price

Measurement (6)

Break-even price = Total variable cost/Average yield

Measurement (7)

Benefit cost ratio = Gross benefit/Total variable cost

3.6.3 Method of marketing channel, marketing cost and marketing margin analysis

The marketing channel starts at the farm's gate and ends at the consumer's front door. In this research, the marketing channel showed the flow of cabbage and cauliflower from the production site (producer) to intermediaries and to the consumers.

The following indicators were used in the analysis,

1. Marketing margin = Average selling price - Average buying price

2. Profit = Gross marketing margin - Total marketing cost
   (https://www.rug.nl/research/portal/files/13174331/c6.pdf)

3. Cost price = Buying price + Total marketing cost
   (https://www.math-only-math.com)

4. Percentage of profit = Profit / Cost price ×100%
   (https://en.wikipedia.org/wiki/Profit_margin)

3.6.4 The determinants factors on cabbage and cauliflower yield of non-contract and contract farmers

In order to estimate the determinants of cabbage and cauliflower production, Production Function Analysis was applied. To determine the factor affecting cabbage and cauliflower supply at farm level in the study area, linear regression function was applied. The dependent variable was used yield of cabbage and cauliflower and independent variables were household head's age, household head's education, household head's farm experience, farm size, sown area, seed rate, total family labor cost, total hired labor cost, total material cost and access to credit (credit=1, not credit=0) was used.

The following regression model was used to examine the determinants of cabbage and cauliflower yield of the non-contract and contract farmers in Kalaw Township. The regression function was follow;

$$\mathbf{LnY = \beta_0 + \beta_1 LnX_{1i} + \beta_2 LnX_{2i} + \beta_3 LnX_{3i} + \ldots + \beta_7 LnX_{7i} + \beta_8 LnX_{8i} + \beta_9 LnX_{9i} + u_i}$$

Where,

Ln Y = natural log of cabbage and cauliflower yield (heads/ha, curds/ha)

LnX_1 = natural log of household head's age (Year)

LnX_2 = natural log of household head's education (Year)

LnX_3 = natural log of household head's farm experience (Year)

LnX_4 = natural log of farm size (ha)

LnX_5 = natural log of seed rate (kg/ha)

LnX_6 = natural log of total family labor cost (MMK/ha)

LnX_7 = natural log of total hired labor cost (MMK/ha)

LnX_8 = natural log of total material cost (MMK/ha)

X_9 = access to credit (credit = 1, not credit = 0)

β_0 = constant

β = estimated coefficient

u_i = disturbance term (i = 1,…,n)

3.6.5 Empirical model for the factors influenced the cabbage and cauliflower yields

The study was expected from the independent variables which affected the factors influencing for cabbage and cauliflower yield in the study area. In this study, the selected variables included household head's age, household head's education, household head's farm experience, farm size, seed rate, total family labor cost, total hired labor cost, total

material cost and access to credit. Expected sign of the independent variables in cabbage and cauliflower yield is shown in Table 3.12.

3.6.6 SWOT analysis

A SWOT analysis was used to observe constraints and challenges of the vegetable supply chain. SWOT analysis is an acronym for "Strengths, Weaknesses, Opportunities and Threats". The analysis of strengths and weakness is internal and usually base on an analysis of facts and assumption on the market research findings. The opportunities and threats analysis is carried out by examining external factors.

Strengths (S)	**Weaknesses (W)**
➢ What advantages does your organization have? ➢ What do people in your market see as your strengths?	➢ What could you improve? ➢ What should you avoid? ➢ What factors lose you sales?
Opportunities (O)	**Threats (T)**
➢ What good opportunities can you spot? ➢ What interesting trends are you aware of?	➢ What obstacles do you face? ➢ Do you have bad debt or cash-flow problems? ➢ Could any of your weaknesses seriously threaten your business?

http://www.mindtools.com/pages/article/newTMC_05.htm

Table 3.13 Expected sign of the independent variables in cabbage and cauliflower yield

Independent Variables	Unit	Expected Sign
Household head's age	Year	(+,-)
Household head's education	Year	(+,-)
Household head's farm experience	Year	(+)
Farm size	ha	(+,-)
Seed rate	kg/ha	(+,-)
Total family labor cost	MMK/ha	(+)
Total hired labor cost	MMK/ha	(+,-)
Total material cost	MMK/ha	(+)
Access to credit		(+)

CHAPTER IV
RESULTS AND DISCUSSION

In this section, the socioeconomic and demographic characteristics of the market participants (farmers, village collectors, commission men, township wholesalers and retailers) along the cabbage and cauliflower supply chain were described. In addition, cost and return analysis of cabbage and cauliflower production of non-contract and contract farmers, marketing channels of cabbage and cauliflower along the supply chain, marketing cost, marketing margin and profit of market participants, determinants of cabbage and cauliflower production, and the major constraints and challenges in cabbage and cauliflower production were explored.

4.1 Demographic and Socioeconomic Characteristics of Sample Farmers in the Study Area

4.1.1 Socioeconomic characteristics of sample farmers in the study area

Socioeconomic characteristics of the sample farmers in the study area were presented in Table 4.1. In cabbage and cauliflower production, average age of non-contract farmers was around 49 years, ranging from the eldest was 77 years old and the youngest was 28 years old. In winter cabbage production, contract farmers had 63 years of the eldest age and 28 years of the youngest. Average age was around 45 years. There were not many differences between average ages of the sample farmers in the study areas.

Farmer's farm experience plays an important role in agricultural farming activities. The non-contract farmers had around 26 years farm experience in average while the contract farmers had less experience showing around 23 years farm experience in average. The average farm experience of non-contract farmers was higher than contract farmers.

Most of the sample farmers had medium education level. The average schooling years of sampled farmers were about 5.68 years (about grade 6) in non-contract farmers with the range of schooling years from 1 to 15 years, and 5.73 years (about grade 6) in contract farmers with the range of schooling years from 1 to 11 years. The education level of farmers was assumed to do decision making of their farming system.

In the study area, family size of non-contract farmers ranging from 2 to 8 persons and average family size was about 5 persons. Family size of contract farmers ranging from 2 to 6 persons and average family size was about 4 persons. Number of family labors of non-contract farmers range from 1 to 6 persons and average family labors were

about 3 members. Family labors of contract farmers ranging from 2 to 5 persons and average family labor was about 3 members. In the study area, family size and family labor were not many differences between non-contract and contract farmers.

Non-contract farmers owned 0.22 ha of lowland, 2.21 ha of upland and 0.10 ha of garden. Contract farmers owned 0.24 ha of lowland and 2.33 ha of upland. Socioeconomic characteristics which are age, farming experience, education, family size, family labor and farm size of non-contract and contract farmers were not in different.

Figure 4.1 showed that cultivated land types of sample farmers in the study area. In terms of cultivated land type of non-contract farmers were owned 74% in upland, 17% in both upland and lowland, 5% in both upland and garden, and 4% in lowland, upland and garden (Figure 4.1 A). On the other hand, 70% of contract farmers used upland for cultivation and while only 30% of contract farmers used both upland and lowland (Figure 4.1 B). In the study area, most of the non-contract and contract farmers cultivated upland.

4.1.2 Farm and household assets of sample farmers in the study area

The farm and household assets of sample farmers were shown in Table 4.2. When comparing household assets such as Television, DVD, mobile and motorcycle were not different in non-contract and contract farmers.

All of the non-contract farmers owned DVD, 99% of the non-contract farmers possessed mobile and TV, 90% of the non-contract farmers possessed motorcycle. About 68% of the non-contract farmers owned radio, 56% owned bicycle, 31% owned solar, 25% owned freight truck, 14% owned bullock cart, 11% owned generator, 6% owned saloon and 14% owned battery. About 13% of the non-contract farmers owned cow and 5% owned buffaloes to use in land preparation. Pigs were owned by 3% for meat production.

All of the contract farmers possessed DVD, mobile and TV. About 87% of the contract farmers owned motorcycle, 90% of the contract farmers possessed radio, 17% owned bicycle, 20% owned solar, 53% owned freight truck, 10% owned bullock cart, 7% owned generator, 3% owned saloon and 10% owned battery. About 13% of the contract farmers possessed cow and 3% owned buffaloes which were to be used in land preparation.

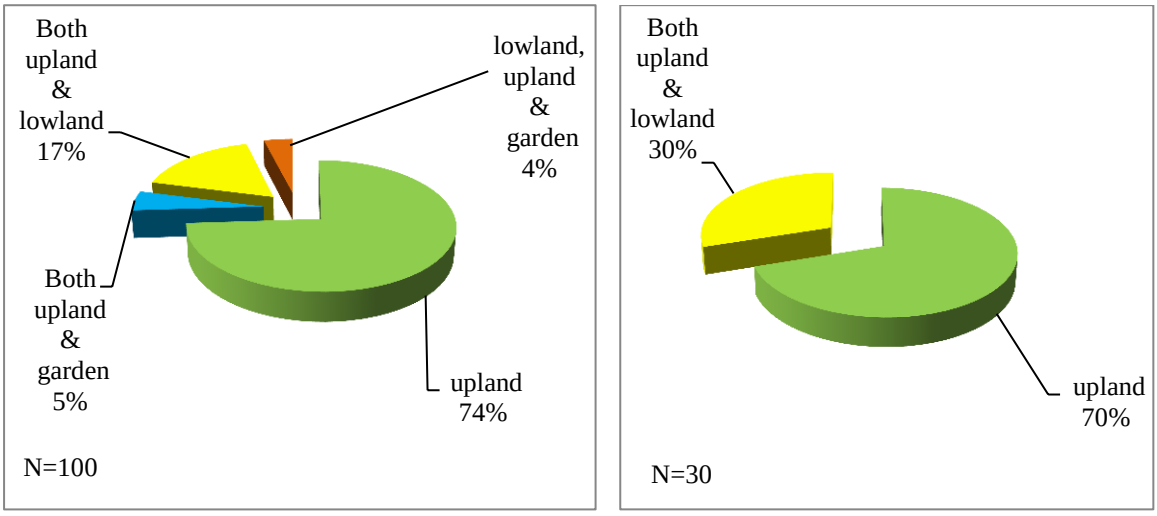
4.1.3 Land holding, average sown area and average yield of cabbage and cauliflower by the sample farmers in the study area

Land holding, average sown area and average yield of cabbage for non-contract and contract farmers in the study area were shown in Table 4.3. The productivity of cabbage and cauliflower production depends on the land holding size. The farmer who possesses the larger sown area produced more cabbage and cauliflower. In the survey area, average land holding capacity of cabbage production by non-contract farmers were 2.27 ha and ranging from 0.41 ha to 9.31 ha. The average sown area of winter cabbage by non-contract farmers and contract farmers were 0.48 ha ranging from 0.20 ha to 1.62 ha and 0.58 ha ranging from 0.41 ha to 1.21 ha, respectively. The average yield of winter cabbage production by non-contract and contract farmers were 27,758 heads/ha ranging from 22,239 heads to 37,065 heads and 27,510 heads ranging from 17,297 heads/ha to 37,065 heads/ha, respectively. The average rain-fed cabbage sown area of non-contract farmers was 0.51 ha and ranging from 0.41 ha to 1.62 ha. The average yield of rain-fed cabbage heads per hectare was about 31,901 heads ranging from 22,239 heads to 37,065 heads. In the study area, average land holding capacity of cabbage production by contract farmers were 2.58 ha and ranging from 0.40 ha to 8.09 ha.

Moreover, land holding, average sown area and average yield of cauliflower for non-contract farmers in the study area were shown in Table 4.4. Also, the land holding capacity found in cauliflower farmers with the average size of 2.39 ha, ranging from 0.41 ha to 9.31 ha. The average winter cauliflower sown area of non-contract farmers was 0.43 ha ranging from 0.20 ha to 0.81 ha. The average yield of winter cauliflower was about 25,946 curds/ha ranging from 19,768 curds/ha to 37,065 curds/ha. The average rain-fed cauliflower sown area of non-contract farmers was 0.49 ha ranging from 0.41 ha to 1.21 ha. The average yield of rain-fed cauliflower was about 25,995 curds ranging from 14,815 curds to 37,037 curds.

Table 4.1 Socioeconomic characteristics of sample farmers in the study area

Item	Unit	Mean		Range	
		Non-contract farmers	Contract farmers	Non-contract farmers	Contract farmers
Age	Year	49.11	44.47	28-77	28-63
Farming experience	Year	25.93	23.16	7-50	7-40
Education	Year	5.68	5.73	1-15	1-11
Family size	No.	4.55	4.20	2-8	2-6
Family labor	No.	3.42	2.73	1-6	2-5
Farm size					
-Lowland	ha	0.22	0.24	0-2.33	0-1.62
-Upland	ha	2.21	2.33	0.40-7.30	0.40-8.10
-Garden	ha	0.10	-	0-2.22	-
N		**100**	**30**		



A. Non-contract farmers **B. Contract farmers**

Figure 4.1 Percentage of land ownership of sample farmers in the study area

Table 4.2 Farm and household assets of sample farmers in the study area

Item	Percentage		Item	Percentage	
	Non-contract farmers [a]	Contract farmers		Non-contract farmers [a]	Contract farmers
DVD	100	100 (30)	Bullock Cart	14	10 (3)
Mobile	99	100 (30)	Generator	11	7 (2)
TV	99	100 (30)	Saloon	6	3 (1)
Motorcycle	90	87 (26)	Battery	14	10 (3)
Radio	68	90 (27)	Cow	13	13 (4)
Bicycle	56	17 (5)	Buffalo	5	3 (1)
Solar	31	20 (6)	Pig	3	-
Freight truck	25	53 (16)			
N	**100**	**30**			

Note: [a] Frequency and percentage are the same because sample size is 100.
Figures in the parentheses represent number of sample farmers.

Table 4.3 Land holding, average sown area and average yield of cabbage by the sample farmers

Item	Unit	Mean value		Range	
		Non-contract farmers	Contract farmers	Non-contract farmers	Contract farmers
Land holding	ha	2.27	2.58	0.41-9.31	0.40-8.09
Average sown area [a]	ha	0.48	0.58	0.20-1.62	0.41-1.21
Average yield [a]	heads/ha	27,758	27,510	22,239-37,065	17,297-37,065
Average sown area [b]	ha	0.51	-	0.41-1.62	-
Average yield [b]	heads/ha	31,901	-	22,239-37,065	-
N		**50**	**30**		

Note: [a] crop grown in 2014(winter), [b] crop grown in 2015 (rain-fed)

Table 4.4 Land holding, average sown area and average yield of cauliflower by the non-contract farmers

Item	Unit	Mean value	Range
Land holding	ha	2.39	0.41-9.31
Average sown area [a]	ha	0.43	0.20-0.81
Average yield [a]	curds/ha	25,946	19,768-37,065
Average sown area [b]	ha	0.49	0.41-1.21
Average yield [b]	curds/ha	25,995	14,815-37,037
N			**50**

Note: [a] crop grown in 2014 (winter), [b] crop grown in 2015 (rain-fed)

4.2 Cropping Patterns and Inputs Used for Crop Growing in the Study Area

4.2.1 Cropping patterns of non-contract and contract farmers in the study area

Cabbage and cauliflower based various cropping patterns of sample farmers in the study area were presented in Table 4.5. Non-contract and contract farmers mainly grew maize and potato as the first crop in summer season. After harvesting maize and potato, most of the farmers grew vegetables especially cabbage and cauliflower. Maize, potato, cabbage and cauliflower were dominant crops in the common cropping patterns in Kalaw Township. In summer season the main crops were ginger, tomato, garlic, mustard, and sesame. The other rain-fed crops such as tomato, mustard, garlic, wheat, garden pea, sweet pepper, golden pea, eggplant, and carrot were also grown. The common winter crops were garlic, groundnut, wheat, carrot, tomato, sweet pepper, niger, golden pea, and mustard.

In winter season, 90% of farm of contract farmers grew winter cabbage by using contract farming system while 8% of farm of contract farmers grew winter cabbage by non-contract farming system. In rainy season, 10% of farm of the contract farmers grew rain-fed cabbage by contract farming system while 92% used non-contract farming system. Most of the contract farmers more concentrated in cabbage production in the winter season as compared to the production in the rainy season (Figure 4.2).

4.2.2 Percent of sample farmers for growing cabbage and cauliflower in the study area

The percent of non-contract and contract farmers for growing cabbage and cauliflower was shown in Figure 4.3. About 51% of non-contract farmers and 3% of the contract farmers had sown both cabbage and cauliflower, 26% of the non-contract farmers and 97% of the contract farmer’s sown only cabbage, and 23% of the non-contract farmers had sown only cauliflower.

4.2.3 Reasons for selecting seed brands of sample farmers in the study area

There were different reasons for selecting seed brands. Selection of seed brands was mainly based on good quality (68% of non-contract farmers, 23% of contract farmers), resistance to pest and disease (15% of non-contract farmers, 23% of contract farmers), more weight than other varieties (20% of contract farmers), short duration (6% of non-contract farmers, 14% of contract farmers) and other reasons (11% of non-contract farmers, 20% of contract farmers) respectively (Figure 4.4).

Table 4.5 Cropping patterns of sample farmers in the study area (%)

Cropping pattern	Non-contract farmers [a]	Contract farmers
Other (Ginger, tomato, garlic, mustard, sesame, etc.) - Cabbage or Cauliflower - Cabbage or Cauliflower	31	20 (6)
Cabbage or Cauliflower - Other (Tomato, mustard, garlic, wheat, garden pea, sweet pepper, golden pea, eggplant, carrot, etc.) - Cabbage or Cauliflower	18	10(3)
No crop- Cabbage or Cauliflower - Cabbage or Cauliflower	17	13 (4)
Potato - Cabbage or Cauliflower - Cabbage or Cauliflower	13	10 (3)
Maize - Cabbage or Cauliflower - Cabbage or Cauliflower	7	10 (3)
Potato - Cabbage or Cauliflower - other (Garlic, groundnut, wheat, carrot, tomato, sweet pepper, niger, golden pea, mustard, etc.)	6	17 (5)
Potato - Cabbage or Cauliflower - Potato	5	7 (2)
Maize - Cabbage or Cauliflower - others	3	13 (4)
N	**100**	**30**

Note: [a] Frequency and percentage are same because sample size is 100.
Figures in the parentheses represent frequency.

