UNIVERSITY OF CO-OPERATIVE AND MANAGEMENT, SAGAING

DEPARTMENT OF STATISTICS

MASTER OF APPLIED STATISTICS

A STUDY ON PADDY PRODUCTION MODELS OF THA LONE VILLAGE, SHWEBO TOWNSHIP

NAN YU MON

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This thesis is submitted to the Board of Examiners in partial fulfillment of the requirement for the degree of Master of Applied Statistics.

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ACCEPTANCE

This is to certify that this paper entitled "**A Study on Paddy Production Models of Tha Lone Village, Shwebo Township**" submitted as a partial fulfillment towards the degree of Master of Applied Statistics has been accepted by Board of Examiners.

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ABSTRACT

The main objective of this study is to analyze the effect of input factors that affecting production of rice farming by using Cobb-Douglas production function in Tha Lone village, Shwebo township. This function is fitted for the relation between a dependent variable such as rice production and set of independent variables such as land, labour and capital. Simple random sampling was used for primary data collection from 304 rice farmers. Descriptive statistics using percentage and frequency tables were used to study the socio- economic characteristics of the rice farmers. According to the results, gender distribution can be found that the number of male paddy farmers is larger than that of female. Most of paddy farmers lie between the age of 57 year to 65 years and have between 4 to 6 family members. Most of the household heads are monastic educational level and own less than 10 acres. Income of rice farmers per month is 100,000 Kyats and 1150,000 Kyats. Twenty seven percent of rice farmers invest between 1,400,000 Kyats and 2,100,000 Kyats. Most of paddy farmers have between 1 and 3 family labour. The largest number of paddy production is under 1000 baskets. Based on the Cobb-Douglas production function, overall goodness of model was revealed from coefficient of determination R^2 is 0.659 and F- statistics is 193.589. Findings from the study indicate that land and capital were positively and significantly related at 1% and 5% level while labour was positive and significant related to rice production in Tha Lone village. It exists constant to scale but its value would increase after efficient use of all inputs. In Multiple regression analysis, the log of monthly expenditure, Climate/ weather condition, rain total yield and capital difficulty are statistically significant. This paper suggests that to promote the yield of rice and farm income, farmer should use good quality seed and crop diversification system.

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LIST OF ABBREVIATIONS

ANOVA	Analysis of Variance
CES	Constant Elasticity of Substitution
DAR	Department of Agricultural Research
DOA	Department of Agriculture
EHS	Environment, Health, and Safety
EU	European Union
FAO	Food and Agriculture Organization
FY	Fiscal Year
GAP	Good Agricultural Practice
GDP	Gross Domestic Product
IFPRI	International Food Policy Rice Institution
IRRI	International Rice Research Institute
MAS	Myanmar Agriculture Services
MOALI	Ministry of Agriculture, Livestock and Irrigation
NGOs	Non-Government Organizations
OLS	Ordinary Least Square
SME	Small and Median Enterprise
SPSS	Statistical Package for the Social Sciences
USAID	United States Agency for International Development
VIF	Variance Inflation Factor

CHAPTER 1
INTRODUCTION

Paddy is an important economic crop because it is the staple food crop for all levels of a large part of the world’s human population, especially in Asia. The crop is highly cherished and consumed daily. The demand for paddy in the country had been soaring and the rising demand was partly as a result of increased income levels, rapid urbanization, and the associated change in occupational structure. It is significantly impact on the country’s food security. Paddy is cultivated in more than a hundred country with a total cultivated area in 2020 of approximately 182 million hectares by producing more than 700 million tons annually.

Paddy is by far the most economically important food crop in many developing countries, providing two thirds of the calorie’s intake of more than 3 billion people in Asia, and one third of the calorie’s intake of nearly 1.5 billion people in Africa and Latin America (FAO, 1995a). Recently, in several developed countries such as North America and European Union (EU), paddy consumption has increased due to caption and immigration.

Paddy production is geographically concentrated in Western and Eastern Asia. Asian countries such as China, India, Vietnam, Indonesia, and Bangladesh are the biggest paddy producers, accounting for 92% of the world's production and consumption of paddy. The main challenge for paddy research and development in the world which includes improvement of the small farmers’ welfare and rural employment on a sustainable and economic basis is to find ways and means to produce more food for the fast-growing population with limited land, less labour, less water and even fewer chemical inputs as well as to improve.

At 676,552 km^2 the Union of Myanmar is the largest country in Southeast Asia. Myanmar is an agricultural country that country’s economy mainly depends on exporting agricultural products to other countries. Nowadays, the government is planning to improve the agricultural sector by laying down the economic policies. As the development of agricultural sectors, implementing the availability of sufficient edible crops for the increasing population plays an important role. Paddy is commercially important and widely grown vegetable crops in the world.

Therefore, efficient paddy production would give more income and export revenue for the country because paddy production alone accounted about 35% of the total crop area in Myanmar. It would in turn allow Myanmar to make an essential step for construction of a developed country through reducing poverty, improving food security for all farms, fostering a more dynamic rural sector and making agriculture as a dynamic contributor to the national economy. Surely, all of these outcomes will be achieved only after framing and executing more effective policies at the sectorial and national levels.

Agriculture in Myanmar, dominated by paddy cultivation, generates a direct or indirect economic livelihood for over 75% of the population. Given that 70% of Myanmar's population lives in rural areas and most of people engages in paddy farming for the livelihoods in agriculture, increasing rural farmers' income is imperative for eradicating rural poverty in Myanmar. Paddy is grown throughout the country by resource poor rural farmers and landless agricultural laborers on small farms averaging only 2.3 ha in size.

Myanmar government is recently trying to increase agricultural productivity and employment to achieve economic development for farmers and to alleviate poverty through various schemes such as micro-credit program, increased agricultural loan, establishing small cooperative groups, encouraging to use prescribed package technology, and etc. However, agricultural growth should be linked to farm profits. Considerable research for agricultural efficiency in the country is still very weak. Agricultural efficiency is gaining attention in the light of agricultural market liberalization and Myanmar currency appreciation.

Given the market reforms, the reduction or removal of subsidies on agricultural inputs such as fertilizer, or various other inputs tends to increase the cost of those inputs to farmers. And new technology package brings additional cost of production for farmers. The agricultural output and productivity can be increased by encouraging using those recommended technology. The profit for farmers are not considered. Policy makers think the profit will be increased if there will be an increased physical production.

And little attention was paid on the relationships among market indicators, household characteristics, and production efficiency particularly during this unfolding process of agricultural and market reform. Those decision makers can better implement reform measures contributing to enhancing agricultural efficiency in which how production efficiency is affected by market indicators and household characteristics. If agricultural households are integrated with output and input markets under the market reform process, then profit maximization becomes an economic goal.

Myanmar is still lag behind in modern agricultural production, especially in the application of farm mechanization. The use of modern agricultural mechanical tools in paddy production will raise productivity, reduce the processing time, and bring about the economy of scale. Mechanization not only increases land and labor productivity, but reduce the need for human and animal labor. At present, agricultural production is more or less traditional in Myanmar. Modernization and development of agricultural sector require the efficient use of farm mechanization tools.