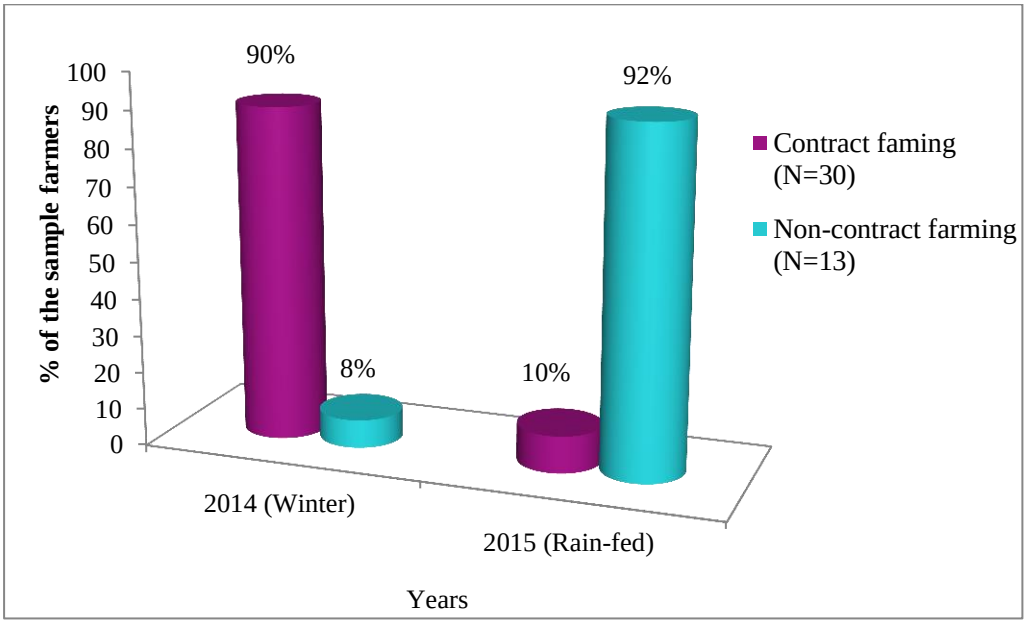
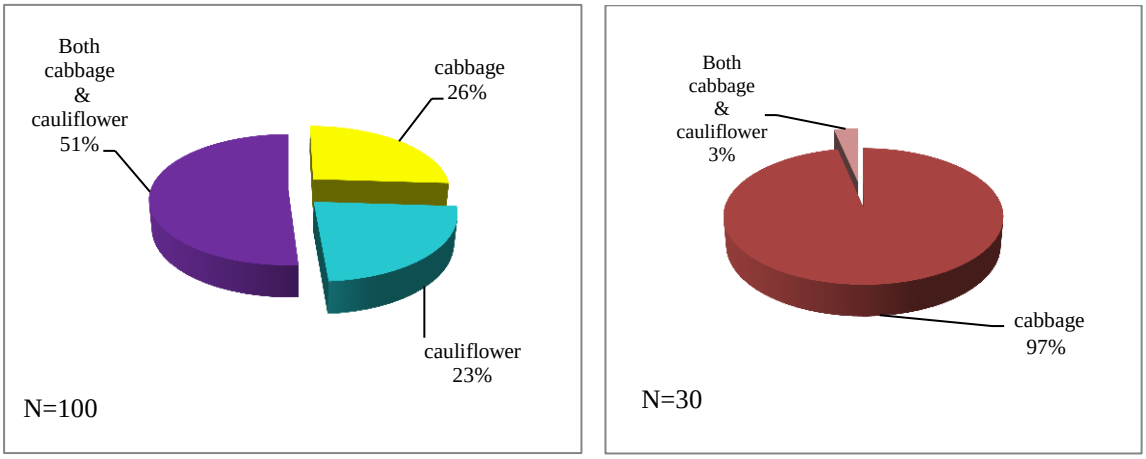


Figure 4.2 Comparison of contract farming and non-contract farming of cabbage grown by the contract farmers



A. Non-contract farmers **B. Contract farmers**

Figure 4.3 Percent of sample farmers for growing cabbage and cauliflower

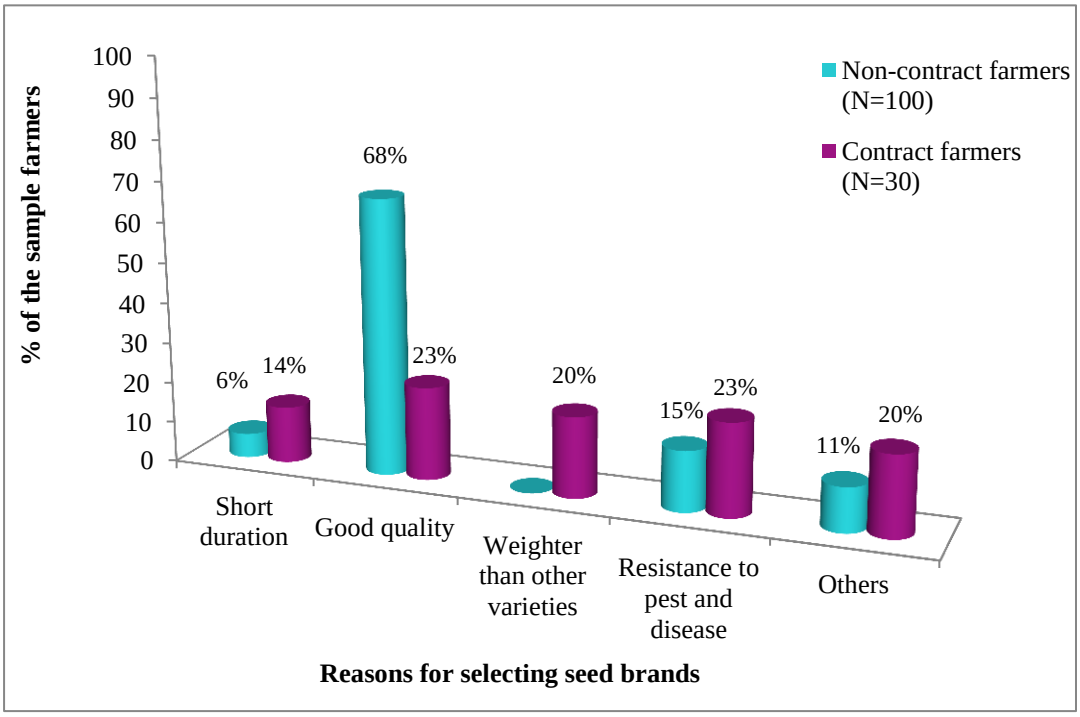


Figure 4.4 Percentage of sample farmer's reasons for selecting seed brands

4.2.4 Cultivated seed brands and seed rate used by the sample farmers

Table 4.6 showed that cultivated seed brands of cabbage grown by non-contract and contract farmers in the study area. In Myanmar, some vegetable seeds especially cabbage and cauliflower were imported from foreign countries such as Thailand and China etc. Myanmar has many varieties of cabbage and cauliflower; the nomenclature varies from region to region. According to the survey records, non-contract farmers used two cabbage seed brands and contract farmers used only one. "Crown" was the most popular seed brand and 86% of the non-contract farmers and 100% of the contract farmers used it. The other brand was "588" and very few farmers grew them. About 14% of the non-contract farmers used this variety while contract farmers did not use it.

Cultivated seed brands of cauliflower grown by non-contract farmers in the study area were shown in Table 4.7. In cauliflower production, two types of cultivated seed brands were founded in the study area. In cauliflower production, 90% of the non-contract farmers used "Red Arrow" brand while 10% of the non-contract farmers used "Pan" brand.

Seed rate used for cabbage production by non-contract and contract farmers in the study area were described in Table 4.8. Both non-contract and contract farmers used the cabbage seeds at the rate of 0.24 kg/ha in average in both growing seasons (winter and rainy). The maximum seed rate of cabbage was 0.25 kg/ha and minimum seed rate was 0.12 kg/ha.

Seed rate of cauliflower used by non-contract farmers in the study area were described in Table 4.9. In winter and rain-fed cauliflower production by non-contract farmers, the average seed rate of cauliflower by the former season was 0.16 kg/ha and 0.12 kg/ha in the latter one. With regard to the cauliflower production by non-contract farmers in both growing seasons (winter and rainy), the maximum seed rate of cauliflower was 0.15 kg/ha and the minimum seed rate was 0.10 kg/ha.

Table 4.6 Cultivated seed brands of cabbage by the sample farmers in the study area

No.	Non-contract farmers		Contract farmers	
	Cultivated seed brands	**Percentage**	**Cultivated seed brands**	**Percentage**
1.	Crown	86 (43)	Crown	100 (30)
2.	588	14 (7)	-	-
Total		**100 (50)**		**100 (30)**

Note: Figures in the parentheses represent frequency.

Table 4.7 Cultivated seed brands of cauliflower by the non-contract farmers in the study area

No.	Cultivated seed brands	Percentage
1.	Red Arrow	90 (45)
2.	Pan	10 (5)
	Total	**100 (50)**

Note: Figures in the parentheses represent frequency.

Table 4.8 Cabbage seed rate used by the sample farmers in the study area

Item	Unit	Non-contract farmers		Contract farmers
		Winter, 2014	**Rain-fed, 2015**	**Winter, 2014**
Mean	kg/ha	0.24	0.24	0.24
Minimum	kg/ha	0.12	0.12	0.12
Maximum	kg/ha	0.25	0.25	0.25
N		**30**	**50**	**30**

Table 4.9 Cauliflower seed rate used by the non-contract farmers in the study area

Item	Unit	Winter, 2014	Rain-fed, 2015
Mean	kg/ha	0.16	0.12
Minimum	kg/ha	0.10	0.10
Maximum	kg/ha	0.15	0.15
N		**30**	**50**

4.2.5 Inputs providers for cabbage and cauliflower production by the sample farmers

Sources of inputs providers for the non-contract farmers were described in Figure 4.5. There were two sources of seed availability in the study area. In cabbage and cauliflower production by non-contract farmers, buying inputs such as seeds, farm yard manure, fertilizers, plant hormone, insecticides and fungicides were available from the agrochemical shops in their native village and in Aungban. In the study area, 86 % of the non-contract farmers bought inputs from Aungban, 14 % of the non-contract farmers bought inputs from native village. There were many different sources of inputs such as Seinleimyae shop, Goldfish shop, Myananda shop, Khonyarzar shop and Awba shop which sell all of the chemical fertilizers, FYM, insecticides, foliar fertilizers and fungicides in Kalaw Township. The largest number 57 % of the non-contract farmers bought all of the inputs from Myananda shop followed by 17 % from Khonyarzar shop, 12 % from Awba shop in Aungban Town, and 7 % from Seinleimyae shop and Goldfish shop in their neighboring village, respectively. This finding showed that most of the non-contract farmers bought all of the inputs from Myananda shop.

Sources of inputs providers for the contract farmers were shown in Figure 4.6. In cabbage production of contract farmers, buying inputs such as seeds, farm yard manure, fertilizers, plant hormone, insecticides and fungicides were available in native village, Aungban, and Myanmar Belle Dehydrated Vegetable Factory. Because, to obtain raw material in time for Myanmar Belle Dehydrated Vegetable Factory and to get financial asset without difficulty for operating cost for contract farmers by using contract farming system, this factory provided pre-support for the seed, fertilizer, pesticides, insecticides and others. All of the contract farmers bought seeds from Myanmar Belle Dehydrated Vegetable Factory, about 76%, 12 %, 9%and 3% of the contract farmers bought FYM from Myanmar Belle Dehydrated Vegetable Factory, Seinleimyae shop, Myananda shop and Goldfish shop, respectively. About 70 %, 13%, 10%, and 7% of the contract farmers bought fertilizer from Myanmar belle dehydrated factory, Myananda shop, Seinleimyae shop, and Goldfish shop, respectively. About 40%, 34%, and 26% of the contract farmers bought plant hormone from Goldfish shop, Seinleimyae shop, and Myananda shop. About 33%, 33%, 27%, and 7% of the contract farmers bought FYM from Myananda shop, Goldfish shop, Seinleimyae shop, and Myanmar Belle Dehydrated Vegetable Factory. About 40%, 34%, and 26%of the contract farmers bought plant hormone from Seinleimyae shop, Goldfish shop, and Myananda shop, respectively.

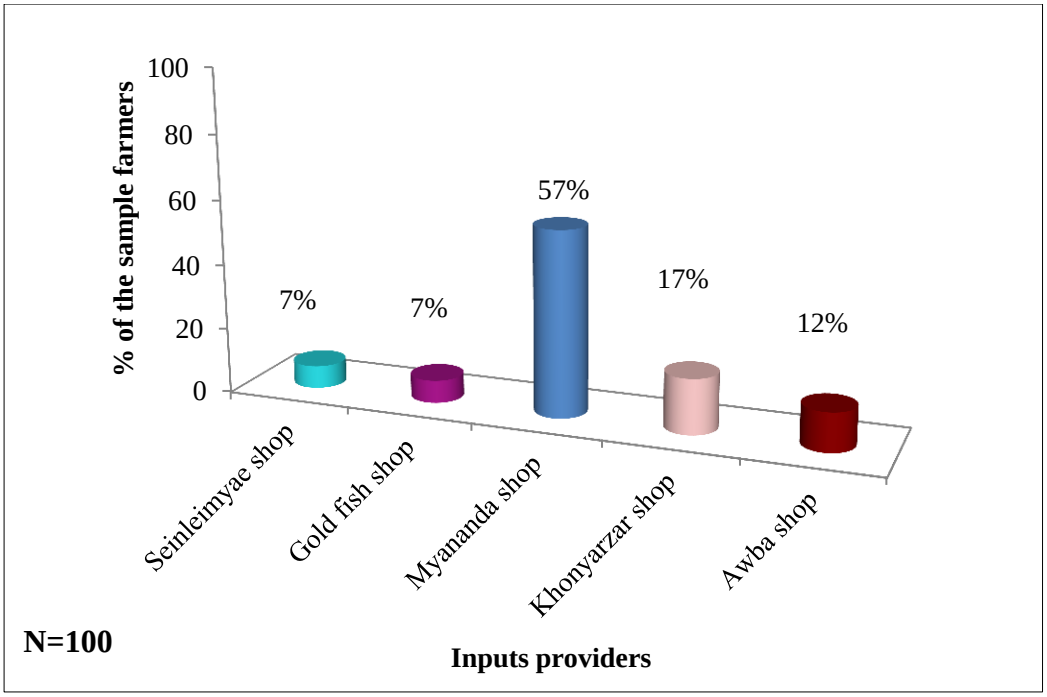


Figure 4.5 Sources of inputs providers for the non-contract farmers

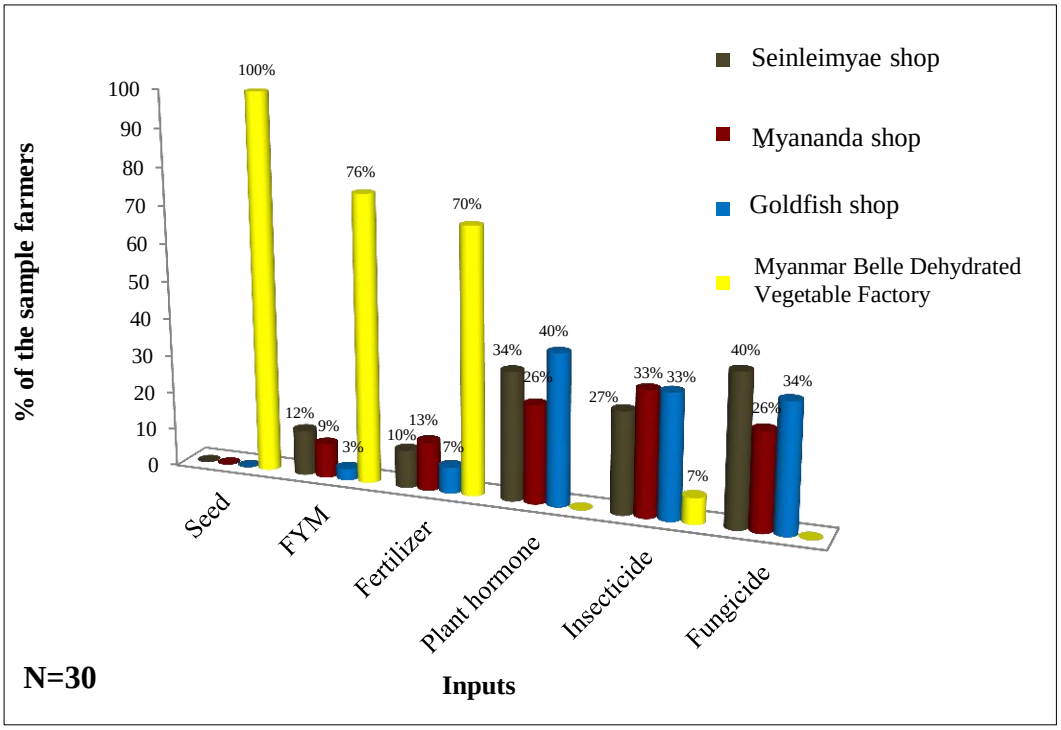


Figure 4.6 Sources of inputs for the contract farmers

4.2.6 Application of inputs in cabbage and cauliflower production by the sample farmers

Use of inputs for cabbage production of non-contract and contract farmers was summarized in Table 4.10. It was found that most of the farmers in the study area applied organic or chemical fertilizer in their winter and rain-fed cabbage and winter and rain-fed cauliflower. Farm yard manure (FYM), especially cow dung was used as the organic fertilizer and urea and compound fertilizers was mainly used as the inorganic fertilizers. They usually put manure in their soil during land preparation and chemical fertilizer at two - three weeks after planting. All of the non-contract and contract farmers used urea and compound fertilizers as main fertilizers. All of the farmers in Kalaw Township used FYM as basal application at the time of land preparation.

The average rates of FYM application in winter cabbage production by non-contract and contract farmers were 5.33 MT/ha and 2.82 MT/ha, respectively. The maximum and minimum rates of FYM by non-contract farmers were 7.41 MT/ha and 2.96 MT/ha. The maximum and minimum rates of FYM by contract farmers were 3.71 MT/ha and 2.22 MT/ha. In rain-fed cabbage production, the average rate of FYM application by non-contract farmers was 4.20 MT/ha. The maximum and minimum rate of FYM by non-contract farmers was 7.41 MT/ha and 2.22MT/ha.

The average rates of urea fertilizer in winter cabbage production by non-contract and contract farmers were 152.36 kg/ha and 137.86 kg/ha. The maximum rate of urea fertilizer by non-contract and contract farmers was 247.10 kg/ha and the minimum rate was 123.55 kg/ha. In rain-fed cabbage production, the average rate of urea fertilizer application by non-contract farmers was 155.67 kg/ha. The maximum rate of urea fertilizer by non-contract farmers was 247.10 kg/ha and the minimum rate was 61.78 kg/ha.