1.1 Rationale of the Study

Myanmar is suffering from a lack of food production, especially paddy production. According to a study conducted on several factors, issues, challenges, and problems affecting Myanmar's paddy cultivation. Furthermore, the paddy industry in Myanmar faces several challenges, including land competition, because urbanization and the expansion of other industrial projects caused a decline in soil fertility because of the use of numerous chemical fertilizers. Besides, land for agricultural activities is limited, caused by the opening of unsustainable forest areas that will damage the environment, especially water pollution occurs.

Myanmar has a traditional agricultural economy based on paddy production. Paddy is the dominant crop in the agriculture sector due to its being a staple food of the people of Myanmar and a major export commodity. Myanmar is the world’s sixth-largest paddy-exporting country. Paddy production contributed nearly 80 per cent to the total value of agricultural produce in 2010 (ADB, 2013). Moreover, 75 per cent of people living in rural areas are primarily engaged in the agriculture sector. Paddy production employs the highest percentage of workers accounting for 61 per cent of the total labour force in rural areas (Kyaw, 2009). Paddy Most agricultural activities globally use freshwater resources to get higher quality for their crops (Firdaus, Leong Tan, Rahmat, & Senevi Gunaratne, 2020). Paddy farming is plagued by infrastructure challenges, contributing to the crop's poor performance production, therefore, still plays an important role in Myanmar’s economy.

As Myanmar grows more paddy than it consumes, the surplus in paddy production helps ensure national food security. The food security of the country is generally achieved by self-sufficiency at the national level (Shwe and Hlaing, 2011). However, like many other developing countries, Myanmar's growing population is increasingly challenging its food security goals: the population is growing at an average annual growth rate of 1.1 percent (Agricultural Extension Division, 2013). This growing population is increasing the domestic consumption of paddy (Kubo & Purevdorj, n.d.). Furthermore, paddy production's low and higher production cost efficiency also influences 'farmers' income. This is because technology usage in the paddy industry remains low because small-scale producers tend towards traditional farming due to insufficient financial support and education. In addition, an investor lacks interest in increasing financial support and developing the best product due to the low-profit perceptions and high risk for investors.

Although one fourth of total area of the country is cultivable land, presently there are only about 20 million acres of net sown area in Myanmar. Most of Agricultural lands are currently cultivated by small scale farmers. The average size of holdings is 5.6 acres and most of the farmers in Myanmar owns lands from 5 acres to 10 acres. In recent situation, the cost of land preparation and cultivation is rather high and productivity is low. For flooded area and deep-water areas, the cost of land preparation is much higher.

Land preparation is very important to get high yield from paddy. In Myanmar, the utilization of farm machineries in land preparation and cultivation is very low in percentage compare to other paddy producing and exporting countries. Most of the farmers are still using manpower and draught cattle. Therefore, Government tried to change from manpower to farm machineries in agriculture. However, it was not completed successfully due to lack of experience.

In accordance with poor knowledge and practice in selection of certified seed, Private-Public sector needs to provide high-yielding varieties and help to upgrade the quality through research and development for small scale farmers. Government also needs to supply technical and financial support in seed breeding process, biotechnology and genetic engineering. There also need to review the existing seed law, rules and regulation. To develop in the area of land preparation, selection of seeds and cultivation, it is important to transfer high technology to farmers through agricultural extension regarding crop cultivation practices, appropriate cropping patterns, provision and proper utilization of agricultural inputs and systematic plant protection practices.

In accordance with high cost of agricultural inputs and lack of microfinance laws, rules and regulations, farmers cannot overcome from debt cycle and increasing rural debt. The cost of agricultural inputs in Myanmar is about minimum 100,000 kyat per acre. If natural disaster such as flooding and untimely rains occurs in agricultural areas, small holder farmers get very low yield and cannot cover the cost of agricultural inputs. Then, paddy in Myanmar is not stable and much fluctuated depending on market demands.

Therefore, farmers are reluctant to grow paddy to a larger scale. In order to support farmers to prevent these adverse effects, government needs to provide strong rural credit insurance schemes for paddy specialization companies, microfinance organizations and also need to support special working capital to small holder farmers. Various credit packages should be introduced to incentivize farmers to produce seeds, to grow high quality and high yield varieties, to provide high quality fertilizers and to do land preparation for mechanization etc.

Usual pattern of paddy in the country is that the paddy is low in the harvesting months of November, December and January and it becomes higher in later months when there is no paddy in the farmers' hand. This paddy pattern prevails for many years in the country and government did not intervene previously. Farmers cannot hold paddy for a long time and want to sell it as quickly as possible to pay loans back and to invest money for another crop. Therefore, Farmers have to sell paddy with low paddy.

As earnings from paddy are much lower than the expectations farmers do not rely much on this crop. Thus, farmers' interest changed to another crop and paddy production is lower. With the advent of change of policy country introduces a scheme of buying paddy from farmers in 2012 for stabilizing paddy and boosting export of paddy. As the scheme is able to attain a good progress, the paddy of paddy is much higher than previous years and farmers can raise earnings from paddy production.

Myanmar was the largest exporter of paddy in the world before 1960. With the change of government policy and management quality on agriculture sector, Myanmar paddy export becomes the lowest among the paddy exporting countries within five decades. It had also been tried very hard to be sufficient on paddy for even domestic use under centralized economic policies. Now the new government amends economic policy on paddy production, storage and marketing. A number of reforms have been introduced in agricultural sector with encouragement of improved agricultural methods, mechanization, the right use of insecticides and fertilizers.

Most of the agricultural reforms have started recently and it needs support from within and outside of the country. If the right steps can be taken in agricultural sector, Myanmar will be a key country contributing sufficiency of food in the world. This research attempts to increase efficiency by identifying the critical factors affecting paddy production efficiency in Myanmar at the national and household levels. This research may contribute to a better understanding of the variables affecting paddy output in Myanmar.

The business people formed a coalition to reclaim their paddy and lay claim that the premium brand that city dwellers had been enjoying was Shwebo Paw San. Shwebo Paw San is now the market leader and most preferred paddy in Yangon, commanding a higher ppaddy domestically than other premium paddy varieties (e.g., Jasmine and Basmati) abroad. Though it has won an international award for its good taste, its lack of quality consistency, and implementation of Environment, Health, and Safety (EHS) standards pose challenges to exporting it internationally

Paw San Wei from Shwebo eaten by roughly fifty percent of the population is the premium paddy of choice across Myanmar. However, Shwebo as a region is relatively new to paddy production. Located in Myanmar's Dry Zone, the region has only been able to produce paddy paddies since the recent building of a nearby dam and irrigation canal system. So how did this type of paddy, in its infancy, gain supremacy over Paw San from Ayeyarwady, where it has been grown for decades? The rise of this variety's popularity reflects important national and social events over the last two decades of Myanmar's history.

Farmers in Shwebo grew Paw San Wei for years prior to its gaining national popularity. Because of Paw San's high yield as paddy and attractive taste and smell, as paddy spread, farmers began growing it in villages across Shwebo. However, its soft texture was not appealing to the palette of Shwebo residents, who preferred tougher variety of paddy, such as the region's historically produced Ma Naw Thu Kha. Further, farmers and traders in Shwebo were generally unaware of the Paw San variety's popularity in lower Myanmar, rendering the paddy stagnant in the market and creating a year-over-year surplus of Shwebo Paw San inside the warehouses of paddy mills and traders.