The average rates of compound fertilizer in winter cabbage production by non-contract and contract farmers were 185.31 kg/ha and 174.89 kg/ha. The maximum rate of compound fertilizer by non-contract and contract farmers was 247.10 kg/ha and the minimum rate was 123.55 kg/ha. In rain-fed cabbage production, the average rate of compound fertilizer application by non-contract farmers was 163.09 kg/ha. The maximum rate of compound fertilizer by non-contract farmers was 370.65 kg/ha and the minimum rate was 123.55 kg/ha.

The average rates of plant hormone in winter cabbage production of non-contract and contract farmers were 0.77 L/ha and 0.74 L/ha. The maximum rate of plant hormone

by non-contract and contract farmers was 1.48 L/ha. The minimum rate of plant hormone by non-contract was 0.25 L/ha and by contract farmers was 0.37 L/ha. In rain-fed cabbage production, the average rate of plant hormone application by non-contract farmers was 0.72 L/ha. The maximum rate of plant hormone by non-contract farmers was 1.48 L/ha and the minimum rate was 0.30 L/ha.

The average rates of insecticide in winter cabbage production of non-contract and contract farmers were 3.99 L/ha and 4.28 L/ha. The maximum and minimum rates of insecticide by non-contract and contract farmers were 7.41 L/ha and 2.47 L/ha. In rain-fed cabbage production, the average rate of insecticide application by non-contract farmers was 3.98 L/ha. The maximum rate of insecticide by non-contract farmers was 14.83 L/ha and the minimum rate was 1.24 L/ha.

The average rates of fungicide in winter cabbage production of non-contract and contract farmers were 3.91 L/ha and 3.13 L/ha. The maximum rate of fungicide by non-contract farmers was 7.41 L/ha and the minimum rate was 2.47 L/ha. The maximum rate of fungicide by contract farmers was 4.94 L/ha and the minimum rate was 0.00 L/ha. In rain-fed cabbage production, the average rate of fungicide application by non-contract farmers was 3.85 L/ha. The maximum rate of fungicide by non-contract farmers was 9.88 L/ha and the minimum rate was 0.00 L/ha. This result found that most of the contract farmers used more insecticide than those of non-contract farmers.

Use of inputs for cauliflower production by non-contract was shown in Table 4.11. FYM application in winter and rain-fed cauliflower of non-contract farmers was 4.89 MT/ha and 3.91 MT/ha. In winter cauliflower production, the maximum rate of FYM was 7.41 MT/ha and the minimum rate was 3.70 MT/ha. In rain-fed cauliflower production, the maximum rate of FYM was 5.93 MT/ha and the minimum rate was 2.97 MT/ha.

Application of urea fertilizer in winter and rain-fed cauliflower production of non-contract farmers were 164.48 kg/ha and 153.20 kg/ha. In winter cauliflower production, the maximum rate of urea fertilizer was 247.10 kg/ha and the minimum rate was 123.55 kg/ha. In rain-fed cauliflower production, the maximum rate of urea fertilizer was 247.10 kg/ha and the minimum rate was 61.78 kg/ha.

Compound fertilizer applications in winter and rain-fed cauliflower production of non-contract farmers were 189.31 kg/ha and 164.32 kg/ha. In winter and rain-fed cauliflower production, the maximum rate of compound fertilizer by non-contract farmers was 247.10 kg/ha and the minimum rate was 123.55 kg/ha.

Plant hormone applications in winter and rain-fed cauliflower production of non-contract farmers were 0.81 L/ha and 0.69 L/ha. In winter cauliflower production, the maximum rate of plant hormone was 1.48 L/ha and the minimum rate was 0.25 L/ha. In rain-fed cauliflower production, the maximum rate of plant hormone was 1.24 L/ha and the minimum rate was 0.30 L/ha.

Insecticide applications in winter and rain-fed cauliflower production of non-contract farmers were 3.34 L/ha and 2.97 L/ha. In winter and rain-fed cauliflower production, the maximum rate of insecticide was 4.94 L/ha and the minimum rate was 2.47 L/ha.

Fungicide applications in winter and rain-fed cauliflower production of non-contract farmers were at the rate of 3.87 L/ha and 2.86 L/ha. In winter and rain-fed cauliflower production, the maximum rate of fungicide were 7.41 L/ha and 4.94 L/ha and the minimum rate in both production seasons were 0.00 L/ha.

According to the chemical applications, these applications pointed out that non-contract farmer used more inputs in winter season production than in rainy season production.

Table 4.10 Use of inputs for cabbage production by the sample farmers

Item	Winter, 2014		Rain-fed, 2015
	Non-contract farmers	Contract farmers	Non-contract farmers
FYM (MT/ha)			
Mean	5.33	2.82	4.20
Range	2.96-7.41	2.22-3.71	2.22-7.41
Urea (kg/ha)			
Mean	152.36	137.86	155.67
Range	123.55-247.10	123.55-247.10	61.78-247.10
Compound (kg/ha)			
Mean	185.31	174.89	163.09
Range	123.55-247.10	123.55-247.10	123.55-370.65
Plant hormone(L/ha)			
Mean	0.77	0.74	0.72
Range	0.25-1.48	0.37-1.48	0.30-1.48
Insecticide(L/ha)			
Mean	3.99	4.28	3.98
Range	2.47-7.41	2.47-7.41	1.24-14.83
Fungicide (L/ha)			
Mean	3.91	3.13	3.85
Range	2.47-7.41	0.00-4.94	0.00-9.88
N	**30**	**30**	**50**

Table 4.11 Use of inputs for cauliflower production by the non-contract farmers

Item	Winter, 2014	Rain-fed, 2015
FYM (MT/ha)		
Mean	4.89	3.91
Range	3.70-7.41	2.97-5.93
Urea (kg/ha)		
Mean	164.48	153.20
Range	123.55-247.10	61.78-247.10
Compound (kg/ha)		
Mean	189.31	164.32
Range	123.55-247.10	123.55-247.10
Plant hormone(L/ha)		
Mean	0.81	0.69
Range	0.25-1.48	0.30-1.24
Insecticide(L/ha)		
Mean	3.34	2.97
Range	2.47-4.94	2.47-4.94
Fungicide (L/ha)		
Mean	3.87	2.86
Range	0.00-7.41	0.00-4.94
N	**30**	**50**

4.2.7 Credit availability and interest rate of sample farmers in the study area

Debt situation of the sample farmers in the study area was shown in Figure 4.7. In the study area, 75% of the non-contract farmers and 83% of the contract farmers were in debt. Sources of credit by the sample farmers were shown in Figure 4.8. About 53% of the contract farmers received credit from both United Nation Development Program (UNDP) and Myanmar Belle Dehydrated Vegetable Factory. About 23% of the contract farmers received credit only from Myanmar Belle Dehydrated Vegetable Factory. About 11% of the contract farmers received credit from Myanmar Agricultural Development Bank (MADB), and Myanmar Belle Dehydrated Vegetable Factory. About 7% of the contract farmers received credit from MADB, Cooperative and Myanmar Belle Dehydrated Vegetable Factory. About 3% of the contract farmers received credit from MADB, UNDP and Myanmar Belle Dehydrated Vegetable Factory. About 40% of the non-contract farmers received credit from MADB, 36% of the non-contract farmers received credit from UNDP, 17% of the non-contract farmers received credit from local money lenders, and 7% of the non-contract farmers received credit from Cooperative. In the study area, most of the non-contract farmers and contract farmers borrowed money from MADB, UNDP and Myanmar Belle Dehydrated Vegetable Factory.

Credit amount and interest rate of non-contract farmers were described in Table 4.12. The non-contract farmers borrowed the average credit amount 47,097 MMK/year from MADB by the interest rate of 5% and 359,259 MMK/year from UNDP by the interest rate of 15%. The average credit amount 395,384 MMK/year from local money lenders by the interest rate of 66% and 200,000 MMK/year from Cooperative society by the interest rate of 18%, respectively.

Credit amount and interest rate of contract farmers were shown in Table 4.13. All of the contract farmers borrowed money from Myanmar Belle Dehydrated Vegetable Factory the average credit amount 200,000 MMK/year by in kind repayment system. The contract farmers borrowed money from UNDP the average credit amount 405,882 MMK/year by the interest rate of 15% and 45,000 MMK/year from MADB by the interest rate of 5%. The average credit amount 300,000 MMK/year from Cooperative society by the interest rate of 18%, respectively. Among the sources of credit, local money lenders and cooperative were higher interest rate than other sources of credit in the study area.

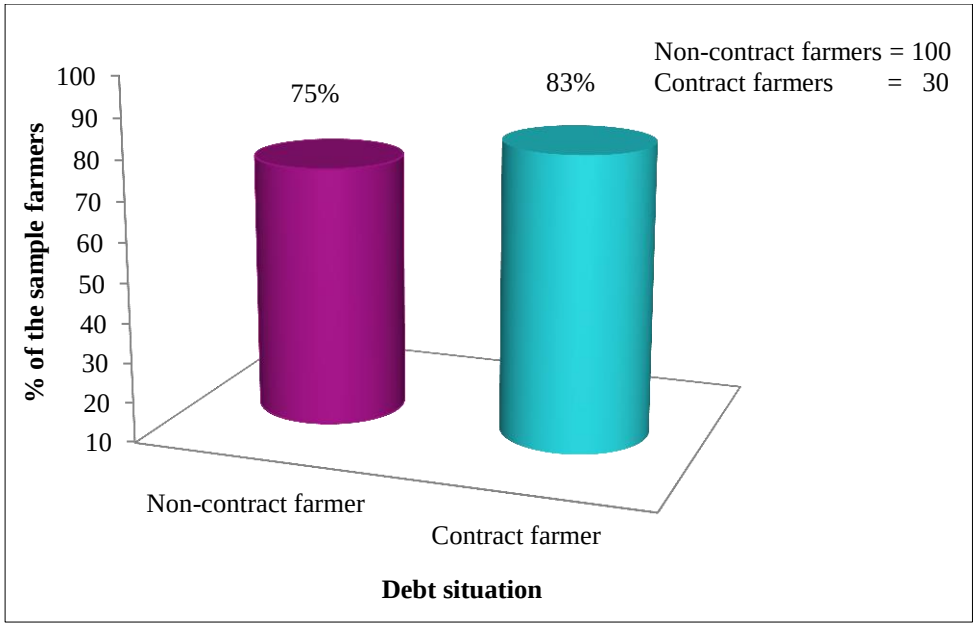


Figure 4.7 Debt situation of sample farmers in the study area

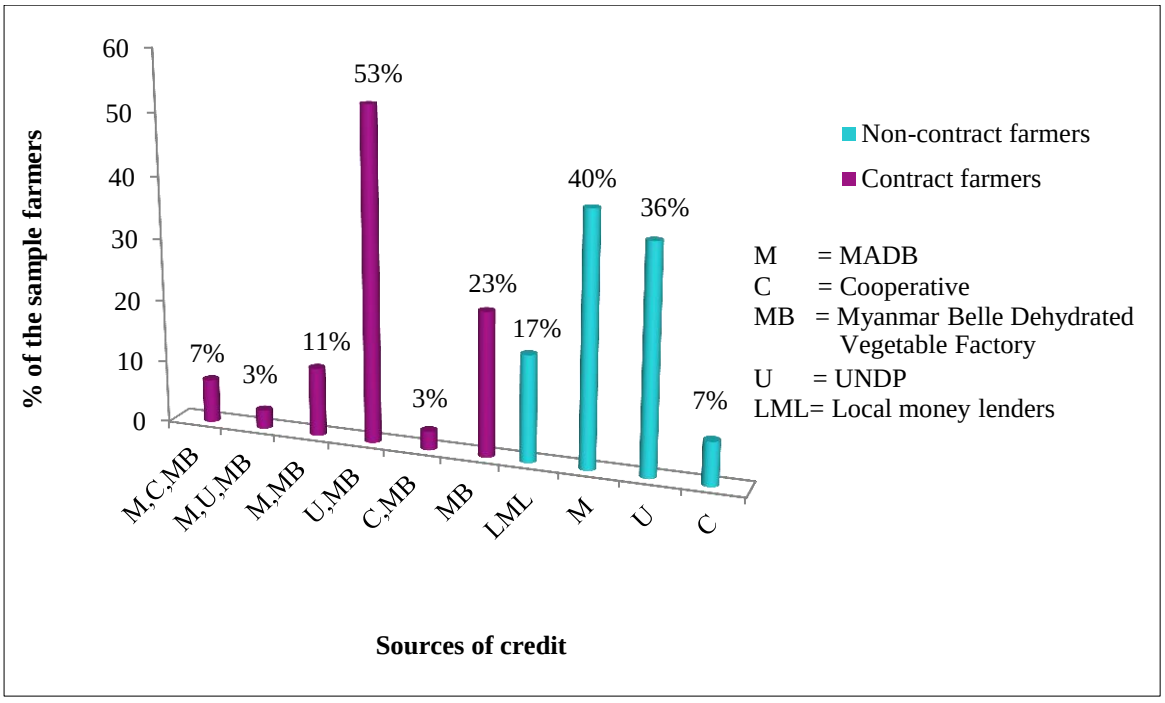


Figure 4.8 Sources of credit by the sample farmers

Table 4.12 Credit amount and interest rate of non-contract farmers

Items	N	Average credit amount (MMK/year)	Average interest rate per month (%)
MADB	30	47,097	0.42
UNDP	27	359,259	1.20
Local money lenders	13	395,384	5.46
Cooperative	5	200,000	1.50
Total	**85**		

Table 4.13 Credit amount and interest rate of contract farmers

Items	N	Average credit amount (MMK/year)	Average interest rate per month (%)
UNDP and MB*	17	405,882 (200,000)	1.20
MADB and MB*	6	45,000 (200,000)	0.42
Cooperative and MB*	2	300,000 (200,000)	1.50
MB*	5	(200,000)	-
Total	**30**		

Note: MB is Myanmar Belle Dehydrated Vegetable Factory.
Figures in the parentheses represent borrowed from MB. *Repayment system is in kind.

4.3 Cost and Return Analysis for Cabbage and Cauliflower Production in the Study Area

4.3.1 Cost and return analysis of cabbage production by the sample farmers

Cost and return analysis of cabbage production for non-contract and contract farmers was presented in Table 4.14. Enterprise budget was used to analyze cost and return for non-contract and contract farmers' cabbage production in Kalaw Township. Variable cost of the production was included material costs, hired labor costs, family labor opportunities costs and interest on cash cost. Return of cabbage production included average yield and return from sale with average current price of cabbage during that period.

Average yield of winter cabbage production by non-contract farmers (27,758 heads/ha) and rain-fed cabbage production by non-contract farmers (31,901 heads/ha) were higher than that of contract farmers (27,510 heads/ha). Average gross benefit of winter cabbage production by non-contract farmers (3,673,159) and rain-fed cabbage production by non-contract farmers (4,242,833) was higher than that of contract farmers (2,934,542). Because of contract farmers did not comply that the training of cultivation practices and the chemical usage of the contractor. Therefore, the cabbage yield of non-contract farmers was lower than non-contract farmers.

In the study area, average total variable cost of winter cabbage production by non-contract farmers (1,391,986 MMK/ha) and rain-fed cabbage production by non-contract farmers (1,405,453 MMK/ha) was higher than that of winter cabbage production by contract farmers (1,231,281 MMK/ha). Average total variable cost of winter cabbage production by non-contract and contract farmers, and rain-fed cabbage production by non-contract farmers were including total material cost, total family labor cost, total hired labor cost and interest on cash cost.

Average total material cost of winter cabbage production by non-contract and contract farmers were 550,893 MMK/ha and 482,973 MMK/ha and total material cost of rain-fed cabbage production by non-contract farmers was 534,628 MMK/ha including seeds, FYM, urea fertilizer, compound fertilizer, plant hormone, insecticide and fungicide. In the study area, average total material cost of winter and rain-fed cabbage production by non-contract farmers was higher than that of winter cabbage production by contract farmers.

Average total family labor cost of winter cabbage production by non-contract farmers and contract farmers were 520,951 MMK/ha and 508,846 MMK/ha and total

family labor cost of rain-fed cabbage production by non-contract farmers was 616,302 MMK/ha including the costs for plowing, harrowing, seeding, watering, seedling pull out, transplanting, weeding, fertilizer application, insecticide application, fungicide application, harvesting and transportation. In the study area, average total family labor cost of winter and rain-fed cabbage by non-contract farmers was higher than that of contract farmers.

Average total hired labor cost of winter cabbage production by non-contract farmers and contract farmers were 294,773 MMK/ha and 218,420 MMK/ha and total hired labor cost of rain-fed cabbage production by non-contract farmers was 231,538 MMK/ha including plowing, harrowing, seeding, watering, seedling pull out, transplanting, weeding, fertilizer application, insecticide application, fungicide application, harvesting and transportation. In the study area, average total hired labor cost of winter cabbage production by non-contract farmers was higher than that of winter cabbage production by contract farmers.

In winter cabbage production, return above cash cost (RAVCC) of non-contract farmers was 2,802,124 MMK/ha and contract farmers was 2,212,107 MMK/ha. In rain-fed cabbage production, RAVCC of non-contract farmers was 3,453,682 MMK/ha. In winter cabbage production, return above variable cost (RAVC) of non-contract farmers was 2,281,173 MMK/ha and that of contract farmers was 1,703,261 MMK/ha. In rain-fed cabbage production, RAVC of non-contract farmers was 2,873,380 MMK/ha.

The benefit cost ratio of winter cabbage production by non-contract farmers was 2.64, winter cabbage production by contract farmers was 2.38 and rain-fed cabbage production by non-contract farmers was 3.02. These benefit cost ratios which are 2.64, 2.38, and 3.02 indicating that return per unit of capital invested was 1.64, 1.38, and 2.02. This means that farmers can earn profit about more than one unit from cabbage production, if they invested a unit cash expense. The benefit cost ratio of winter and rain-fed cabbage production by non-contract farmers were higher than that of winter cabbage production by contract farmers.

Break-even yield and price was the point where the average yield and average price for cabbage production would need to cover the cost of cabbage production in which the share of profit obtained is excluded. Break- even yield was the point at which the money value brought in from the sale of a product is equal to the cost of marketing the product.

Table 4.14 Cost and return analysis of cabbage production by the sample farmers

(MMK/ha)

Item	Non-contract farmers [a]	Contract farmers [a]	Non-contract farmers [b]
Average yield (heads/ha)	27,758	27,510	31,901
Average price	132	107	133
Gross benefit	3,673,159	2,934,542	4,242,833
Total materials cost (a)	550,893	482,973	534,628
Total family labor cost (b)	520,951	508,846	616,302
Total hired labor cost (c)	294,773	218,420	231,538
Interest on cash cost (d)	25,370	21,042	22,985
Total variable cost (TVC) (a+b+c+d)	1,391,986	1,231,281	1,405,453
Total variable cash cost (TVCC) (a+c+d)	871,036	722,435	789,151
Return above variable cost (GB-TVC)	2,281,173	1,703,261	2,873,380
Return above variable cash cost (GB-TVCC)	2,802,124	2,212,107	3,453,682
Benefit cost ratio (GB/TVC)	2.64	2.38	3.02
Break-even yield (TVC/average price per head)	10,519	11,543	10,591
Break- even price (TVC/ average yield per ha)	50	45	44
N	**30**	**30**	**50**

Note: [a] crop grown in 2014 (winter), [b] crop grown in 2015 (rain-fed)

4.3.2 Cost and return analysis of cauliflower production by the non-contract farmers

Cost and return analysis of cauliflower production for non-contract farmers was shown in Table 4.15. Average yield of winter cauliflower production by non-contract farmers (25,946 curds/ha) was higher than that of rain-fed cabbage production by non-contract farmers (25,995curds/ha). Therefore, average gross benefit of rain-fed cauliflower production by non-contract farmers was higher than that of winter cauliflower production by non-contract farmers.

In the study area, average total variable cost of winter cauliflower production by non-contract farmers (1,397,708 MMK/ha) was higher than that of rain-fed cauliflower production by non-contract farmers (1,310,672 MMK/ha). Average total variable cost of winter and rain-fed cauliflower production by non-contract farmers were including total material cost, total family labor cost, total hired labor cost and interest on cash cost.

Average total material cost of winter and rain-fed cauliflower production by non-contract farmers were 597,572 MMK/ha and 522,767 MMK/ha. Average total material cost of winter cauliflower production by non-contract farmers was higher than that of rain-fed cauliflower production by non-contract farmers.

Average total family labor cost of winter and rain-fed cauliflower production by non-contract farmers were 559,204 MMK/ha and 578,679 MMK/ha. Average total family labor cost of rain-fed cauliflower production by non-contract farmers was higher than that of winter cauliflower production by non-contract farmers.

Average total hired labor cost of winter and rain-fed cauliflower production by non-contract farmers were 216,510 MMK/ha and 187,906 MMK/ha. Average total hired labor cost of winter cauliflower production by non-contract farmers was higher than that of rain-fed cauliflower production.

Return above cash cost of winter and rain-fed cauliflower production by non-contract farmers (RAVCC) were 3,364,748 MMK/ha and 3,921,112 MMK/ha. Return above variable cost of winter and rain-fed cauliflower production by non-contract farmers (RAVC) were 2,805,544 MMK/ha and 3,342,433 MMK/ha. The benefit cost ratio of winter and rain-fed cauliflower production were 3.01 and 3.55, respectively. According to the benefit cost ratio, rain-fed cauliflower production by non-contract farmers was more profitable than winter cauliflower production by non-contract farmers during the study period.

Table 4.15 Cost and return analysis of cauliflower production by the non-contract farmers

(MMK/ha)

Item	Winter, 2014	Rain-fed, 2015
Average yield (curds/ha)	25,946	25,995
Average price	162	179
Gross benefit	4,203,252	4,653,105
Total materials cost (a)	597,572	522,767
Total family labor (b)	559,204	578,679
Total hired labor cost (c)	216,510	187,906
Interest on cash cost (d)	24,422	21,320
Total variable cost (TVC) (a+b+c+d)	1,397,708	1,310,672
Total variable cash cost (TVCC) (a+c+d)	838,504	731,993
Return above variable cost (GB-TVC)	2,805,544	3,342,433
Return above variable cash cost (GB-TVCC)	3,364,748	3,921,112
Benefit cost ratio (GB/TVC)	3.01	3.55
Break-even yield (TVC/average price per curd)	8,628	7,322
Break- even price (TVC/ average yield per ha)	54	50
N	**30**	**50**

4.4 Marketing of Cabbage and Cauliflower in the Study Area

4.4.1 Selling method and mode of transportation of sample farmers

The selling method and mode of transport used by the non-contract and contract farmers were shown in Table 4.16. In the ways of selling method by the farmers, 52 % of the non-contract farmers directly flowed to village collectors, 21% of the non-contract farmers flowed to Township wholesalers, 18% of the non-contract farmers flowed to commission men and 9% of the non-contract farmers flowed to retailers. Selling method of contract farmers was different from non-contract farmers. All of the contract farmers directly sold the cabbage to Myanmar Belle Dehydrated Vegetable Factory. The most convenient system for transportation of non-contract and contract farmers was by truck and by bullock cart. Myanmar Belle Dehydrated Vegetable Factory collected the product from the contract farmers by Myanmar Belle Dehydrated Vegetable Factory arrangement. About 85% of the non-contract farmers transported their products by truck and 15% of them transported by bullock cart.

4.4.2 Demographic characteristics of market participants in the study area

Table 4.17 mentioned that age, experience and education level of market participants. An average age of village collectors were around 48 years, ranging from 28 years to 58 years when they had average business experience was around 23 years. Educational levels of village collectors were 40% in high school level, 30% in primary level and the rest 30% in secondary level.

An average age of commission men was around 52 years, ranging from 47 years to 58 years when they had average business experience was around 24 years. Educational levels of commission men were high as most of them (50%) were high school level, some (17%) were primary level and the remaining (33%) in secondary level.

An average age of township wholesaler was around 47 years, ranging from 34 years to 55 years when they had average business experience was around 22 years. The business was led by the household head. Educational levels of township wholesalers were 50% in high school level, 12% in primary level and the rest 38% in secondary level.

An average age of retailers was around 34 years, ranging from 19 years to 54 years when they had average business experience was around 11 years. Educational levels of retailers were 30% in high school level, 20% in primary level and the rest 50% in secondary level.

Table 4.16 Selling method and mode of transportation of sample farmers

Selling method and mode of transportation	Non-contract Farmers [a]	Contract farmers
Main buyers of cabbage and cauliflower		
Village Collectors	52	-
Local wholesalers	21	-
Commission men	18	-
Retailers	9	-
Myanmar Belle Dehydrated Vegetable Factory	-	100 (30)
Mode of transportation		
By truck	85	100 (30)
By bullock cart	15	-
N	**100**	**30**

Note: [a] Frequency and percentage are same because sample size is 100.

Figures in the parentheses represent frequency.

Table 4.17 Age, experience and education level of market participants

Characters	Village collectors	Commission men	Township wholesalers	Retailers
Age (year)				
Mean	48.40	52	47.38	34.33
SD	9.22	4.15	7.17	10.66
Range	28-58	47-58	34-55	19-54
Experience (year)				
Mean	22.80	24.33	21.88	11.20
SD	7.63	5.01	9	8.43
Range	10-30	18-30	7-31	2-30
Education level (%)				
Primary school	30	17	12	20
Secondary school	30	33	38	50
High school	40	50	50	30
N	**10**	**6**	**8**	**10**

4.4.3 Percent share of cabbage and cauliflower marketing by the market participants in Kalaw Township

Percent share of cabbage and cauliflower marketing by the market participants in Kalaw Township was shown in Table 4.18. Along the cabbage and cauliflower marketing chain, the village collectors played as key roles in the distribution of vegetable crops from producers to consumers. Village collectors also have the connection with the township wholesalers and other township wholesalers and inform about the buying and selling prices. The village collectors in Kalaw Township have integrated their business with other township wholesalers, township wholesalers and farmers.

Daily marketed volume of cabbage and cauliflower by village collectors were 35,075 heads and 85,925 curds, respectively. Among them, most of the village collectors in Kalaw Township sold about 34% of the cabbage to Yangon. 29% and 14% of the cabbage directly sold to Toungoo and Mawlamyine, respectively. About 7% of the cabbage sold to Pyinmana, about 5% to Meiktila, about 3% to Danyingon and Yamethin, about 2% to Aungban and Myeik, and 1% to Mandalay. Village collectors sold about 31% of the cauliflower to Yangon. About 26% of the cauliflower sold to Toungoo and 20% of the cauliflower sold to Mawlamyine. The village collectors in Kalaw sold about 9% and 5% of the cauliflower to Pyinmana and Meiktila, respectively. About 3%of the cauliflower directly sold to Danyingon, Mandalay and Myeik. About 2%and 1% of the cauliflower sold to Aungban and Yamethin, respectively. The village collectors usually get the price information from the central wholesalers in Yangon, township wholesalers and Aungban market. Most of the village collectors mainly sold the cabbage and cauliflower to Yangon.

Commission men also have the connection with the other township wholesalers and township wholesalers. Commission men collected the cabbage directly from the farmers. Daily marketed volume of cabbage by village collectors was 61,400 heads. Among them, commission men in Kalaw Township sold about 36% of the cabbage to Yangon. About 20% of the cabbage directly sold to Mawlamyine. They sold 28% and 16% of the cabbage to Aungban and Myeik, respectively. Daily market volume of cauliflower by commission men was 31,150 curds. As in market volume of cauliflower, about 37% of the cauliflower mainly sold to Yangon. About 24% of the cauliflower directly sold to Mawlamyine. The commission men in Kalaw Township sold about 21% and 18% of the cauliflower to Myeik and Aungban. Most of the commission men usually get the cabbage price information from the wholesalers in Aungban and Yangon. In the

study area, also the most of the commission men mainly sold the cabbage and cauliflower to Yangon.

Township wholesalers played second important roles in the distribution of vegetable crops. Township wholesalers also had the connection with the other township wholesalers. Daily marketed volume of cabbage and cauliflower by the township wholesalers were 54,900 heads and 47,900 curds. Same as the marketed volume of cabbage, township wholesalers in Kalaw sold about 17% of the cabbage to Bago and 11% to Yangon and Mawlamyine. They sold about 9% and 8% of the cabbage to Pyu and Kanyutkwin, respectively. Township wholesalers in Kalaw sold 7% of the cabbage to Toungoo and Pyinmana, and 6% to Thazi, Kyaikto and Nyaunglebin, about 5% to Penwegon, about 4% to Meiktila, about 1% to Aungban, Mandalay, and Kyauktaga. Among them the daily marketed volume of cauliflower, about 16% of the cauliflower sold to Bago. About 11% and 10% of the cauliflower transport to Mawlamyine and Nyaunglebin, respectively. About 9% of the cauliflower transport to Pyu and about 8% of the cauliflower to Yangon and Kyaikto. About 7% of the cauliflower directly sold to Penwegon and 6% to Toungoo and Kanyutkwin, respectively. About 4% of the cauliflower to Pyinmana, Thazi and Kyauktagaand about 3% of the cauliflower sold to Meiktila and Mandalay. About 1% of the cauliflower sold to Aungban. Most of the township wholesalers also mainly sold the cabbage and cauliflower to Bago. The township wholesalers normally get the price information from the central wholesalers in Yangon.

The retailers had the last stage in marketing channel. Retailers also had the connection with township wholesalers and village collectors and inform about the buying and selling prices. In the study area most of the retailers can get the cabbage from farmers in their neighboring villages. Weekly marketed volume of cabbage by retailers was 1,650 heads. In the Aungban market, retailers sold about 49% of the cabbage to Innkhaung market. Retailers sold about 30% of the cabbage to Aungban, and about 21% of the cabbage to Heho market. Weekly marketed volume of cauliflower by retailers was 1,320 curds. As in the marketed volume of cauliflower, retailers sold about 39% of the cauliflower sold to Aungban market and 38% of the cauliflower to Innkhaung, and 23% of the cauliflower sold to Heho. All of the retailers weekly sold the cabbage and cauliflower to the Aungban, Innkhaung and Heho market. The retailers usually get the price information from the wholesalers in Aungban market.

Table 4.18 Percent share of cabbage and cauliflower marketing by the market participants in Kalaw Township

Market	Village collectors		Commission men		Township wholesalers		Retailers	
	A	B	A	B	A	B	A	B
Yangon	34	31	36	37	11	8	-	-
Toungoo	29	26	-	-	7	6	-	-
Mawlamyine	14	20	20	24	11	11	-	-
Pyinmana	7	9	-	-	7	4	-	-
Meiktila	5	5	-	-	4	3	-	-
Danyingon	3	3	-	-	-	-	-	-
Yamethin	3	1	-	-	-	-	-	-
Aungban **(Local market)**	2	2	28	18	1	1	30	39
Myeik	2	3	16	21	-	-	-	-
Mandalay	1	3	-	-	1	3	-	-
Thazi	-	-	-	-	6	4	-	-
Kyaikto	-	-	-	-	6	8	-	-
Kyauktaga	-	-	-	-	1	4	-	-
Bago	-	-	-	-	17	16	-	-
Kanyutkwin	-	-	-	-	8	6	-	-
Nyaunglebin	-	-	-	-	6	10	-	-
Penwegon	-	-	-	-	5	7	-	-
Pyu	-	-	-	-	9	9	-	-
Innkhaung **(Local market)**	-	-	-	-	-	-	49	38
Heho **(Local market)**	-	-	-	-	-	-	21	23
Marketed volume	35,075	85,925	61,400	31,150	54,900	47,900	1,650	1,320
N	**10**		**6**		**8**		**10**	

Note: A= Cabbage, B= Cauliflower

4.4.4 Marketing activities of market participants in Kalaw Township

Marketing activities of the market participants in Kalaw Township were described in Table 4.19. About 70% of the village collectors applied cash down payment system in buying cabbage and cauliflower and 30% received half in credit system. Most of the village collectors used only cash down payment system in purchasing of cabbage and cauliflower. In selling cabbage and cauliflower, village collectors used only cash down payment system and received half in credit system. About 80% of the village collectors sold the cabbage and cauliflower used cash down payment system and about 20% of them used half in credit payment system.

About 50% of the commission men used cash down payment system in buying cabbage and cauliflower, 33% received half in credit system and 17% used cash down payment system with commission fees. All of the commission men used cash down payment system with commission fees in selling of cabbage and cauliflower.

About 87% of the township wholesalers applied cash down payment system in buying cabbage and cauliflower and 13% used half in credit system. Most of the township wholesalers used cash down payment system in purchasing of cabbage and cauliflower. In selling cabbage and cauliflower, 62% of the township wholesalers used only cash down payment system and 38% of the township wholesalers received half of the cash down and credit.

In the case of retailers, all of the retailers used cash down payment system in purchasing and selling of cabbage and cauliflower in the study area. With regard to transportation, all of the sample village collectors, commission men, township wholesalers used the truck and all of the retailers used the tri-cycle.

Table 4.19 Marketing activities of market participants

Activities	Village collectors	Commission men	Township wholesalers	Retailers
Types of transaction in purchasing				
Use cash down payment system	70	50	87	100
Received half of the cash down and credit	30	33	13	-
Use cash down payment system with commission fees	-	17	-	-
Types of transaction in selling				
Use cash down payment system	80	-	62	100
Received half of the cash down and credit	20	-	38	-
Use cash down payment system with commission fees	-	100	-	-
Mode of transportation				
By truck	100	100	100	-
By tri-cycle	-	-	-	100
N	**10**	**6**	**8**	**10**

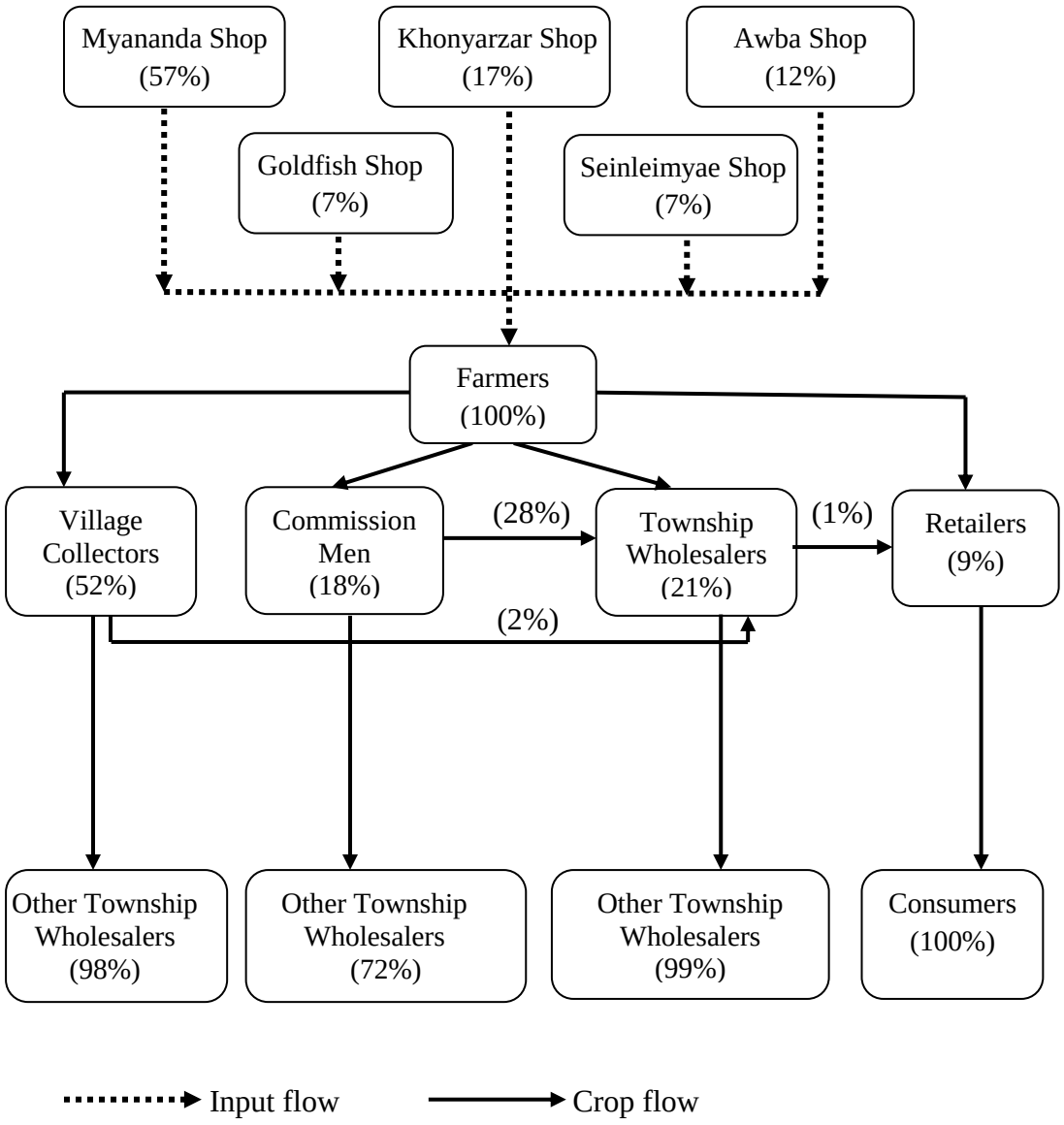
4.4.5 Supply chain of cabbage and cauliflower by the non-contract and contract farmers

Supply chain of cabbage and cauliflower was intended to demonstrate the channel flow from input providers to ultimate consumers in the study area. About 57% of the non-contract farmers brought all of the input from Myananda shop, 17% from Khonyarzar shop and 12% from Awba shop, 7% from Goldfish shop and remaining 7% from Seinleimyae shop. Among the various actors, village collectors had the highest potential for getting cabbage and cauliflower directly from farmers in the study area. About 52% and 18% of the non-contract farmers directly sold the cabbage and cauliflower to village collectors and commission men, respectively. About 21% and 9% of the cabbage and cauliflower transport, respectively, to township wholesalers and retailers. Seven marketing channels were performed along the supply chain of cabbage and cauliflower by non-contract farmers and village collectors were active among the market intermediary.