Problems faced by paddy farmers in Shwebo township at this moment include capital limitation, also low profit caused by inefficient production factor allocation particularly in fertilizer production factor under suggestion and average in pesticides input utilization that tend to be excessive. This has caused production cost for farmer become quite large. High production cost would reduce farmer's profit. Through management refinement, such as production factors reorganization, it is expected that input utilization efficiency could improve thus farmer's profit from paddy farming could also increasing. One way to bring about increased agricultural production and productivity is introduction of improved technology and Agricultural research.

Tha Lone's agricultural sector represents a small, but vital component of Tha Lone's economy. Shwebo farmers, especially those in Tha Lone village, have prospered from the grain's popularity. Over the past several decades agriculture's role in the economy has been heavily influenced by Tha Lone's involvement in political condition and by varying degrees of government efforts to promote or control agricultural production.

Therefore, this study would be helped the farmers for earning money and increasing farm income from the cultivation of paddy crop which gives continuous higher income by maintaining irrigation facilities and financial facilities. The cultivation of paddy crop engages farmers, family labour and hire labour. It supplies food stuff to his family and provide the better utilization of land, labour, and capital. In addition to this it reduces pressure on cereal as well as it gives a much higher return.

1.2 Objectives of the Study

The objectives of the study are;

1. to study the socio-economic factors of paddy-farmers in Tha Lone village
2. to analyze the effect of input factors that affecting production of paddy farming
3. to determine the types of return to scale of paddy production

1.3 Methods of Study

Both primary and secondary data were applied in this study. The total households in Tha Lone village are 910 households. Among them, 650 households in Tha Lone village grow paddy. The paddy farmers 304 households are collected to analyze the effect of input factors that affecting production of paddy farming by using simple random sampling method with questionnaire interview. In this paper, descriptive statistics is applied for the analysis of data using simple statistical tools like average and percentages. The Cobb-Douglas production function and multiple regression analysis were applied to analyze the paddy production of Tha Lone village, Shwebo township.

1.4 Scope and Limitations of the Study

In this study, the analysis is based on primary data and it was collected from the Tha Lone village. The 650 households in Tha Lone village grow paddy. Among various production function, Cobb-Douglas production function is used in this study. In addition, multiple linear regression analysis is used in this paper. Additional information is obtained from published by the Settlement and Land Records Departments.

1.5 Organization of the Study

The study is structured in five chapters. Each of these explores and presents a different aspect of the research investigating the paddy production of Tha Lone village, Shwebo township. Chapter 1 presented introduction. Chapter 2 is the literature review, showing the literature on the main constructs of the topic. Chapter 3 is the methodology of the research. Chapter 4 is the analysis of paddy production of Tha Lone village with Cobb-Douglas production function. Chapter 5 will be conclusions that provide a summary of the study.

CHAPTER 2
LITERATURE REVIEW

This chapter reviews the literature on importance of rice, history of rice production of the world and history of rice production of Myanmar, empirical review and inputs factor of rice production.

2.1 Importance of Rice

Rice is a major staple food and a mainstay for the rural population and for household food security. It is mainly cultivated by small farmers in holdings of less than one hectare. Rice also plays an important role as a "wage" commodity for workers in the cash crop or non-agricultural sectors. It plays a pivotal role for the food security of over half of the world population. It is also a central component of the culture of a number of communities. For those reasons, rice is considered as a "strategic" commodity in many countries, both developed and developing (Caple, 2006).

There are only two major species of cultivated rice: Oryza sativa, or Asian rice, and Oryza glaberrima, or African rice. Rice can be produced under a wide spectrum of locations and climates, but, geographically, Asia is the hub of 90 percent of world production, with China and India responsible for 30 percent and 21 percent, respectively of the world aggregate (Food and Agriculture Organization of the United Nations [FAO], 2006).

Rice is an economically important crop in the world ((Odjo et al., 2017), Dossou, Dansi, Bonou & Kombate, 2017). And also, rice is one of the most important crops globally for food production, supporting livelihoods and its role in global biogeochemical processes. Rice agriculture faces major challenges in the coming decade because of increasing resource pressures, severe weather and climate change, population growth and shifting diets, and economic development. Nowadays, the majority of rice in world market is grown in South and Southeast Asia (India, China, Indonesia, Bangladesh, Thailand, Vietnam, Myanmar, Philippines). The world average consumption of rice in 1999 was 58 kg, with the highest intake in some Asian countries; Myanmar has the highest annual consumption at 211 kg per person. Asia accounted for 60% of the global population, about 92% of the world's rice production, and 90% of global rice consumption (IRRI, 2007).

Seventy percent of the rural population of Myanmar engages in rice farming for their livelihood; rice is thus our life, our economics, and our politics. It is vital to keeping peace and tranquility in the country. Agriculture is the main source of livelihood of the Myanmar people. Rice is the major agriculture commodity grown in almost 50% of the cultivated area. The Ayeyarwaddy delta, central dry zone, Yangon deltaic, and Rakhine coastal areas are the major rice producing eco-physiographic regions(*MOALI 2015.Pdf*, n.d.).

2.1.1 Rice Production in Myanmar

Myanmar, formerly Burma, the second largest country of Southeast Asia, is located between 9°58′N to 28°31′N and 92°9′E to 101°10′E. The population of the country was approximating 51.7 million in 2014, and is increasing at an annual rate of 1.01%. At present about 70% of Myanmar's population are rural dwellers whose livelihoods depend on farming. The agricultural sector contributes 22.1% to the GDP, 20% to the total export earnings and it employs 61.2% of the labour force. Rice is by far the most important crop and is grown in areas categorized as rainfed, irrigated and upland, occupying 48%, 20% and 3% of the total sown areas, respectively (MOALI, 2014b).

Myanmar's rice-growing areas can be categorized into two agro-ecosystems namely, favorable lowlands, which account for 68% of the 7.59 million hectare sown area in 2012-2013, and unfavorable rainfed, which comprises 32% of the rice areas. These two agro-ecosystems are further divided into seven rice sub-ecosystems. The favorable lowland is comprised of the rained lowlands (48%) and irrigated lowlands (20%). The unfavorable rained area is subdivided as drought prone, deep-water, submerged, salt affected and uplands (Department of Agriculture (*DOA 2013.Pdf*, n.d.).

Rice production is central to the economy and food security of Myanmar. Between 1900 and 1940, Myanmar exported 2 to 3 million metric tons of rice annually, up to 70% of national production (Win, 1991). Ward, Smith and Tran (2016) identified that nine intervention areas in the rice production cycle where improvements in productivity and profitability can be achieved. Each of these intervention areas has relevance to both the rain fed lowland and irrigated rice systems. There areas were (1) seed selection, (2) land preparation, (3) crop establishment, (4) water management, (5) soil fertility management, (6) pest management, (7) harvesting and threshing, (8) drying and storage and (9) crop rotation.

Rice production is forecast to increase to 37.31593 million metric tons in Myanmar 2017/2018 from 12.65 million metric tons in 2016/2017 mainly due to favorable weather and the expectation of more irrigated water being provided for farmers. In Myanmar 2018/2019, rice production is forecast to rebound to 13.4 million metric tons in anticipation of more price incentives, utilization of high yielding seeds, greater farm mechanization, and replacement of rice for pulses are due to low pulse prices resulting from an Indian pulse import ban in August 2017. Growth will also be propelled by robust rice export demand and more loans for Agricultural related small and median enterprise (SME) in 2018.

Rice accounts for the largest area of crops grown in Myanmar, about 8 million hectares, or 34% of the total (planted) cropped areas of 23.5 million hectares in Fiscal Year (FY) 2010. Rice production has increased considerably since the introduction of high-yielding varieties in the late 1970s and the expansion of double cropping of summer rice since 1992. Between FY 1990 and FY 2010, the area harvested increased from 4.76 million hectares to 8.01 million hectares, or 68%. Rice production increased from 13.7 million metric tons to 32.1 million metric tons in the same period, a rise of 134%; and rice yield from 2.9 ton ha-1 to 4 ton ha-1, a rise of 38%.

A decomposition of the factors contributing to production increases shows that area growth contributed 58% and yield growth 42%. For FY 2010, self-sufficiency based on total utilization (that is, adjusting for seeds and losses) is estimated to be 147%. According to a Myanmar Rice Federations estimate, total production of milled rice is about 14-15 million metric tons, with domestic consumption of 11-13 million metric tons. This translates into a 2-3 million metric tons exportable surplus, which is captured as normal exports via ports as well as both formal border posts established by the Ministry of Commerce and illegal border trade(Wong & Wai, n.d.)(2013).

Before World War II (1921-1941) Myanmar was the largest rice exporting country in the world. After gaining independence considerable attention was given to increasing rice productivity but Myanmar's role in the world rice market declined after the 1960s (Dawe, 2002). From 1977/1978 to 1985/1986, the Whole Township Rice Production Program, as a part of the Green Revolution, through the High-Yielding Program was implemented to increase rice production by the introduction of modern rice varieties in combination with improved production technologies. As a result of this program, rice yields increased from 1.8 to 3.1 ton ha-1 during that period. Despite continuing efforts of the Myanmar government and farmers, the national average yield is still stagnating within 3 to 4 ton ha-1 MOALI (2015).

During the 1930s, Myanmar was the world's largest rice exporter at about 3 million tons annually. Exports considerably reduced after the 1930s and nearly vanished in the 1970s. Market liberalization in the late 1980s led to the lifting of the ban on private exports in 1988; in 2004 export of rice was again privatized. Rice exports started to expand after the liberalization of domestic and international markets in 2003 and by 2013/2014 it had reached 1.6 million tons, the highest level in 40 years. The government set target of rice exports of 2 million tons a year by 2015 and 4 million tons by 2020.

In 2016, Ministry of Agriculture, Livestock and Irrigation (MOALI) has developed the Road Map for Myanmar Seed Sector, in collaboration with the private sector, and international organizations such as Asian Development Bank (ADB), Food and Agriculture Organizations (FAO), International Food Policy Rice Institution (IFPRI), International Rice Research Institute (IRRI) and the Netherlands Mission and United States Agency for International Development (USAID) (Department of Agriculture, 2016). The objective of Road Map is to develop a strategic agenda for the period of 2017-2020 that highlights the steps needed to transform from the current seed sector to competitive seed sector, and to fulfil the needs of farmers in Myanmar.

However, the quality and price of the rice exported from Myanmar remain lower than the 6 international market even as world demand for aromatic rice has increased as a result of the preference for high quality rice of high-income consumers. At present, the price of aromatic rice is more than double the price of normal white rice but the share of aromatic rice exporters in the world market remains small. In Southeast Asia, Thailand used to be the sole exporter of Jasmine rice. Recently, however, Vietnam and Cambodia have emerged as important exporters, Vietnam since 2007 and Cambodia beginning 2013 (Myint & Napasintuwong, 2016).

2.1.2 Monsoon and Summer Seasons of Rice Production

Rice is grown in Myanmar during the monsoon (June to November) and summer (December to May) seasons. There are two dominant rice production systems: rained lowland and irrigated lowland. During the monsoon season, Myanmar's rainfall in the delta and coastal region is sufficient for growing rice without supplemental irrigation from dams, river and stream diversions or groundwater. Where available irrigation together with drainage structures, improves stability of production and reduces the risks of flooding and stagnant water (Denning, Baroang & Sandar, 2013).

Rice can be grown twice a year in areas where irrigation is available. The monsoon (rained) crop is far more important in terms of area than the irrigated secondary (summer) crop. Nevertheless, secondary (summer) crop yields are usually higher than those of the monsoon crop because of better soil-moisture control under irrigation. Overall, about 85% of the annual rice production is grown during the monsoon and 15% during the secondary summer season. Rice is mostly transplanted in both seasons. Average rice yields in Myanmar (generally between 3.8 and 4.7 ton ha-1) are similar to those achieved in Thailand but are significantly lower than in Vietnam (5.8 ton ha-1) and China (6.9 ton ha-1) (Goodbody, Kurbanova, Coslet & Wise, 2016).

Rice double cropping, or the so-called summer rice program, was introduced in 1992, supported generously with irrigation and other services. Farmers were under a strict government request to grow rice in the summer season wherever irrigation facilities were provided. But the record showed that despite higher yields the areas under summer rice have not increased notably in the past 10-15 years.

Rice-pulse-rice cropping pattern is mostly found in Yagon, Bago, Mon and Ayeyarwaddy, which are located in Lower Myanmar. Monsoon paddy is grown in many areas such as Bago, Tanintharyi, Mon, Kayin and Rakhine Regions in lower Myanmar, and Sagaing, Mandalay and Magway Regions in Upper Myanmar. These crops are also grown in other regions where irrigated water is available (FAO, 2009). Rice-pulse cropping pattern is mainly practised in the Central Dry Zone, especially in Mandalay, Sagaing and Magway.

In recent years, there has been a decrease in summer paddy cultivation in many parts of the country due to insufficient irrigated water. Many farmers now cultivate pulses and beans in the dry season. Planting these crops following the monsoon rice crop offers numerous benefits to farmers. Farmers need less water, can benefit from the moisture that remains after the harvesting of the rice crop, need less chemical fertilizer than does rice, and their prices are improving.

Between fiscal year 2000 and fiscal year 2010, the total rice-cropped area increased by 1.71 million hectares, of which 91% was accounted for by monsoon rice. In this period, the summer rice area only increased from 1.1 million hectares to 1.25 million hectares, while the monsoon rice area grew from 5.2 million hectares to 6.76 million hectares. On the other hand, the yield rate of summer rice grew faster because almost

100% of this rice was planted with high-yielding varieties, while the coverage of these varieties was only 60% for monsoon rice over this period (Wong & Wai, 2013). The following table show harvest area and production of rice in Myanmar in 2000 to 2019.

Table 2.1 Sown Acreage, Harvested Acreage and Production of Paddy in Myanmar (2000-2019)

Year	Sown (Million Acreages)	Harvest (Million Acreages)	Production (Million Ton)
2000-2001	15.71	15.57	20.98
2002-2003	15.98	16.38	21.80
2003-2004	16.16	16.13	22.77
2004-2005	16.94	16.82	24.36
2005-2006	18.25	18.25	27.24
2006-2007	20.07	19.95	30.43
2007-2008	19.99	19.80	30.95
2008-2009	20.00	19.96	32.06
2009-2010	19.93	19.91	32.17
2010-2011	19.88	19.80	32.07
2011-2012	18.76	18.70	28.55
2012-2013	17.89	17.27	26.22
2013-2014	17.99	17.18	26.37
2014-2015	17.72	16.97	26.42
2015-2016	17.82	16.73	26.21
2016-2017	17.69	16.62	25.67
2017-2018	17.93	16.67	25.62
2018-2019	17.86	17.67	25.57

Source: Statistical Yearbooks (2006 to 2020)

The above table shows the sown acreage, harvested acreage and production of paddy in Myanmar in the year 2000 to 2019**.** The sown acreages in 2006-2007 is the highest and the 2000-2001 is the lowest sown acreages. The harvested acreages in 2008-2009 is the highest acreages and the 2000-2001 is the lowest acreages. The paddy production of Myanmar in 2009-2010 is the highest production and the 2000-2001 is the smallest production. In 2008, rice production declined as a million acres of rice paddy fields were affected by Cyclone Nargis.