About 98% of the village collectors sold the cabbage to other township wholesalers and 2% of the cabbage directly sold to township wholesalers. About 72% of the commission men directly sold the cabbage to other township wholesalers and 28% of the cabbage to township wholesalers. About 99% of the township wholesalers directly sold the cabbage to other township wholesalers and 1% of the cabbage to retailers. All of the retailers directly sold the cabbage to the consumers (Figure 4.9).

About 98% of the village collectors sold the cauliflower to other township wholesalers and 2% of the cauliflower directly sold to township wholesalers. About 82% of the commission men directly sold the cauliflower to other township wholesalers and 18% of the cauliflower to township wholesalers. About 99% of the township wholesalers directly sold the cauliflower to other township wholesalers and 1% of the cauliflower to retailers. All of the retailers directly sold the cauliflower to the consumers (Figure 4.10).

About 24% of the contract farmers brought all of the input from Seinleimyae shop, 22% of contract farmers brought all of the inputs from Myananda shop, and 23% of contract farmers brought all of the inputs from Goldfish shop. In the study area, most of the contract farmers (31%) were brought the inputs from Myanmar Belle Dehydrated Vegetable Factory. All of the cabbage directly flowed from contract farmers to Myanmar Belle Dehydrated Vegetable Factory. All of dehydrated or drying cabbage product directly flowed from Myanmar Belle Dehydrated Vegetable Factory to Yangon port. And then, 62% of the product directly transports from Yangon port to Korea and 38% of the product directly transport to Japan (Figure 4.11).



Channel 1; Input providers- Farmers- Village collectors- Other township wholesalers

Channel 2; Input providers- Farmers- Village collectors- Township wholesalers

Channel 3; Input providers- Farmers- Commission men- Other township wholesalers

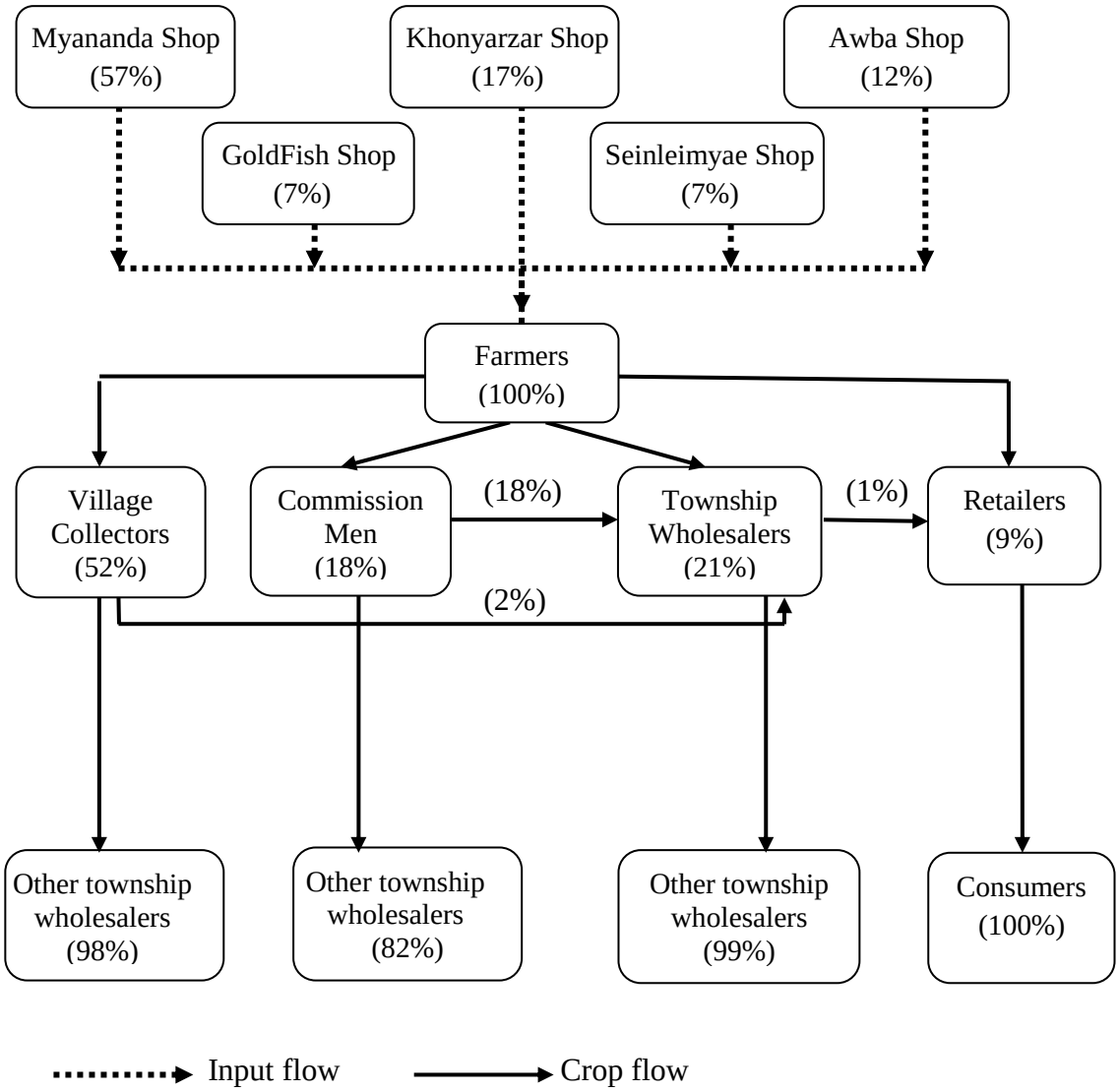
Channel 4; Input providers- Farmers- Commission men- Township wholesalers

Channel 5; Input providers- Farmers- Township wholesalers- Other township wholesalers

Channel 6; Input providers- Farmers- Township wholesalers- Retailers

Channel 7; Input providers- Farmers- Retailers- Consumers

Figure 4.9 Supply chain mapping of cabbage by the non-contract farmers



Channel 1; Input providers- Farmers- Village collectors- Other township wholesalers

Channel 2; Input providers- Farmers- Village collectors- Township wholesalers

Channel 3; Input providers- Farmers- Commission men- Other township wholesalers

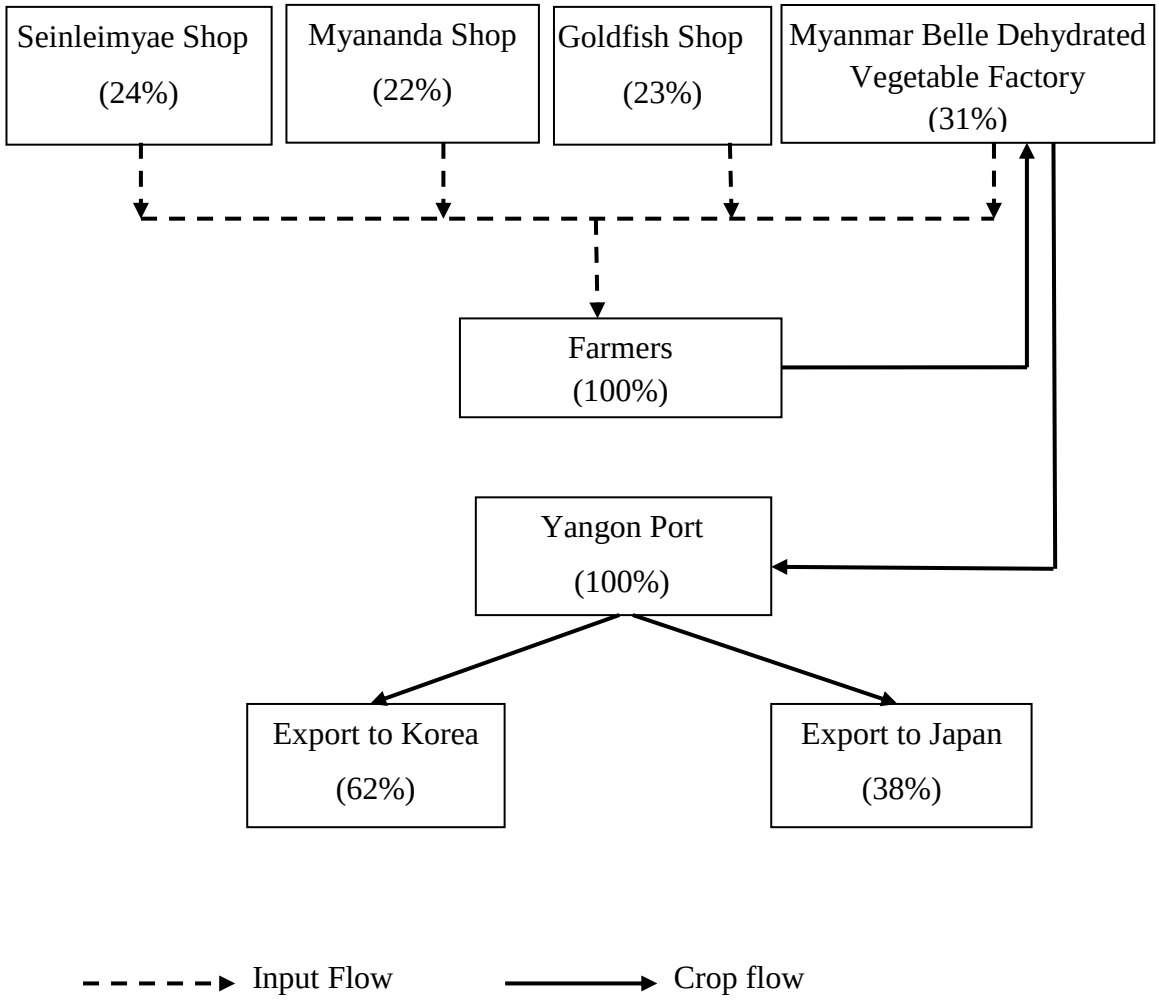
Channel 4; Input providers- Farmers- Commission men- Township wholesalers

Channel 5; Input providers- Farmers- Township wholesalers- Other township wholesalers

Channel 6; Input providers- Farmers- Township wholesalers- Retailers

Channel 7; Input providers- Farmers- Retailers- Consumers

Figure 4.10 Supply chain mapping of cauliflower by the non-contract farmers



Channel 1: Input providers- Farmers- Myanmar Belle Dehydrated Vegetable Factory

Channel 2: Input providers- Farmers- Myanmar Belle Dehydrated Vegetable Factory- Yangon Port

Channel 3: Input providers- Farmers- Myanmar Belle Dehydrated Vegetable Factory- Yangon Port-Korea

Channel 4: Input providers- Farmers- Myanmar Belle Dehydrated Vegetable Factory- Yangon Port- Japan

Figure 4.11 Supply chain mapping of cabbage by the contract farmers

4.4.6 Marketing margin, cost and profit of market participants

Trends in commodity prices and domestic marketing margins are important indicators of market performances. Along the cabbage and cauliflower marketing channel, traders including village collectors, township wholesalers, commission men and retailers have an important role in distributing products to consumers. In the marketing channel of Kalaw Township, the marketing costs, margins and profit were calculated for main agents in marketing channels such as village collectors, township wholesalers, commission men and retailers. Village collectors, commission men and township wholesalers in the studied areas served as agents of other township wholesalers. So, village collectors, commission men and township wholesalers transported the cabbage and cauliflower directly to the other township market. The overall marketing cost, margin analysis was calculated based on one head for cabbage and one curd for cauliflower.

Marketing margin, cost and profit of cabbage by market participants was shown in Table 4.20. In the first channel, average margin of cabbage by village collectors was 99 MMK/head. Total marketing cost of village collectors was 78 MMK/head. The percentage of profit obtained by village collectors was 12% of farm gate price. In the second channel, average margin of village collectors was 47 MMK/head. Total marketing cost of village collectors was 27 MMK/head. The percentage of profit obtained by village collectors was 15% of farm gate price. In the third channel, average margin of commission men was 140 MMK/head. Total marketing cost of commission men was 118 MMK/head. The percentage of profit obtained by commission men was 8% of farm gate price. In the fourth channel, average margin of commission men was 100 MMK/head. Total marketing cost of commission men was 81 MMK/head. The percentage of profit obtained by commission men was 8% of farm gate price. In the fifth channel, average margin of township wholesalers was 89 MMK/head. Total marketing cost of township wholesalers was 57 MMK/head. The percentage of profit obtained by township wholesalers was 15% of farm gate price. In the sixth channel, average margin of township wholesalers was 30 MMK/head. Total marketing cost of township wholesalers was 11 MMK/head. The percentage of profit obtained by township wholesalers was 17% of farm gate price. In the seventh channel, buying price of retailers was the lowest because farmers sold not good quality of the cabbage directly to retailers. The average margin of retailers was 50 MMK/head and total marketing cost of retailers was 13 MMK/head. The percentage of profit obtained by retailers was 59% of farm gate price. According to the

survey results, the average profit obtained by township wholesalers and retailers was relatively higher than the profit of village collectors and commission men in study areas.

Marketing margin, cost and profit of cauliflower by market participants was shown in Table 4.21. In the first channel, average margin of village collectors for cauliflower was 107 MMK/head. Total marketing cost of village collectors was 77 MMK/head. The percentage of profit obtained by village collectors was 12% of farm gate price. In the second channel, buying price of the village collectors was the lowest because village collectors bought not good quality of the cauliflower from farmers for selling to the township wholesalers. The average margin of village collectors was 58 MMK/head and total marketing cost of village collectors was 29 MMK/head. The percentage of profit obtained by village collectors was 24% of farm gate price. In the third channel, average margin of commission men was 152 MMK/head. Total marketing cost of commission men was 125 MMK/head. The percentage of profit obtained by commission men was 8% of farm gate price. In the fourth channel, average margin of commission men was 109 MMK/head. Total marketing cost of commission men was 85 MMK/head. The percentage of profit obtained by commission men was 8% of farm gate price. In the fifth channel, average margin of township wholesalers was 83 MMK/head. Total marketing cost of township wholesalers was 50 MMK/head. The percentage of profit obtained by township wholesalers was 12% of farm gate price. In the sixth channel, average margin of township wholesalers was 40 MMK/head. Total marketing cost of township wholesalers was 14 MMK/head. The percentage of profit obtained by township wholesalers was 12% of farm gate price. In the seventh channel, average margin of retailers was 50 MMK/head. Total marketing cost of retailers was 12 MMK/head. The percentage of profit obtained by retailers was 34% of farm gate price. According to the survey results, the average profit obtained by village collectors and retailers was relatively higher than the profit of commission men and township wholesalers in the study area.

Table 4.20 Marketing margin, cost and profit of cabbage by the market participants

Item	Cabbage (MMK/head)						
	C.1 VC-OTW	C.2 VC-TW	C.3 CM-OTW	C.4 CM-TW	C.5 TW-OTW	C.6 TW-R	C.7 R-C
(1) Buying price	101	103	167	150	153	100	50
(2) Selling price	200	150	307	250	242	130	100
(3) Marketing Margin (2-1)	99	47	140	100	89	30	50
(4) Total Marketing Cost	78	27	118	81	57	11	13
Cost of transportation	71	21	111	75	48	5	1
Cost of labor	7	6	7	6	9	6	12
(5) Cost price (1+4)	179	130	285	231	210	111	63
(6) Profit per unit of crop (3-4)	21	20	22	19	32	19	37
(7) Percentage of profit (6/5)*100%	12%	15%	8%	8%	15%	17%	59%
N	**10**	**1**	**6**	**2**	**7**	**1**	**10**

Note: C= Channel, VC= Village collectors, CM= Commission men, TW= Township wholesalers, R= Retailers, OTW= Other township wholesalers

Table 4.21 Marketing margin, cost and profit of cauliflower by the market participants

Item	Cauliflower (MMK/curd)						
	C.1 VC-OTW	C.2 VC-TW	C.3 CM-OTW	C.4 CM-TW	C.5 TW-OTW	C.6 TW-R	C.7 R-C
(1) Buying price	180	92	225	225	226	200	100
(2) Selling price	287	150	377	334	309	240	150
(3)Marketing Margin (2-1)	107	58	152	109	83	40	50
(4) Total Marketing Cost	77	29	125	85	50	14	12
Cost of transportation	66	19	11	80	46	4	11
Cost of labor	11	10	11	5	4	10	1
(5) Cost price (1+4)	257	121	350	310	276	214	112
(6) Profit per unit of crop (3-4)	30	29	27	24	33	26	38
(7) Percentage of profit (6/5)*100%	12%	24%	8%	8%	12%	12%	34%
N	**10**	**1**	**6**	**2**	**7**	**1**	**10**

Note: C= Channel, VC= Village collectors, CM= Commission men, TW= Township wholesalers, R= Retailers, OTW= Other township wholesalers

4.5 Determinants of Cabbage and Cauliflower Production in the Study Area

Linear regression model form was used to determine the influencing factors on cabbage and cauliflower production by SPSS version 17.0. Unstandardized B regression coefficient indicates the average change in the dependent variable associated with one unit changes in the independent variable, statistically controlling for the other independent variables. Standardized beta coefficient was used to compare the strength of the effect of each independent variable on the dependent variable. The independent variables with the largest standardized beta had the strongest effect.