Table 2.2 Sown Acreages and Production of Rice in Sagaing (2000-2019)

Year	Sown (Thousand Acreages)	Production (Thousand Ton)
2000-2001	1769	2335
2001-2002	1789	2478
2002-2003	1773	2265
2003-2004	1713	2319
2004-2005	1870	2618
2005-2006	2017	2864
2006-2007	2396	3498
2007-2008	2283	3471
2008-2009	2265	3533
2009-2010	2275	3565
2010-2011	2292	3621
2011-2012	2181	2896
2012-2013	1832	2956
2013-2014	2093	2997
2014-2015	1922	3001
2015-2016	2126	3040
2016-2017	2130	3043
2017-2018	2203	3031
2018-2019	2179	3731

Source: Statistical Yearbooks (2006 to 2020)

The above table shows the sown acreage and production of paddy in Sagaing in the year 2000 to 2019**.** The sown acreage is described in thousand acreages and the production of paddy is shown in thousand ton. The sown acreages in 2006-2007 is the highest and the 2003-2004 is the lowest sown acreages. The paddy production of Sagaing in 2018-2019 is the highest and the 2003-2004 is the lowest production. The sown acreage and production of paddy in Sagaing is relatively high in the year 2000 to 2019.

2.1.3 Local Rice Varieties

Local varieties are valuable as they possess a huge treasure of genetic material for development and improvement programs (Odjo et al., 2017). They are adapted to local growing conditions. Local crop does well in a particular region because it has qualities that help it survive the conditions it faces there. Therefore, the local crop varieties from their areas are suitable for local temperature, rainfall and soil conditions of their relevant area. They also tolerate to common local pests well. Many local rice varieties are surely synonymous. Different names are given to the same variety in different localities.

Some 2000 rice varieties have been recorded in Myanmar. They entered market-oriented agriculture; mixed varieties that differ in shape, size, and hardness of grain caused inefficient milling and produced inferior products. There were many rice varieties in the country. Although identical of rice varieties, farmers called as different names in different localities (Win, 1991). Most traditional rice varieties in the tropics are tall, sensitive to photoperiod and have long maturity periods. When they applied high levels of nitrogen, they tend to lodge at later growth stages. And then, their grain yields are extremely low. When these varieties are planted later than usual, they have shorter growth duration and usually are shorter in height, and consequently, have increased lodging resistance (Yoshida, 1981).

Today in Myanmar, the price differential between traditional local varieties and modern “IRRI-type” varieties is large. Paw San Yin, a fragrant variety produced in the delta, can fetch double the price of higher yielding semi-dwarf types. Trading by individual varietal names has increased since the 1990s (Okamoto, 2005).

Modern rice varieties (also known as high yielding varieties) are variously reported to be used for 70-80% of the monsoon crop and for virtually all the summer crop. Fang et al. (2009) stated that farmers often prefer local varieties during the monsoon season, especially in areas that are subjected to flooding. Local varieties, such as Paw San Yin, are typically of higher eating quality and bring as much as double the price of the high yielding varieties. High yielding varieties are widely grown in the summer season because of their early maturity and the absence of flooding risk at that time of year. Nationwide, high yielding varieties adoption has been reported as 61%, with highest level of adoption in the dry zone. According to the technology package with 10 impact points for high yielding rice production, Myanmar Agriculture Services (MAS) have been undertaken in 1975-1976.

Technology Package with 10 Impact Points are:

1. Applying and selection of high yielding rice varieties
2. Deep ploughing and harrowing for land preparation
3. Transplanting 25-30 days old seedlings
4. Fulfillment to plant population acre-1
5. Applying recommended rate of fertilizers
6. Using cow dung and compost manures as basal fertilizers
7. Controlling of weeds
8. Management and control of pests and diseases
9. Irrigation and drainage regularly
10. Harvesting to reduce minimum waste

2.2 Inputs Factors of Production

In study of many researches, land, labor and capital are the basic factors of production. Different models and recommendations have been suggested. The rate at which an economy becomes transformed from a primarily agriculture economy to mixed economy depends mostly on the proportion of the labor force, the technique of farming, the capital used, and the way the land is maintained. It has been hypothesized that the differences in technical inputs and human capital (education) do account for the agricultural productivity gap among countries(Hayami & Ruttan, n.d.).

Many agricultural development theories have explained how the basic sources of growth (labor, natural, resources capital, specialization, improved efficiency, and technological progress) can be stimulated and combined to generate broad-based agricultural growth. This theory is to expand the use of abundant resources such as land and labor to produce agricultural products. But it was known that expansion of unutilized land resources provides few opportunities for sustainable growth in developing countries because other factors such as disease, insects and soil problems prevent its use in agriculture. Another related theory is conservation theory. It refers to intensive use of resources such as crop rotations, forage livestock systems, drainage and irrigation.

In many developing countries, the existing resources are prepared to increase land productivity. While agricultural scientists are trying to gain additional knowledge of new technologies, expanding resource exploitation and conservation effort simultaneously play an important role for future agricultural development till now. The input of land is measured in terms of paddy grown area per farm in the cropping season when survey is done. Total land area is the number of total crops under cultivation in the same cropping season. The total labor expenditure per farm includes the calculated costs of family labor used in production at the wage rate paid to permanent hired labor. The money wage rate is computed by dividing the total labor expenditure for rice production per farm by the quantity of labor including both family and hired labor.

Capital input can be obtained as the sum of costs of animal and mechanical power used in rice production. Fertilizer price is measured as total expenditure on fertilizer kilogram including transportation and application cost. Recent government policy has no subsidy schemes of price and input to farmers. So that production and distribution of inputs and outputs come from the forces of demand and supply. The farm level specific prices differ a little across the farms due to their product quality. Input prices are not different since most of the companies come and distribute fertilizer directly to farms in the survey area.

2.3 Empirical Review

Empirical review of the study is shown in Table 2.3.

Table 2.3 Empirical Studies on Paddy Production

Author	Title	Objective	Methodology	Findings
Praneetvatakul et al. (2002)	Productivity of pesticide use in rice production of Thailand	To examines the productivity of insecticides, use in rice production in two regions of Thailand	Cobb-Douglas production and regression analysis	The land, labor and capital, pesticides are damage control inputs and therefore do not increase the output directly. Results of this study that are challenged with the reform of crop protection policy in Thailand towards reducing the dependence on chemical pesticides.
Majumder et al. (2009)	Productivity and resource use efficiency of Boro (winter) rice production in Bhola District	To measure and compare resource use efficiency and relative productivity of farming under	Cobb-Douglas production function and efficiency of resource allocation method	The cash tenant operators were found more efficient than those of owner and crop share tenant operators. The existing land tenure arrangement is the major determinant of

Author	Title	Objective	Methodology	Findings
		different tenure conditions in an area of Bhola district		mode of production, which is a vital constraint for achieving the higher level of production efficiency in agriculture of Bhola district.
Akighir and Shabu (2011)	Efficiency of resource use in rice farming enterprise in Kwande Local Government Area of Benue State, Nigeria	To examines the resource use efficiency in rice production in Kwande Local Government Area of Benue State Nigeria	Cobb Douglas production function and technical efficiency techniques	The findings are rice farmers in Kwande Local Government were technically inefficient in the use of farm resources. The technical efficiency in rice production in Kwande Local Government could be enhanced through better use of such inputs.
Ingabire et al. (2013)	Determinants and profitability of rice production in Cyabayaga Watershed, Eastern Province, Rwanda	To analyze the determinants of rice production and its financial profitability in the watershed of Cyabayaga, Eastern Province of Rwanda	Cobb-Douglas production function and cost-benefit analysis approach	The average production of rice in the watershed is yet insufficient compared to theoretical bench mark of 7 tons per hectare. This is partly explained by lower productivity of production factors used by farmers for rice production that is mostly capital measured as investment in seeds and fertilizers. Labor and land have significant effects on rice production in Cyabayaga watershed and are the main factors determining the profit gained by farmers in rice production.
Patil et al. (2013)	Input use and production pattern of paddy cultivation under leased-in	To examine input use pattern and production pattern under	Fishers t' test and Cobb Douglas production function	There was no significant difference in input use, production pattern between owners cultivated land and leased-in land.

Author	Title	Objective	Methodology	Findings
	land in Tungabhadra project area	paddy cultivation		Total cost of cultivation and net returns of leased-in farmers were significantly different than total cost of cultivation and net returns of owner farmers resulting in higher gross return per rupee of cost in owner cultivated land as against leased-in land.
Abiola et al. (2016)	Resource-use and allocative efficiency of paddy rice production in Muda Agricultural Development Authority, Malaysia	To examine resource-use and allocative efficiency of paddy rice production in the Muda Agricultural Development Authority, Malaysia	F-tests, ordinary least square analyses techniques, descriptive statistics, gross margin analysis and Cobb-Douglas production function analysis	The inputs used were positively significant. Rice production was found to be profitable as farmers realized 2,054.03 ringgit per hectare as gross margin in the study area. Result of the allocative efficiency of inputs confirmed that rice producers in the area did not attain optimal allocative efficiency, seed input had the highest allocative efficiency while fertilizer input showed the least allocative efficient input.
Amaechina and Eboh (2017)	Resource use efficiency in rice production in the lower Anambra irrigation project, Nigeria	To examine resource use efficiency in rice production.	Cobb Douglas production function	The findings are although rice production is profitable in the area, some resources were not efficiently being utilized. Rice production in the scheme is income yielding and profitable, the enterprise is not organized or managed in ways to ensure efficiency.

Author	Title	Objective	Methodology	Findings
Islam et al. (2017)	Profitability and productivity of rice production in selected coastal area of Satkhira district in Bangladesh	To assess the profitability, constraints and factors affecting rice production in coastal area of Shamnagar upazila, Satkhaira district, Bangladesh	Simple statistical technique and Cobb-Douglas production function	The study found that the small farmers got higher net returns than the medium and large farmers per hectare, respectively. It is found that the coefficient of seed, fertilizer, power tiller, irrigation cost and human labor have significantly impact on gross return.
Bashir and Yuliana (2019)	Identifying factors influencing rice production and consumption in Indonesia	To explore the factors affecting rice production in rural southeastern Cambodia	Ordinary least square and Cobb-Douglas production function	Rice production can be affected by human capital, labour, wages, wetland, urban population and rice prices. Rice consumption model were affected by human capital, per capita income, population and consumption the previous year.
Siagian et al. (2019)	Analysis of factors that influence the production of wetland rice in Banten Province	To know the condition of wetland rice farming in Banten Province, to know the factors that influence the production of wetland rice in Banten Province, to know the efficiency of the use of production	Cobb Douglas production functions and descriptive analysis	The productivity of paddy rice is 5.91 tons harvested dry grain per hectare. Significant factors affecting the production of paddy rice in rainy season 2017/2018 are the amount of use of solid organic fertilizer, the amount of solid herbicide use, the amount of use of human labor rent, and the arable land area.

Author	Title	Objective	Methodology	Findings
		inputs		
Subedi et al. (2020)	Profitability and resource use efficiency of rice production in Jhapa district of Nepal.	To determine the profitability and resource use efficiency of rice production from January to June, 2020 in Jhapa District of Nepal	Descriptive statistics and Cobb-Douglas production function	The rice production was financially viable; it's a profitable enterprise. Jhapa District was found to be highly productive and potential area for rice production. It has been revealed that the inputs used in rice production were inefficiently utilized.
Noormansyah and Cahrial (2020)	Efficiency of production factors and constraints of organic rice farming at rained rice	To determine the efficiency of the use of production factors and the constraints of organic rice farmers in rained rice	Cobb Douglas method and descriptive manner	The factors of production used had a very significant influence on organic rice production. Factors of production that do not significantly affect organic rice production are seeds, organic fertilizer, compound fertilizer, and labor. Factors of land production and vegetable pesticides have not been efficient.
Basnet et al. (2022)	Analysis of profitability and effect of factors of production in paddy cultivation in Morang, Nepal	To analyze the profitability and effect of factors of production in paddy cultivation in Morang district of Nepal	Descriptive Statistics and Cobb-Douglas Production	The variables such as seed, labor and mechanical power are contributed in this study.

Sources: Various Studies

CHAPTER 3
METHODOLOGY

This chapter presented the methodology adopted in the current study. It covers information on study area, sample size determination, research design and methods of data collection. And, the production function method, history of Cobb-production function, multiple regressions and ordinary least square method and Yamane's formula for calculating sample size are described in this chapter.

3.1 Study Area

The study area, Sagaing Region is the largest one of seven regions and "the second largest of States and Regions in Myanmar. It is bordered by Kachin State, Shan State, Mandalay Region, Magway Region, Chin State and India in clock-wise direction. There are eight Districts (Sagaing, Shwebo, Monywa, Ye U, Katha, Mawlaik, Hkamti and Tamu) in Sagaing. Shwebo Township has 62 villages and 10 wards. Shwebo District is roughly rectangular in shape and with the exception of a strip a few miles in width along the Ayeyarwady and a small area in the south-west that drains into the Chindwin, lies wholly within the basin of the Mu River. Shwebo Township is situated on the Mu Valley railway line about three hours run from Sagaing Township. Shwebo Township, Upper Granary of Myanmar as well as producer of Shwebo Baygya rice commanding the biggest market in paddies, has been made research study site. This research was conducted in Tha Lone Village located in Shwebo Township.

3.2 Sample Size Determination

There are several approaches to determining the sample size based on the following criteria. They are the level of precision, the confidence or risk level and the degree of variability in the attributes being measured. Among them, the level of precision criteria is used in this study. The following formular represents, the sample size (n) from the population size.