4.5.1 Factors affecting the cabbage and cauliflower yield of sample farmers in the study area

Mean values of dependent and independent variables of winter and rain-fed cabbage production by non-contract farmers, winter cabbage production of contract farmers, and winter and rain-fed cauliflower production of non-contract farmers were shown in Table 4.22. In the production function, the specific yield of cabbage and cauliflower were estimated by using 9 independent variables; household head's age, household head's education, household head's farm experiences, farm size, cabbage and cauliflower seed rate, total family labor costs, total hired labor cost, and total material cost. Dummy variable of access to credit (credit=1, no credit=0) was also included. Cabbage yield and cauliflower yield was the dependent variable.

Regression model was used to identify the factors influencing the cabbage and cauliflower yield of non-contract and contract farmers in the study area. The results of the model were presented in Table 4.23. According to the regression analysis of cabbage yield in winter cabbage production, cabbage yield non-contract farmers was positively and significantly influenced by total family labor cost and access to credit, and negatively influenced by total hired labor cost, respectively. Based on the result of the log linear regression analysis, winter cabbage yield was positively affected by total family labor cost and access to credit at 1% significant level. It means that if total family labor cost increased by 1%, cabbage yield will be 0.366%increased.If the credit received by farmers in winter cabbage production 1% increased, yield of winter cabbage would be 0.149% increased. The cabbage yield was negatively and significantly influenced by total hired labor cost at 5% significant level. Other things being equal, 1% increase in total hired labor cost will decrease the cabbage yield by 0.085% respectively. R square value was 0.582 means that 58.2% of the variation in winter cabbage yield is explained by

independent variables used in the production function in the study area.

As regard to the regression analysis of cabbage yield in rain-fed cabbage production by non-contract farmers, the significant influencing factors were household head's age, household head's farm experience, farm size and total material cost. Rain-fed cabbage yield was positively and significantly affected by household head's farm experience and total material cost at 1% and 10% significant level. It means that if household head's farm experience 1% increased, rain-fed cabbage yield will be 0.192% increased. If total material cost 1% increased, rain-fed cabbage yield of non-contract farmers will be 0.185% increased. Rain-fed cabbage yield was negatively and significantly influenced by household head's age and farm size at significant 10% and 5% level. It means that if household head's age 1% increased, rain-fed cabbage yield will be 0.219% reduced. If farm size 1% increased, rain-fed cabbage yield of non-contract farmers will be 0.062% decreased. R square value was 0.434 means that 43.4% of the variation in rain-fed cabbage yield was explained by independent variables used in the production function.

According to the regression analysis of cabbage yield in winter cabbage production, cabbage yield of contract farmers was positively influenced by household head's farm experience, total family labor cost and total material cost at 5% significant level and access to credit at 10% significant level. It means that if household head's farm experience, total family labor cost, total material cost and access to credit increase by 1%, winter cabbage yield will be 0.284%, 0.219%, 0.387% and 0.111% increased, respectively. The winter cabbage yield of contract farmers was negatively influenced by farm size and total hired labor cost at significant 5% level. One percent increase in farm size and total hired labor cost will decrease the cabbage yield by 0.101% and 0.026%, respectively. R square value was 0.663 means that 66.3% of the variation in winter cabbage yield was explained by independent variables used in the production function.

. Regarding to the regression analysis of cauliflower yield in winter cauliflower production by contract farmers, the significant influencing factors were household head's farm experience, seed rate, total hired labor cost and access to credit. Cauliflower yield was positively affected by household head's farming experience at significant 5% level and access to credit at significant 1% level. It means that if household head's farm experience and access to credit increase by 1%, cauliflower yield will be 0.080% and 0.240% increased. The cauliflower yield was negatively influenced by seed rate and total hired labor cost at significant 1% level. 1% increase in seed rate and total hired labor cost

will decrease the cauliflower yield by 0.922% and 0.217%. R square value was 0.696 means that 69.6% of the variation in rain-fed cauliflower yield was explained by independent variables used in the production function.

According to the regression analysis of cauliflower yield in rain-fed cauliflower production by non-contract farmer, the significant influencing factor was seed rate. Based on the result of the log linear regression analysis, rain-fed cauliflower yield was negatively affected by seed rate at significant 1% level. It means that if seed rate increase by 1%, rain-fed cabbage yield of non-contract farmers will be 0.648% decreased. R square value was 0.343 means that 34.3% of the variation in rain-fed cauliflower yield was explained by independent variables used in the production function.

The regression analysis pointed out that the total hired labor cost of cabbage and cauliflower production of non-contract and contract farmers were negatively affected to the yield. These mean that total hired labor using by non-contract and contract farmers to cause the low of cabbage and cauliflower yield. Because of family labor regards during the cultivation period by careful to increase their yield while the hired labors don’t care the farm during the cultivation period.

Table 4.22 Mean values of dependent and independent variables of cabbage and cauliflower yield function

Item	Yield	HHH age	HHH edu	HHH exp	Farm size	Seed Rate	TFLC	THLC	TMC
Unit									
-Cabbage	Heads/ha	Year	Year	Year	ha	kg	MMK	MMK	MMK
-Cauliflower	Curds/ha	Year	Year	Year	ha	kg	MMK	MMK	MMK
Minimum									
Cabbage (N.C) [a]	22,239	28	1	7	0.41	0.12	212,000	46,949	429,391
Cabbage (N.C) [b]	22,239	28	1	7	0.41	0.12	316,288	49,420	410,433
Cabbage (C) [a]	17,297	28	1	7	0.41	0.12	134,422	0.00	348,411
Cauliflower (N.C)[a]	19,768	32	1	10	0.41	0.09	300,474	70,176	469,136
Cauliflower (N.C) [b]	14,815	32	1	7	0.41	0.09	331,114	23,722	325,432
Maximum									
Cabbage (N.C) [a]	37,065	66	11	46	6.07	0.25	874,981	963,000	708,504
Cabbage (N.C) [b]	37,065	77	15	46	9.31	0.25	128,2400	576,237	736,358
Cabbage (C) [a]	37,065	63	11	40	8.09	0.25	751,184	553,504	877,205
Cauliflower (N.C)[a]	37,065	72	15	50	9.31	0.15	814,442	342,975	783,307
Cauliflower (N.C) [b]	37,037	72	15	50	9.31	0.15	869,298	371,144	603,395
Mean									
Cabbage (N.C) [a]	27,758	49	5	26	1.91	0.25	520,950	294,772	550,893
Cabbage (N.C) [b]	31,901	49	5	26	2.27	0.24	616,302	231,537	534,628
Cabbage (C) [a]	27,510	44	6	23	2.58	0.24	508,845	218,419	482,973
Cauliflower (N.C) [a]	25,946	50	6	29	2.21	0.13	559,204	216,509	597,572
Cauliflower (N.C) [b]	25,995	49	6	26	2.38	0.12	578,678	187,906	522,767
SD									
Cabbage (N.C) [a]	3,638.17	11.17	3.12	10.45	1.36	0.02	140,037.05	208,442.64	69,802.28
Cabbage (N.C) [b]	3,733.21	11.00	3.52	11.60	1.81	0.03	197,686.45	123,020.82	79,738.25
Cabbage (C) [a]	4,242.01	10.14	3.82	10.24	2.13	0.03	129,131.58	112,157.57	96,527.80
Cauliflower (N.C)[a]	5,496.64	12.07	3.52	12.10	1.98	0.02	144,719.28	74,585.25	88,488.07
Cauliflower (N.C) [b]	5,093.40	10.97	3.20	11.02	1.89	0.01	133,453.25	93,655.88	72,313.08

Note: [a] crop grown in 2014 (winter), [b] crop grown in 2015 (rain-fed)

edu= education, exp= experience, TFLC= Total family labor cost, THLC= Total hired labor cost, TMC= Total material cost, (N.C)= Non-contract farmers, (C)= Contract farmers, HHH= Household head

Table 4.23 Determinants of cabbage and cauliflower yield by the sample farmers

Independent variables	Unstandardized Coefficients (B)				
	Cabbage			Cauliflower	
	(N.C) [a]	(N.C) [b]	(C) [a]	(N.C)[a]	(N.C) [b]
(Constant)	3.739*	8.480***	8.236***	11.583***	7.565**
Ln HHH age	0.067[ns]	-0.219*	-0.442 [ns]	0.039 [ns]	-0.316 [ns]
Ln HHH education	0.000 [ns]	-0.001 [ns]	-0.002 [ns]	0.080**	-0.052 [ns]
Ln HHH experience	0.075 [ns]	0.192***	0.284**	0.075 [ns]	0.162 [ns]
Ln Farm size	-0.032 [ns]	-0.062**	-0.101**	0.030 [ns]	0.048 [ns]
Ln Seed rate	-0.182 [ns]	-0.133 [ns]	-0.185 [ns]	-0.922***	-0.648***
Ln TFLC	0.366***	0.053 [ns]	0.219**	0.116 [ns]	0.090 [ns]
Ln THLC	-0.085**	-0.016 [ns]	-0.026**	-0.217***	-0.019 [ns]
Ln TMC	0.062 [ns]	0.185*	0.387**	0.039 [ns]	0.081 [ns]
Access to credit (credit=1, not credit=0)	0.149***	0.045 [ns]	0.111*	0.240***	0.057 [ns]
R^2	**0.582**	**0.434**	**0.663**	**0.696**	**0.343**
N	**30**	**50**	**30**	**30**	**50**

Note: [a] crop grown in 2014 (winter), [b] crop grown in 2015 (rain-fed)

***, ** and * are significant level at 1%, 5% and 10% level and ns is not significant.

TFLC= Total family labor cost, THLC= Total hired labor cost, TMC= Total material cost,

(N.C)= Non-contract farmers, (C)= Contract farmers, HHH= Household head

4.6 Strength, Weakness, Opportunity and Threat of Vegetable Supply Chain in the Study Area

A SWOT analysis was used to describe strengths, weaknesses, opportunities and threats of the vegetable supply chain. SWOT analysis was an acronym for "Strength, Weaknesses, Opportunities and Threats". SWOT analysis for the vegetable supply chain in Kalaw Township was identified as follows. The analysis of strengths and weaknesses was internal factors and usually based on an analysis of facts and assumptions on the market research findings. The opportunities and threats analysis was carried out by examining external factors such as internal weakness and strength of actors and external opportunities and threats were analyzed under categories of economic, social, technological, demographic and institutional themes.

4.6.1 Strength, weakness, opportunity and threat of non-contract farmers in cabbage and cauliflower production

Strength, weakness, opportunity and threat of cabbage and cauliflower production of non-contract farmers were shown in Table 4.24. Regarding to the strengths, sample farmers in the study area thought that price information availability by mobile phone asset, convenient growing and harvesting practices and availability of inputs at right time. Among the three strengths, most of the sample farmers (35%) responded they can get price information by mobile phone asset. Because, they usually connect with market intermediaries by mobile phone to know the crop prices for selling their products. About 15% of the non-contract farmers talked about convenient growing and harvesting practices. Because of the cabbage and cauliflower were not difficult to grow and easy to harvest the heads of the cabbage and the curds of the cauliflower by cutting with knife. The remaining 13% of the sample farmers expressed availability of inputs at right time because they can buy needed input easily in their villages.

Regarding to the weaknesses, non-contract farmers faced with not resistance pest and disease, ineffective chemical, low fertilizer quality, low access to high quality seed and limited capital investment. In these weaknesses, most of the non-contract farmers (34%) thought that the cultivated varieties were not resistance to pest and diseases, because of the serious problem of insect, pest and diseases for farmers in the study area year by year. Cabbage and cauliflower yield level was still low and the farmers need to access pest resistant varieties to increase their yield. About 27% of the non-contract farmers faced with limited capital investment. This was one of the problems in promoting

cabbage and cauliflower production. In the study area, non-contract farmers got insufficient amount of credit from MADB therefore they wanted to get the adequate credit amount for cabbage and cauliflower production. About 24% of the sample farmers considered ineffective chemical application because farmers used insecticides and fungicides with high concentration in controlling pest and disease. When the farmers used chemical successively, chemical was ineffective to pest and disease and causes pest and disease immune. Moreover, about 23% of the sample farmers answered low fertilizer quality. Therefore, non-contract farmers wanted to get high quality of fertilizer for increase their yield. The remaining 9% of the non-contract farmers assumed low access to high quality seed. Because, there was no market of the improved seed varieties in rural area and the training program about the quality seed was also needed for the selected farmers.

Among the opportunities, 37% of non-contract farmers expressed high demand of product because various actors in the vegetable supply chain received high demand for both local and export markets. About 12% of the sample farmers talked about market potential for domestic and the rest of 6% of the non-contract farmers thought that more value added potential because more dehydrated vegetable factories may be founded in future such as Myanmar Belle Dehydrated Vegetable Factory.

Non-contract farmers faced with three threats such as instable product price, summer drought and high interest rate on credit. About 46% of the non-contract farmers faced with instable product price. Because, non-contract farmers got the price depend on the quality of the products and the crops' prices fluctuate around the year based on the local supply. About 31% of the non-contract farmers expressed summer drought. Non-contract farmers in the study area did not have irrigation system and they totally relied on natural water sources such as natural precipitation, lake and stream. Therefore, they were not confident in producing cabbage and cauliflower due to uncertain weather conditions as both of these crops are very sensitive to growing condition. The remaining 24% of the non-contract farmers responded high interest rate on credit. Because of non-contract farmers received higher interest rate from cooperative and UNDP than the interest rate of MADB. So, most of the non-contract farmers were not saving money to invest the crop cultivation in the next season.

4.6.2 Strength, weakness, opportunity and threat of contract farmers in cabbage production

Table 4.25 mentioned that strength, weakness, opportunity and threat of cabbage production by contract farmers. In the study area, contract farmers thought that the four strengths such as price information availability by mobile phone asset, saving the time for selling, no transportation cost for selling and sufficient capital investment. Most of the sample farmers (53%) responded price information availability. Because, they usually connect with market intermediaries by mobile phone to know the crops price for selling their product. About 40% of the sample farmers expressed saving the time for selling. Because, Myanmar Belle Dehydrated Vegetable Factory bought the cabbage form contract farmers by their selves. Therefore, cabbage production by contract farmers had more saving the time than another farmer. The remaining 13% of the contract farmers answered no transportation cost for selling. They did not need to hire the transportation vehicle for selling the cabbage to Myanmar Belle Dehydrated Vegetable Factory because this factory bought the cabbage from farmers with the truck by it selves. The rest of 10% of the contract farmers thought that sufficient capital investment. Because of contract farmers could borrow from Myanmar Belle Dehydrated Vegetable Factory by 200,000 MMK per acre to purchase the farm yard manure and other inputs in time.

Among the weaknesses, contract farmers expressed not resistance pest and disease. Because of contract farmers used the chemical extremely for increasing cabbage yield. Therefore, pest and disease were resistance to the chemical fertilizer in the study area. About 40% of the contract farmers answered about low crop yield. Myanmar Belle Dehydrated Vegetable Factory trained about the contract farmers about the cultural practices for high cabbage yield but they did not apply correctly these practices. Therefore, the cabbage yield of contract farmers was lower than the non-contract farmers. The remaining 13% of the contract responded that low fertilizer quality.

Regarding to the opportunities, 76% of the contract farmers thought that availability of local and export market because various actors in the vegetable supply chain received a high demand for both local and export markets. About 40% of the sample farmers expressed more value added potential because contract farmers received high demand of the cabbage form Myanmar Belle Dehydrated Vegetable Factory to produce the dehydrated cabbage. About 23% of the sample farmers expressed crop price stability because they bonded with Myanmar Belle Dehydrated Vegetable Factory by using contract price when they sold their crops. The remaining 22% of the contract

farmers assumed market potential for domestic and export because Myanmar Belle Dehydrated Vegetable Factory transported the dehydrated cabbage to Korea and Japan.

According to the threats, contract farmers expressed summer drought. Because of contract farmers in the study area did not have advanced irrigation system and they totally relied on natural water access such as natural precipitation, lake and stream. About 8% of the contract farmers answered high cost of seed and fertilizer because when the contract farmers bought seed and fertilizer form the shop of near villages with high cost. The remaining 5% of the contract farmers had to pay high interest rate on credit. Because of contract farmers usually pay higher interest rate for credit of cooperative and UNDP.

4.6.3 Strength, weakness, opportunity and threat of market participants in cabbage and cauliflower marketing

When the market participants were interviewed about the strength, weakness, opportunity and threat of cabbage and cauliflower marketing, responded problems were indicated in Table 4.26. In the study area, market participants expressed two strengths such as price information availability by mobile phone asset and more mobile phone asset for improving communication. About 50% of the market participants responded about price information availability because they usually communicate with other township wholesalers personally and via mobile phone to exchange the crops price for buying from farmers and selling to other township market. The remaining 32% of the market participants expressed more mobile phone asset for improving communication. Market participants in the study area usually used the mobile phone because they do not need to meet to the other township wholesalers by persons to know the crop price. Therefore, they used the mobile phone day by day to know the crop price for transaction.

In the study area, market participants faced with three weaknesses. These were limited transportation vehicle, poor crop quality and limited capital investment. About 58% of the market participants faced with limited transportation vehicle during peak harvesting season. Most of the sample market participants did not possess the transportation vehicle. They needed to hire it with high price when they can’t get the transportation vehicle for transportation to the other township market at needed time. About 44% of the market participants expressed poor crop quality. When the market participants purchased the cabbage and cauliflower from the farmers, they didn’t satisfy for low quality of crops. Therefore, the price received was low in marketing when the

market participants selling the crops to the other market because of poor quality. The rest of 35% of the market participants responded limited capital investment. Most of the market participants needed more capital to invest in marketing.

Regarding to the opportunities, market participants thought that about high demand of product, high supply and market potential for domestic and export market. About (41%) of the sample market participants expressed high demand of product in local and other markets. About 35% of the market participants answered high supply because cabbage and cauliflower was essential crop for human in domestic and useful for salad and cooking. Many people bought the cabbage and cauliflower day by day therefore its supply was higher than the other crops. The remaining 24% of the sample market participants responded market potential for domestic and export. Therefore, farmers wanted to grow cabbage and cauliflower more than before due to high domestic and export demand.

Market participants faced with the three threats such as high transportation cost, fluctuate and low market price and frequently over supply then market demand. About 47% of the market participants expressed high transportation cost. Because of most of the market participants did not possess the vehicle for transportation. When they transport the crops to other towns in time, they needed to hire vehicle from other person with high cash down payment system. About 38% of the market participants answered about fluctuate and low market price. The crop prices fluctuated around the year based on the quality of the products and the crops according to the changing weather condition.