Yamane (1967) suggested another simplified formula for calculation of sample size from a population which is an alternative to Cochran's formula. According to him, for a 95% confidence level and p = 0.5, size of the sample should be

$$n = \frac{N}{1+Ne^2} \qquad (3.1)$$

where, N is the population size

e is the level of precision

$$n = \frac{910}{1 + 910(0.05)^2} = \frac{910}{3.275} = 277.86 \cong 278$$

The result above that sample is 278, 304 households arecollected from the total population households of 910 which the lower number of responses from the respondents to maintain a 95% confident interval.

After calculating the representative sample size, the main aim of an investigator is to find the proper method of selecting samples. Sampling is simply the process of learning about the population on the basis of sample collected from the population. Sample is constituted by a part or fraction of the population. Thus, in the sampling technique, instead of every unit of the population, only a part of it is studied and the conclusions are drawn for the entire population on the basis of the sample.

3.3 Research Design

The design of research consists of a quantitative approach and primary data and secondary data. The survey method was employed to collect the data from sample people by distributing questionnaires. In this study, primary data and quantitative research methods were used. Quantitative research method was significant to generate the measurable cause and effect of variables, and the relationship between the variables. Sample survey research design with the form of questionnaire was used to collect the data from selected sample. Data were collected from a simple random sample of 304 paddy farmers. Secondary data is collected from various sources such as reports, documents from government departments, especially from Department of Agriculture and Statistical Year Book. The quantitative research methods mostly concern with the collection and analysis of information in numerical form such as percentages or statistic.

By using descriptive statistics analysis to present the figures from the findings with tables and charts, the respondents were interviewed with standard questionnaires during the research. Descriptive statistics are concerned with summarizing the properties of the sample of observations. Inference statistics apply the mathematical theory of probability to make decisions about the likely properties of populations based on sample evidence. The simple random sampling method was used in selecting a sample household for the interview.

3.4 Methods of Data Collection

In this paper, the quantitative data collection method was applied to collect data. Quantitative data collection focused only on rice production of rice farmers. Both primary and secondary data were used in this study. The primary information was collected by personal interview with a structured questionnaire. This questionnaire survey process was conducted in 2019. So, the survey is based on paddy farmers in Tha Lone village. Those villagers in this village were purposely selected among other existing villages because rice is potentially cultivated.

Secondary data is collected from various sources such as documents from government departments, especially from Department of Agriculture. The survey questionnaire covered the following areas: gender, ages, education, family size, number of students, monthly income and expenditure, paddy production, situation of land ownership and utilization of family labour. And cultural practices of production such as rice production area, seed source, varieties used, seed rate per hectare, animal husbandry, utilization of fertilizer, seed, pesticide and herbicide were collected. The survey also identified any problems and constraints faced by farmers in obtaining fertilizers, and what methods of application were used.

3.5 Production Function Method

According to Dominick (1991) production function for any commodity is an equation, table or graph which helps to produce maximized production at the combination of different alternatives of inputs. The production function can also be called as a mathematical representation of the various technological techniques through which a firm wish to structure its production process. The production function appears in the micro-economic analysis as one of the two determining factors of the economic sustainability of the firm.

If a business aims a state of equilibrium and tries to maximize profits in the short run, it must on the same hand also consider the technological characteristics of its installations, and the possible ways to produce it. The cost of production must also be in consideration (Aurora 1999). The production function can also be called as mathematical representation of the various technological procedures from which a firm can choose to configure its production process. Or in other words it helps in maximizing production of the firm at different levels of inputs (David 2010).

The production function depends on the exogenous technological conditions. The technological progress might occur after some time, due to the changes in the technological conditions. This shifts the production function (David & Daum, 2010).

A production function shows the technological relationship between inputs and outputs. The output of a firm can be a final commodity or and intermediate commodity. Input are the resources used in the production of output. Inputs include labor, capital and land. Inputs can be classified into two categories: fixed and variable. (Dominick 2004) A firm produces goods and services through combining land, labor and capital and raw material to maximize its profits or maximizing sales or growth. How much of the land, labor and capital is to be used has always been a question for the organization to produce the output most efficiently. The firm needs technological and engineering data on production possibilities to product the efficient output. These possibilities are summarized in the production function.

Banaeian (2011) has defined production function as "specification of the minimum of the input requirements to produce an output, at available technology". In the neoclassical economics, production function has a vital position for economic analysis. Philips (1894) was considered as the pioneer of the production function because he was the first economist who algebraically expressed the production function in a formula i.e. $P = f(x^1, x^2, \dots, x^m)$. There are also certain evidences that John von Thünen was the pioneer of this function (Humphrey, 1997).

Production function is used not only at micro level, for firms, but also at the macro level, on whole economy. At the firm's level it is used for cost effectiveness and input demands. At macro level it is used to find the contribution of inputs, income and technology in the economic growth (Thomas 1997). In general terms any production function can be expressed as:

$$Q = f(x_1, x_2, x_3, \dots)$$

Where Q represents output of a product and X_1, X_2, X_3 represent the various inputs (Nick 2005).

If it is assumed that only one type of product is produced by firm with two inputs, labor and capital, then the formula will be:

$$Q = f(L, K)$$

The equation above means that the production is a function of or depends on, the inputs: labor and capital. Here we assume that L and K are homogenous or identical.

Where Q is the production, L is labor employed and K is capital invested. This equation depicts the maximum output produced depends on the amount of human resource or capital employed by the firm (Dominick 2004).

The production function is estimated as:

$$Q = A\, K^{a} L^{b} \tag{3.2}$$

Where, Q is the quantity of output, K is capital invested and L is the labor and A, a, b are the parameters which are to be estimated empirically. The above equation is often referred as Cobb Douglas production function.

Production function can sometimes be written as $Q \leq f(L, K)$ which means that the quantity produced by the firm is theoretically less than the maximum level of output (Eric 2008).

(1) Linear and Fixed Proportion Production Function

Linear production function is expressed as $Q = aL + bK$, where a and b are positive constants. In a linear production function inputs are infinitely substitutable for each other therefore the inputs are said to be perfect substitutes (Eric 2008).

When the inputs are employed in fixed proportions the production function is known as fixed proportions production function. The inputs in this kind of production function are known as perfect complements and they are combined in a fixed ratio to each other. This function is also known as Leontief production function, after the economist Wassily Leontief. He used this model to estimate relationships of different sectors in national economy (Eric, 2008).

(2) Constant Elasticity of Substitution Production Function

This kind of production function includes all of the special production functions as special cases. This function is written as

$$A = (aL \overset{\sigma-1}{\widehat{\sigma}} + bK \overset{\sigma-1}{\hat{\sigma}}\ \hat{\sigma})^{\sigma-1/\sigma} \tag{3.3}$$

Where a, b, and σ are positive constants. σ is the elasticity of substitution.

Systematic relationship between input and output in an economy is described by a macroeconomic production function. Cobb-Douglas and constant elasticity of substitution (CES) are the two production functions which are used extensively (Eric, 2008).