According to the SWOT analysis, non-contract and contract famers said that price information availability as strong strengths. As weaknesses, not resistance pest and disease was expressed. In the faced opportunities, availability of local and export market was the most potential. As threaten, summer drought was the worst condition in the study area. Regarding to the SWOT analysis, most of the market participants responded price information availability was major strength, limited transportation vehicle was serious weakness, high demand of product was main opportunity and high transportation cost was key factor in threats.

Table 4.24 SWOT analysis for percent of non-contract farmers

(N=100)

Strengths	Weaknesses
• Price information availability by mobile phone asset (35) • Convenient growing and harvesting practices (15) • Availability of inputs at right time (13)	• Not resistance pest and diseases (34) • Limited capital investment (27) • Ineffective chemical (24) • Low fertilizer quality (23) • Low access to high quality seed (9)
Opportunities	**Threats**
• High demand of product (37) • Market potential for domestic (12) • More value added potential (6)	• Instable product price (46) • Summer drought (31) • High interest rate on credit (24)

Note: Figures in the parenthesis represent percentage of the sample farmers.

Table 4.25 SWOT analysis for percent of contract farmers

(N=30)

Strengths	Weaknesses
• Price information availability by mobile phone asset (53) • Saving the time for selling (40) • No transportation cost for selling (13) • Sufficient capital investment (10)	• Not resistance pest and diseases (73) • Low crop yield (40) • Low fertilizer quality (13)
Opportunities	**Threats**
• Availability of local and export market (76) • More value added potential (40) • Crop price stability (23) • Market potential for domestic and export (22)	• Summer drought (77) • High cost of seed and fertilizer (8) • High interest rate on credit (5)

Note: Figures in the parentheses represent percentage of the market participants.

Table 4.26 SWOT analysis for percent of market participants

(N=34)

Strengths	**Weaknesses**
• Price information availability by mobile phone asset (50) • More mobile phone asset for improving communication (32)	• Limited transportation vehicle (58) • Poor crop quality (44) • Limited capital investment (35)
Opportunities	**Threats**
• High demand of product (41) • High supply (35) • Market potential for domestic and export (24)	• High transportation cost (47) • Fluctuate and low market price (38) • Frequently over supply than market demand (35)

Note: Figures in the parentheses represent percentage of the market participants.

CHAPTER V
CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion of the Study

Myanmar is an agricultural based country and depends on agriculture sector for raising the incomes of the rural poor and reducing poverty. Vegetable cultivation is the main strategy to reduce poverty and to overcome food security problems. Cabbage and cauliflower are the most popular vegetables cultivated in Kalaw Township. They are winter season crops and the best to grow them in a relatively cool temperature with a wet atmosphere. In this study, demographic characteristics, cultural practices, cost and benefit, marketing cost, margin and profit, cabbage and cauliflower supply chain, yield determinants of cabbage and cauliflower production, and constraints and challenges of non-contract farmers, contract farmers and market participants were studied.

In the case of demographic characteristics, the average age of the non-contract farmers were around 49 years old and contract farmers were around 44 years old. There were not many differences between average age of the non-contract and contract farmers in study areas. The non-contract farmers had 28.44 years farm experience in average while the contract farmers had more experience showing 20.13 farming years in average. This finding shows that the non-contract farmers were more educated than those contract farmers. Average farm size of non-contract farmers, lowland was 0.21 ha, upland was 2.10 ha and garden was 0.10 ha. The average farm size of contract farmers, lowland was 0.22 ha and upland was 2.33 ha. The majority of cultivated land types of both non-contract and contract farmers were upland. There were not significant different in age, farm size and family size between non-contract and contract farmers but there were significant different in farm experience, education and family labor. When comparing home assets, luxury assets such as DVD player, Television, mobile and motorcycle were not different in non-contract and contract farmers. Bicycle, solar, bullock cart, generator, saloon, battery and buffalo were more utilized in non-contract farmers compared with contract farmers.

Regarding the cultural practices, the most common cropping pattern of non-contract and contract farmers was other- cabbage or cauliflower- cabbage or cauliflower cropping pattern. The most popular seed brands of cabbage were “Crown” and “588”, and the most popular seed brands of cauliflower were “Red Arrow” and “Pan”. The average yield of winter cabbage obtained by non-contract farmers was higher than that of contract farmers. By comparison with winter and rain-fed cabbage production, the average yield of

rain-fed cabbage obtained by non-contract farmers was higher than that of winter cabbage yield obtained by non-contract farmers. In the study area, average rain-fed cabbage yield obtained by non-contract farmers was highest and average winter cabbage yield obtained by contract farmers was lowest. The average seed rate of winter and rain-fed cabbage production by non-contract and contract farmers was 0.24 kg/ha. The average seed rate of winter and rain-fed cauliflower production by non-contract farmers, was 0.13 kg/ha and 0.12 kg/ha. Non-contract farmers bought quality seed from the village (Myinmahti and Heho) and Aungban Town and contract farmers bought quality seed from Myanmar Belle Dehydrated Vegetable Factory. All of the non-contract and contract farmers applied FYM, urea, compound, plant hormone and insecticide. More or less non-contract and contract farmers used fungicide in cabbage and cauliflower production. Moreover, the majority of non-contract and contract farmers used compound fertilizer and applied FYM in the land preparation. Most of the non-contract farmers received credit mainly from MADB and contract farmers received credit mainly from both UNDP and Myanmar Belle Dehydrated Vegetable Factory. The major requirements of the sample farmers were credit needs and improved technology for agricultural development.

According to the cost and return analysis, total variable cost of winter cabbage production by non-contract farmers was higher than that of winter cabbage production by contract farmers additionally total gross benefit of non-contract farmers was higher due to the higher yield and the higher price received. In winter cabbage production, the benefit cost ratio of non-contract and contract farmers was 2.64 and 2.38, respectively. The benefit cost ratio of rain-fed cabbage production of non-contract farmers was 3.02 indicating that return per unit of capital invested was 2.02. Rain-fed cabbage production of non-contract farmers was more profitable than winter cabbage production of non-contract and contract farmers. In winter and rain-fed cauliflower production, the benefit cost ratio of the non-contract farmers was 3.01 and 3.55 indicating that return per unit of capital invested was 2.01 and 2.55. This means that farmers can earn profit about more than one unit from cabbage and cauliflower production if they invested a unit cash expense. Therefore, the results showed that rain-fed cabbage and cauliflower production was economically more attractive for farmers than winter cabbage and cauliflower production during the study period.

Among the market participants, the mean age of village collectors, commission men, township wholesalers were above 40 years old. However, the mean age of retailers was above 30 years old. Commission men had relatively more experience (24 years) than

village collectors (23 years), township wholesalers (22 years) and retailers (11 years). Mostly, village collectors and township wholesalers had 20 years of experience in cabbage and cauliflower marketing. However, most of the retailers had 10 years of experience in cabbage and cauliflower marketing. Most of the village collectors, commission men and township wholesalers obtained high school education level indicating that they had more considerable knowledge and decision along the supply chain than most of the retailers who were at secondary school level. All of the retailers and most of the village collectors, commission men and township wholesalers used cash down payment system in purchasing. The remaining village collectors, commission men and township wholesalers used received half of the cash down and credit, and use cash down payment system with commission fees, respectively. In selling, most of the village collectors and township wholesalers used only cash down payment system, all of the commission men used cash down payment system with commission fees and all of the retailers used only cash down payment system. As regard to the mode of transportation, all of the village collectors, commission men and township wholesalers used truck and retailers used tri-cycle.

Along the cabbage and cauliflower marketing channel, marketing agents including village collectors, commission men, township wholesalers (Aungban) and retailers have the main role in distributing products to consumers. According to the comparison of channel 1 and 2 cabbage and cauliflower, the profit received by village collectors in channel 1 was relatively higher than the channel 2. According to comparison of channel 3 and 4 cabbage and cauliflower, the profit received by commission men in channel 3 was relatively higher than channel 4. According to comparison of channel 5 and 6 cabbage and cauliflower, the profit received by township wholesalers in channel 5 was relatively higher than channel 6. According to comparison of channel 7 cabbage and cauliflower, the profit received by retailers in cauliflower was relatively higher than cabbage. When the percentage of profit among the market participants was calculated and compared, the township wholesalers and retailers got the higher achievement in the cabbage marketing channels. When the percentage of profit among the market participants was calculated and compared, the village collectors and retailers got the higher achievement in the cauliflower marketing channels than other participants.

Based on the findings, most of the non-contract farmers purchased the inputs such as seed, FYM, urea, compound, plant hormones, insecticides, and fungicides from the Myananda, Khonyarzar, Awba, Goldfish, Seinleimyae shops in the study area. In this

study, it was found that seven types of marketing channels. In the cabbage and cauliflower marketing channel, the main actor involved farmers, village collectors, commission men, township wholesalers and retailers. In the supply chain analysis, all of the non-contract farmers in the study area sold cabbage and cauliflower directly to village collectors, commission men, township wholesalers and retailers. The buyers of the products were mainly village collectors. Village collector traded 99% and 98% of the cabbage and cauliflower to Yangon, Toungoo, Mawlamyine, Pyinmana, Meiktila, Danyingon, Yamethin, Aungban, Myeik and Mandalay about 1% and 2% of the cabbage and cauliflower to township wholesalers (Aungban). Commission men traded 72% and 82% of the cabbage and cauliflower to Yangon, Mawlamyine, Aungban and Myeik. About 28% and 18% of cabbage and cauliflower directly sold to township wholesalers (Aungban). Most of the village collectors and commission men mainly traded the cabbage and cauliflower to Yangon. Township wholesalers traded 99% of the cabbage and cauliflower to Yangon, Toungoo, Mawlamyine, Pyinmana, Meiktila, Aungban, Kanyutkwin, Pyu, Thazi, Kyaikto, Nyaunglebin, Penwegon, Mandalay and Kyauktaga respectively and 1% of the cabbage and cauliflower to retailers. Township wholesalers mainly traded the cabbage and cauliflower from Aungban to Bago. Retailers mainly sold cabbage and cauliflower to their local market.

According to the regression analysis, the significant influencing factors of cabbage and cauliflower yield were household head's age, household head's education, household head's farm experience, farm size, seed rate, total family labor cost, total hired labor cost, total material cost and access to credit. Winter cabbage yield of non-contract farmers was positively influenced by total family labor cost and access to credit and negatively influenced by total hired labor cost respectively. Based on the results of the log linear regression analysis, rain-fed cabbage yield was positively affected by household head's farm experience and total material cost and it was negatively influenced by household head's age and farm size. Winter cabbage yield of contract farmer's regression analysis, cabbage yield was positively influenced by household head's farm experience, total family labor cost and total material cost and negatively influenced by farm size and total hired labor cost. Winter cauliflower yield of non-contract farmer's regression analysis, cauliflower yield was positively affected by household head's farming experience and negatively influenced by amount of seed and total hired labor cost. Rain-fed cauliflower yield of non-contract farmer's regression analysis, the significant influencing factor was amount of seed. Based on the result of the log linear regression

analysis, cauliflower yield was negatively affected by seed rate.

Internal and external factors of various actors were analyzed under categories of economic, social, technological, demographic and institutional themes. The internal factors include strengths and weaknesses, and external factors include opportunities and threats. Cabbage and cauliflower production and marketing of the various actors along the supply chain were faced the different problems. In the study area, sample farmers expressed six strengths such as price information availability by mobile phone asset, saving the time for selling, convenient growing and harvesting practices, availability of inputs at right time, no transportation cost for selling and sufficient capital investment. Regarding as the weaknesses, sample farmers faced with not resistance pest and diseases, low crop yield, limited capital investment, ineffective chemical, low fertilizer quality and low access to high quality seed. According to the opportunities, sample farmers answered availability of local and export market, more value added potential, high demand of product, crop price stability, market potential for domestic and export and more value added potential. The threats of sample farmers were summer drought, instable product price, high interest rate on credit and high cost of seed and fertilizer. The strengths of market participants were price information availability by mobile phone asset and more mobile phone asset for improving communication. The weaknesses of market participants were poor crop quality, limited capital investment and limited transportation vehicle. Regarding to the opportunities, market participants expressed high demand of product, high supply and market potential for domestic and export. Then, the threats of market participants were high transportation cost, fluctuate and low market price and frequently over supply than market demand.

5.2 Recommendations

In this study area, good quality seed is a necessary condition for the improvement in yields of cabbage and cauliflower production apart from other inputs like fertilizer, pesticide, etc. The cultivated seeds which produced from their own farms by using traditional method cause the poor quality of the crops produced and consequently, reduces the income and return of the cabbage and cauliflower farmers. Under this condition, it is urgently needed to develop seed industry through public private partnership and farmers' effort themselves to meet the growing demand for quality seed.

Technology dealing with crop production practices and management system was also important for farmers. Effective extension services to promote farmers' adoption to

improved varieties and appropriate technologies should be provided to get quality products. . In this case, government and private sector can take a leading role in promoting the adoption of improved seed varieties and better farm practices.

The SWOT analysis pointed out that the sampled farmers faced with drought in summer cabbage and cauliflower production. According to the insufficient water for cultivation, farmers cannot grow the crops in every season and faced with limited cultivation. Sample farmers in the study area did not have irrigation system and totally relied on natural water sources. Most of the sample farmers in this area could not produce cabbage and cauliflower in summer season. Therefore, the sample farmers should make drainage irrigation cannels in their fields by themselves to get sufficient water for increasing yield. If the regional governments can solve that problem, crop productivity will increase and the farmer will get more income from summer crops production.

Furthermore, availability of irrigation water supply plays as a key role to enhance per unit crop of cabbage and cauliflower for efficient crop production. The availability of adequate water resources for agriculture is essential for increased production. However, efficient use of this resource in the study area does not imply for large scale. Generally Kalaw Township depends solely on rain water for crop production and agricultural activities were limited in drought periods. Therefore, water saving system should be promoted.

The constraint analysis pointed out that the credit for farmers received from MADB are very low. This is necessary to improve access to credit. Major constraints on credit availability for farmers should be explored and the effective rural financing system collaborating with INGOs and government organizations such as MADB will be highly appreciated. Most of the non-contract farmers and contract farmers faced with insufficient capital investment for cabbage and cauliflower cultivation. There was low particular credit system for cabbage and cauliflower although sufficient credit availability was only for rice crop. Capital investment was one of the important constraints in promoting cabbage and cauliflower production. Insufficient capital was also a common problem therefore both private and public institutions need to provide credit especially for cabbage and cauliflower growers. Moreover, this analysis pointed out that the credit for farmers received high interest rate on credit from Cooperative and UNDP than the interest rate of MADB. Farmers wanted to improving access the credit amount and to reduce the interest rate. Both private and public institutions need to provide credit not only for farmers but also to marketing agents in order to facilitate procurement operations

and transportation investment. In the SWOT analysis, the advantages of the contract farmers were saving the time for selling, no transportation cost for selling and sufficient capital investment in time. Non-contract farmers did not receive these factors during the cultivation and selling period. Therefore, contract farming should be promoted for farmers to get higher benefit.

Based on the results, most of the sampled farmers faced with high production cost including high labor wages and input prices especially in peak season. There were capital constraints in crop production, and inputs especially quality seeds and fertilizers. The decision makers should pay attention to decrease inputs price in the agrochemical market. By doing this, farmer can use more fertilizers for getting higher crop yield and earns higher income from their crop production. Farm mechanization should be supported to farmers who were faced with labor scarcity in cabbage and cauliflower production. To get the maximum profit and income for the sampled farmers, it was required to reduce the total production cost by using machinery in the study areas.

Provision of market information was very important for cabbage and cauliflower market development. In the study area, price information was transmitted from township wholesalers to the farmers. Government should provide market information on different qualities of cabbage and cauliflower in domestic and international markets in timely not only for farmers but also for other market participants in cabbage and cauliflower marketing channels to decide rational decisions for sale. Media such as radio, newsletters and mobile communication should be used for transmission of price information in time.

In cabbage and cauliflower supply chain, efficiency of market participants including village collectors, commission men, township wholesalers and retailers can improve by reducing constraints on marketing facilities, market information, and credit, etc. Especially market participants faced with the highest marketing cost in payment for transportation. Therefore, both government and private sectors should participate to solve the constraints along the vegetable supply chain to be more active marketing transactions and to achieve higher benefit for market participants.

According to this study, most of the farmers who have more farm experience can produce more products. Therefore, advanced cultivation practices should be educated to the farmers to achieve higher income from their products and to raise their livelihoods.

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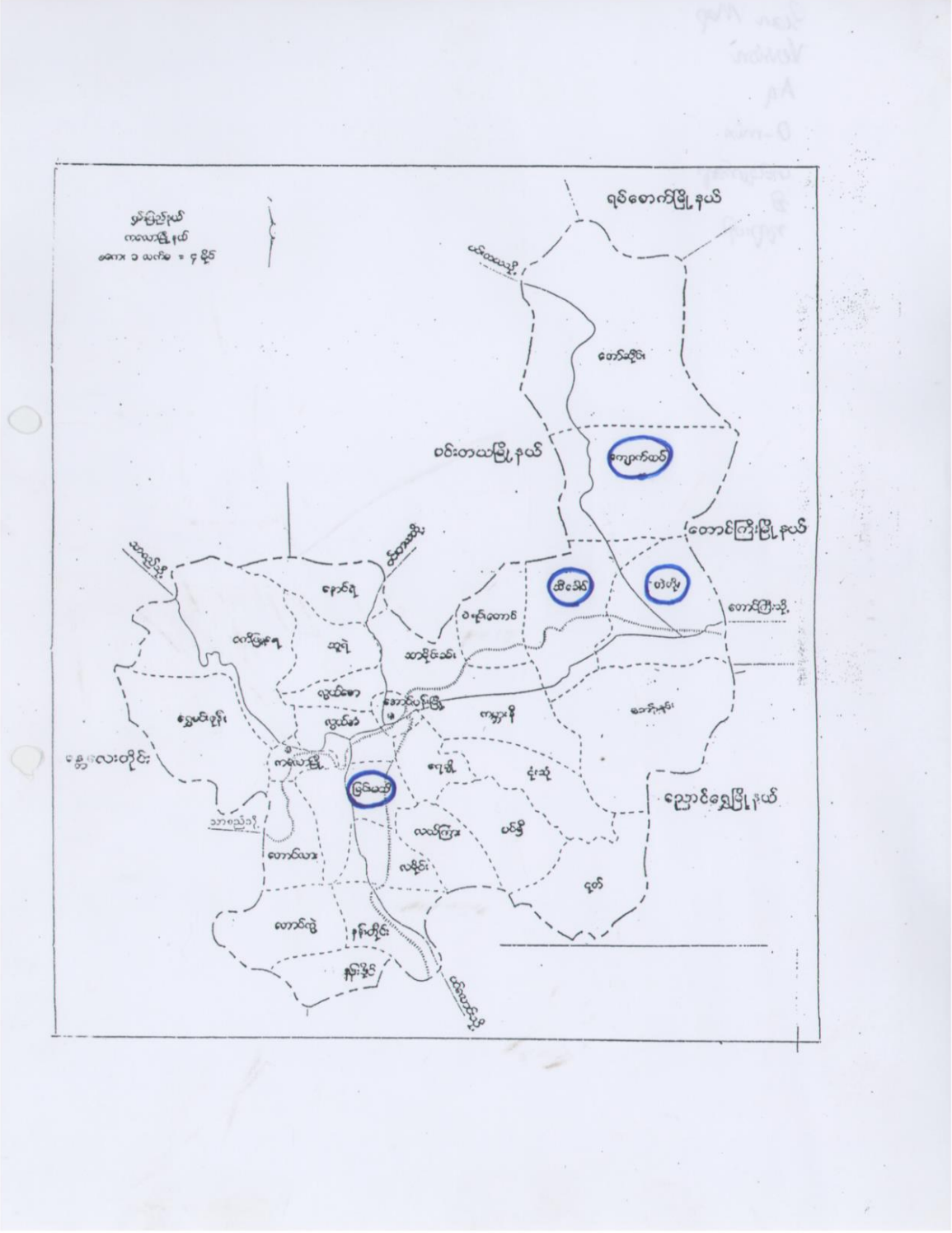
APPENDICES



Appendix 1 Map of Kalaw Township

Source: DoA, Kalaw, 2015

Appendix 2 Enterprise Budget of cabbage production for the non-contract and contract farmers (MMK/ha)

Item	Unit	Average value		
		(N.C)[a] (N=30)	(C)[a] (N=30)	(N.C)[b] (N= 50)
1. Total gross benefit	MMK/ha	**3,673,159**	**2,934,542**	**4,242,833**
Average yield	heads/ha	27,758	27,510	31,901
Average price	MMK/head	132	107	133
2. Variable Costs				
(a) Material Cost				
Seed	kg/ha	54,238	54,033	54,510
FYM	MT/ha	162,951	134,422	182,459
Urea	kg/ha	65,811	66,223	69,139
Compound	kg/ha	142,288	133,681	130,914
Plant Hormone	L/ha	34,854	16,902	21,470
Insecticides	L/ha	48,538	47,608	40,055
Fungicides	L/ha	42,213	30,105	36,082
Total Material Cost		**550,893**	**482,973**	**534,628**
(b)Family Labor Cost				
Plowing	MMK/ha	11,282	44,429	19,096
Harrowing	MMK/ha	14,803	18,977	13,398
Seedling	MMK/ha	13,768	18,714	19,185
Watering	MMK/ha	174,383	210,859	228,340
Seedling pull out	MMK/ha	11,297	19,504	21,982
Transplanting	MMK/ha	10,803	21,349	13,966
Weeding	MMK/ha	61,211	35,319	62,625
Fertilizer application	MMK/ha	59,234	53,505	63,099
Insecticide application	MMK/ha	89,088	64,839	90,794
Fungicide application	MMK/ha	61,211	21,349	64,523
Harvesting	MMK/ha	6,519	-	10,477
Transportation	MMK/ha	7,351	-	8,817
Total family labor cost		**520,951**	**508,846**	**616,302**
(c) Hired Labor Cost				
Plowing	MMK/ha	33,696	26,390	40,949
Harrowing	MMK/ha	7,102	1,318	7,146
Seedling	MMK/ha	6,948	1,581	2,530
Watering	MMK/ha	28,198	5,271	12,652
Seedling pull out	MMK/ha	8,925	5,271	5,110
Transplanting	MMK/ha	34,623	22,667	27,517
Weeding	MMK/ha	37,588	41,381	30,818
Fertilizer application	MMK/ha	45,619	49,815	29,889
Insecticide application	MMK/ha	30,175	54,197	32,084

Fungicide application	MMK/ha	26,716	10,526	14,866
Harvesting	MMK/ha	784,860	-	1,898
Transportation	MMK/ha	27,334	-	26,079
Total Hired Labor Cost		**294,773**	**218,420**	**231,538**
(d) Interest on cash cost				
Material cost	MMK/ha	16,527	14,489	16,039
Hired labor cost	MMK/ha	8,843	6,553	6,946
Interest on cash cost		**25,370**	**21,042**	**22,985**
3.Total Variable cost	MMK/ha	1,391,986	1,231,281	1,405,453
4.Total Variable cash cost	MMK/ha	871,036	722,435	789,151
5.Return above variable cost	MMK/ha	2,281,173	1,703,261	2,837,380
6.Return above variable cash cost	MMK/ha	2,802,124	2,212,107	3,453,682
7.Benefit cost ratio	MMK/ha	2.64	2.38	3.02
8.Break- even yield	Heads/ha	10,519	11,543	10,567
9.Break- even price	MMK/head	50	45	44

Note: (N.C) = Non-contract farmers, (C)= Contract farmers

Appendix 3 Enterprise Budget of cauliflower production for the non-contract farmers (MMK/ha)

Item	Unit	Average value	
		(N.C)[a] (N=30)	(N.C)[b] (N= 50)
1. Total gross benefit	MMK/ha	**4,203,252**	**4,653,105**
Average yield	Curds/ha	25,946	25,995
Average price	MMK/curd	162	179
2. Variable Costs			
(a) Material Cost			
Seed	kg/ha	67,854	68,963
FYM	MT/ha	211,257	172,092
Urea	kg/ha	74,937	68,420
Compound	kg/ha	149,420	128,741
Plant Hormone	L/ha	20,443	20,437
Insecticides	L/ha	34,296	33,358
Fungicides	L/ha	39,364	30,756
Total Material Cost		**597,572**	**522,767**
(b)Family Labor Cost			
Plowing	MMK/ha	16,243	7,067
Harrowing	MMK/ha	20,559	22,990
Seedling	MMK/ha	19,636	20,242
Watering	MMK/ha	113,851	20,406
Seedling pull out	MMK/ha	20,971	20,401
Transplanting	MMK/ha	18,104	18,028
Weeding	MMK/ha	55,960	64,602
Fertilizer application	MMK/ha	63,142	71,007
Insecticide application	MMK/ha	74,212	80,653
Fungicide application	MMK/ha	45,779	48,867
Harvesting	MMK/ha	11,745	1,128
Transportation	MMK/ha	99,001	9,588
Total family labor cost		**559,204**	**578,679**
(c) Hired Labor Cost			
Plowing	MMK/ha	29,784	31,041
Harrowing	MMK/ha	3,591	2,155
Seedling	MMK/ha	4,580	1,291
Watering	MMK/ha	31,629	22,931
Seedling pull out	MMK/ha	6,260	4,744
Transplanting	MMK/ha	25,976	23,247
Weeding	MMK/ha	25,369	21,666
Fertilizer application	MMK/ha	22,239	26,885

Insecticide application	MMK/ha	22,600	18,345
Fungicide application	MMK/ha	15,000	9,805
Harvesting	MMK/ha	2,586	1,107
Transportation	MMK/ha	26,896	24,690
Total Hired Labor Cost		**216,510**	**187,906**
(d) Interest on cash cost			
Material cost	MMK/ha	17,927	15,683
Hired labor cost	MMK/ha	6,495	5,637
Interest on cash cost		**24,422**	**21,320**
3.Total Variable cost	MMK/ha	1,397,708	1,310,672
4.Total Variable cash cost	MMK/ha	1,181,198	731,993
5.Return above variable cost	MMK/ha	2,805,544	3,342,433
6.Return above variable cash cost	MMK/ha	3,022,054	3,921,112
7.Benefit cost ratio	MMK/ha	3.01	3.55
8.Break- even yield	Curds/ha	8,628	7,322
9.Break- even price	MMK/curd	54	50

Note: (N.C)= Non-contract farmers

Appendix 4 Mean values of dependent and independent variables of winter cabbage yield function

Variables	Mean	Range	SD
Cabbage yield (Heads/ha)	27,758	22,239-37,065	3,638.17
Household head's age (year)	49	28-66	11.17
Household head's education (year)	5	1-11	3.12
Household head's farm experience (year)	26	7-46	10.45
Farm size (No.)	1.91	0.41-6.07	1.36
Seed rate (kg/ha)	0.25	0.12-0.25	0.02
Total family labor cost (MMK/ha)	520,950	212,000-874,981	140,037
Total hired labor cost (MMK/ha)	294,772	46,949-963,000	208,442
Total material cost (MMK/ha)	550,893	429,391-708,504	69,802
N		**30**	

Appendix 5 Determinants of winter cabbage yield by the non-contract farmers

Independent variable	Unstandardized Coefficients B	Standardized Coefficients Beta	t	Sig.
(Constant)	3.739*		1.843	0.080
Ln Household head's age	0.067 ns	0.132	0.220	0.828
Ln Household head's education	0.000 ns	0.003	0.015	0.988
Ln Household head's farm experience	0.075 ns	0.306	0.512	0.614
Ln Farm size	-0.032 ns	-0.158	-1.016	0.322
Ln Seed rate	-0.182 ns	-0.189	-1.093	0.288
Ln Total family labor cost	0.366***	0.778	4.143	0.001
Ln Total hired labor cost	-0.085**	-0.451	-2.459	0.023
Ln Total material cost	0.062ns	0.167	1.020	0.320
Credit (credit=1, not credit=0)	0.149***	0.567	2.889	0.009

R^2= 0.582

Note: ***, ** and * are significant level at 1%, 5% and 10% level and ns= not significant

Appendix 6 Mean values of dependent and independent variables of winter cauliflower yield function

Variables	Mean	Range	SD
Cabbage yield (Heads/ha)	25,945	19,768-37,065	5,496
Household head's age (year)	50	32-72	12.07
Household head's education (year)	6	1-15	3.52
Household head's farm experience (year)	29	10-50	12.10
Farm size (No.)	2.21	0.41-9.31	1.98
Seed rate (kg/ha)	0.13	0.09-0.15	0.02
Total family labor cost (MMK/ha)	559,204	300,474-814,442	144,719
Total hired labor cost (MMK/ha)	216,509	70,176-342,975	74,585
Total material cost (MMK/ha)	597,572	469,136-783,307	88,488
N		**30**	

Appendix 7 Determinants of winter cauliflower yield by the non-contract farmers

Independent variable	Unstandardized Coefficients B	Standardized Coefficients Beta	t	Sig.
(Constant)	11.583***		4.527	0.000
Ln Household head's age	0.039 ^{ns}	0.059	0.101	0.920
Ln Household head's education	0.080**	0.378	2.304	0.032
Ln Household head's farm experience	0.075 ^{ns}	0.212	0.345	0.734
Ln Farm size	0.030 ^{ns}	0.137	0.984	0.336
Ln Seed rate	-0.922***	-0.643	-3.384	0.003
Ln Total family labor cost	0.116 ^{ns}	0.190	1.265	0.220
Ln Total hired labor cost	-0.217***	-0.521	-3.656	0.001
Ln Total material cost	0.039 ^{ns}	0.035	0.243	0.810
Credit (credit=1, not credit=0)	0.240***	0.699	4.783	0.000

R^2= 0.696

Note: ***, ** and * are significant level at 1%, 5% and 10% level and ns= not significant

Appendix 8 Mean values of dependent and independent variables of rain-fed cabbage yield function

Variables	Mean	Range	SD
Cabbage yield (Heads/ha)	31,901	22,239-37,065	3,733.21
Household head's age (year)	49	28-77	11
Household head's education (year)	5	1-15	3.52
Household head's farm experience (year)	26	7-46	11.60
Farm size (No.)	2.27	0.41-9.31	1.81
Seed rate (kg/ha)	0.24	0.12-0.25	0.03
Total family labor cost (MMK/ha)	616,302	316,288-1282,400	197,686
Total hired labor cost (MMK/ha)	231,537	49,420-576,237	123,020
Total material cost (MMK/ha)	534,628	410,433-736,358	79,738
N		**50**	

Appendix 9 Determinants of rain-fed cabbage yield by the non-contract farmers

Independent variable	Unstandardized Coefficients B	Standardized Coefficients Beta	t	Sig.
(Constant)	8.480***		5.400	0.000
Ln Household head's age	-0.219*	-0.442	-1.849	0.072
Ln Household head's education	-0.001 ^{ns}	-0.009	-0.058	0.954
Ln Household head's farm experience	0.192***	0.845	3.372	0.002
Ln Farm size	-0.062**	-0.372	-2.936	0.005
Ln Seed rate	-0.133 ^{ns}	-0.188	-1.366	0.180
Ln Total family labor cost	0.053 ^{ns}	0.127	0.967	0.339
Ln Total hired labor cost	-0.016 ^{ns}	-0.078	-0.637	0.528
Ln Total material cost	0.185*	0.227	1.732	0.091
Credit (credit=1, not credit=0)	0.045 ^{ns}	0.159	1.277	0.209

R^2= 0.434

Note: ***, ** and * are significant level at 1%, 5% and 10% level and ns= not significant

Appendix 10 Mean values of dependent and independent variables of rain-fed cauliflower yield function

Variables	Mean	Range	SD
Cabbage yield (Heads/ha)	25,995	14,815-37,037	5,093.40
Household head's age (year)	49	32-72	10.97
Household head's education (year)	6	1-15	3.20
Household head's farm experience (year)	26	7-50	11.02
Farm size (No.)	2.38	0.41-9.31	1.89
Seed rate (kg/ha)	0.12	0.09-0.15	0.01
Total family labor cost (MMK/ha)	578,678	331,114-869,298	133,453
Total hired labor cost (MMK/ha)	187,906	23,722-371,144	93,655
Total material cost (MMK/ha)	522,767	325,432-603,395	72,313
N		**50**	

Appendix 11 Determinants of rain-fed cauliflower yield by the non-contract farmers

Independent variable	Unstandardized Coefficients B	Standardized Coefficients Beta	t	Sig.
(Constant)	7.565*		2.268	0.029
Ln Household head's age	-0.316 ^{ns}	-0.362	-1.110	0.274
Ln Household head's education	-0.052 ^{ns}	-0.184	-1.244	0.221
Ln Household head's farm experience	0.162 ^{ns}	0.397	1.229	0.226
Ln Farm size	0.048 ^{ns}	0.171	1.284	0.207
Ln Seed rate	-0.648***	-0.447	-3.053	0.004
Ln Total family labor cost	0.090 ^{ns}	0.089	0.624	0.536
Ln Total hired labor cost	-0.019 ^{ns}	-0.077	-0.539	0.593
Ln Total material cost	0.0281^{ns}	0.018	0.123	0.903
Credit (credit=1, not credit=0)	0.057^{ns}	0.103	0.770	0.446

R^2= 0.343

Note: ***, ** and * are significant level at 1%, 5% and 10% level and ns= not significant

Appendix 12 Mean values of dependent and independent variables of winter cabbage yield function

Variables	Mean	Range	SD
Cabbage yield (Heads/ha)	27,510	17,297-37,065	4,242.01
Household head's age (year)	44	28-63	10.14
Household head's education (year)	6	1-11	3.82
Household head's farm experience (year)	23	7-40	10.24
Farm size (No.)	2.58	0.41-8.09	2.13
Seed rate (kg/ha)	0.24	0.12-0.25	0.03
Total family labor cost (MMK/ha)	508,845	134,422-751,184	129,131
Total hired labor cost (MMK/ha)	218,419	0.00-553,504	112,157
Total material cost (MMK/ha)	482,973	348,411-877,205	96,527
N		**30**	

Appendix 13 Determinants of winter cabbage yield by the contract farmers

Independent variables	Unstandardized Coefficients B	Standardized Coefficients Beta	t	Sig.
(Constant)	8.236***		3.201	0.004
Ln Household head's age	-0.442 ^{ns}	-0.640	-1.340	0.195
Ln Household head's education	-0.002 ^{ns}	-0.013	-0.072	0.944
Ln Household head's farm experience	0.284**	0.908	2.115	0.047
Ln Farm size	-0.101**	-0.472	-2.520	0.020
Ln Seed rate	-0.185 ^{ns}	-0.202	-1.033	0.314
Ln Total family labor cost	0.219**	0.434	2.699	0.014
Ln Total hired labor cost	-0.026**	-0.369	-2.497	0.021
Ln Total material cost	0.387**	0.418	2.488	0.022
Credit (credit=1, not credit=0)	0.111*	0.309	1.917	0.070

R^2= 0.663

Note: ***, ** and * are significant level at 1%, 5% and 10% level and ns= not significant

Appendix 14 Summary production function of yield for cabbage production of non-contract farmers

Dependent variable / Independent variables	Yield		
	(N.C)[a] (N=16)	**(C)[a] (N=30)**	**(N.C)[b] (N=50)**
Household head's age	**ns (+)**	***** (-)**	**ns (-)**
Household head's education	**ns (+)**	**ns (-)**	**ns (-)**
Household head's farm experience	**ns (+)**	******* (+)**	******** (+)**
Sown area	**ns (-)**	******** (-)**	******** (-)**
Seed rate	**ns (-)**	**ns (-)**	**ns (-)**
Total family labor cost	******* (+)**	**ns (+)**	******** (+)**
Total hired labor cost	******** (-)**	**ns (-)**	******** (-)**
Total material cost	**ns (+)**	***** (+)**	******** (+)**
Access to credit	******* (+)**	**ns (+)**	***** (+)**

Note: (N.C)= Non-contract farmers, (C)= Contract farmers

Appendix 15 Summary production function of yield for cauliflower production of non-contract farmers

Dependent variable / Independent variables	Yield	
	(N.C)[a] (N=10)	**(N.C)[b] (N=50)**
Household head's age	**ns (+)**	**ns (-)**
Household head's education	******** (+)**	**ns (-)**
Household head's farm experience	**ns (+)**	**ns (+)**
Sown area	**ns (+)**	**ns (+)**
Seed rate	******* (-)**	******* (-)**
Total family labor cost	**ns (+)**	**ns (+)**
Total hired labor cost	******* (-)**	**ns (-)**
Total material cost	**ns (+)**	**ns (+)**
Access to credit	******* (+)**	**ns (+)**

Note: (N.C)= Non-contract farmers, (C)= Contract farmers