3.6 History of Cobb Douglas Production Function

In economics, Cobb Douglas production function is widely used to show the relationship between inputs and outputs. This model was proposed by Knut Wicksell in 1851-1926, and then Charles Cobb and Paul Douglas tested it against statistical evidence in 1928. In 1928 a study was conducted by Charles cob and Paul Douglas in which the growth of the US economy during the period 1899-1922 was modeled. In their model production output was determined by the amount of labor & capital used. Their model performed very well, since then many economists used this model for solving economic problems. (Bao Hong, 2008). (Eric Miller, 2008). The Cobb Douglas production function has various useful properties:

1. First, the marginal product of capital and the marginal product of labor depend on both the quantity of capital and quantity of labor used in production, as is often the case in the real world.
2. Second, the exponents of K and L: a, b represent, the output elasticity of labor and capital, (EK and EL) and in the sum of the exponents (i.e. a + b) measures the returns to scale. If a + b = 1, we have constant returns to scale; if a + b > 1, we have increasing returns to scale, and if a + b, we have decreasing returns to scale.
3. Third, Cobb Douglas production function can be estimated by regression analysis by transforming it into

$$\ln Q = \ln A + a \ln K + b \ln L$$

This is linear in the logarithms. Therefore, the Cobb-Douglas production function can easily be extended to deal with more than two inputs (say capital, labor, and natural resources or capital, production labor, and nonproduction labor).

3.6.1 Cobb Douglas Production Function

The Cobb-Douglas production function is the mostly used empirical analysis for growth and productivity. The estimation of the parameters of aggregate production function is still the chief components of the today's work on growth, technological change, productivity, and labor. Potential output, technical changes, or the labor demand are based on the empirical estimates of the aggregate production function, which is an essential tool of analysis in macroeconomics. (Jesus Felipe 2005). The Cobb Douglas production function is in-between linear production function and a fixed proportion production function. In this model Labor and capital can be substituted for each other.

The elasticity of substitution for Cobb Douglas lies between 0 and ∞ (David Besanko 2010). The Cobb Douglas production function has declining marginal products at all levels of inputs but the decline is increasing as the input increases. It involves constant elasticities and that is the main advantage of Cobb Douglas production function. The elasticity in this case is the output elasticities; the coefficient b refers to output elasticity with respect to labor. Meaning that every 1 percent increase in labor input will increase output by b percent assuming that capital input is held constant (Nick Wilkinson 2005).

The Cobb Douglas is the most widely used production function used in empirical work. The function is expressed as

$$Q = AK^{\alpha}L^{\beta}$$

Where Q is the output and L and K are the labor and capital respectively. A, α and β are the positive parameters. The greater the value of A, the advanced is the technology. The α and β also shows the returns to scale, if α + β > 1 it shows that there is increasing returns to scale, α + β < 1 shows that there are decreasing returns to scale and α + β =1 there are constant returns to scale (Dominick 1991).

3.6.2 Assumptions Made by Cobb Douglas

Following are the assumptions of this model:

1. If either labor or capital vanishes, then so will production.
2. The marginal productivity of labor is proportional to the amount of production per unit of labor.
3. The marginal productivity of capital is proportional to the amount of production per unit of capital. (BANAEIAN N 2011)

Because the production per unit of labor is P/L, assumption 2 says that

$$\int \frac{\partial P}{\partial L} = \alpha \frac{P}{L}$$

For constant α, keeping K constant ($K = K_0$), then this partial differential equation becomes an ordinary differential equation:

$$\frac{dP}{dL} = \alpha \frac{P}{L}$$

This separable differential equation can be solved by re-arranging the terms and integration both sides:

$$\int \frac{1}{P} dP = \alpha \int \frac{1}{l} dL$$

$$\ln(P) = \alpha \ln(cL)$$

$$\ln(P) = \ln cL^{\alpha}$$

And finally,

$$P(L, K_0) = C_1(K_0)L^{\alpha}$$

Where $C_1(K_0)$ is the constant of integration and we write it as a function of K_0since it could depend on the value of K_0 (Banaeian 2011).

3.6.3 Criticism for Cobb Douglas Production Function

Following little criticism are presented for the Cobb Douglas production function (K.V. Bhanumurthy 2002).

1. A large number of inputs cannot be handled.
2. It is based on the assumptions of perfect competition in the factor and product markets
3. Constant returns to scale are assumed.
4. Common problems of this function are Serial correlation and heteroscedasticity which be set this function too.
5. Correlation is made between L & K hence estimates are be biased.
6. Unitary elasticity of substitution is unrealistic.
7. Inflexibility.
8. Single equation estimates are bound to be inconsistent.
9. Other criticism relates to the level of aggregation and nature of technology.
10. It cannot measure technical efficiency levels and growth very effectively.

3.6.4 Estimating the Production Function

According to the Cobb Douglas production function

$$Q = AK^{\alpha}L^{\beta}$$

The MP_K and MP_L are functions of parameters A, α, and β and the ratios of the K and L inputs.

$$MP_K = \frac{\delta Q}{\delta K} . \alpha AK^{\alpha-1}L^{\beta}$$

$$MP_L = \frac{\delta Q}{\delta K} \beta AK^{\alpha}L^{\beta-1}$$

$\alpha + \beta > 1$ increasing returns to scale

$\alpha + \beta = 1$ constant returns to scale

$\alpha + \beta < 1$ decreasing returns to scale

3.7 Converting Non-Linear Production Function into Linear Production Function

The behavior of production is usually non-linear, and can be analyzed by Cobb Douglas production function. The non-linear relation is made linear by Ordinary Least Square method (OLS). Therefore, Cobb Douglas is transformed into linear form by logarithm, in order to use OLS. This type of regression model is performed through nonlinear regression option of SPSS.

The Cobb Douglas function does not lend itself directly to estimation by the regression method because it is nonlinear relationship. Technically, an equation must be a linear function of the parameters in order to use the ordinary least squares regression method of estimation.

However, a linear equation can be derived by taking the logarithm of each term i.e.

$$\text{Log}\, Q = \log A + a \log K + b \log L$$

Here $Y = \text{Log}\, Q,\ A = \log A, X_1 = \text{Log}\, K\ X_2 = \text{Log}\, L$

$$Y = A + aX_1 + bX_2 \qquad (3.4)$$

This function can be estimated directly by this least square regression technique, and the estimated parameters can be used to determine all the important production relationships. Then the antilogarithm of both sides can be taken, which transforms the estimated function back to its conventional multiplicative form.

Estimate the parameters (A, α, and β) of a Cobb Douglas production function using the least squares regression method.

Use the estimated parameters to determine a) returns to scale (b) equation for the marginal product of L and K.

First transform the production function by taking the natural logarithm of each term in the function i.e.

$$\ln Q = \ln A + \alpha \ln K + \beta \ln L \qquad (3.5)$$

3.8 Multiple Regressions and Ordinary least Square Method

Regression is a family of techniques that can be used to explore the relationship between one continuous dependent variable and a number of independent variables or predictors (usually continuous). It allows a more sophisticated exploration of the xliii interrelationship among a set of variables. This makes it ideal for the investigation of more complex real-life research questions (Julie, 2007).

In this study multiple regressions has been applied to show the influence of two independent variables labor and capital. In the light of this influence the model is constructed.

It is a statistical method which is used to assess causality. It analyzes whether an independent variable or a set of independent variables influences a dependent variable. It is also used for inference. It is given what we find in a sample of data, what can be inferred about the population from which it was drawn. The method of least squares produces a line that minimizes the sum of the squared vertical distances from the line to the observed data points. Here in this study the nonlinear function of Cobb Douglas is converted into linear by the help of OLS.

3.8.1 Multiple Regression Model

Multiple regression analysis is the study of how a dependent variable y is related to two or more independent variables. In the general case, using k refers to the number of explanatory variables.

The introduction of a model in multiple regression analysis is very similar to introduce this concept in simple regression analysis. The equation which describes how the dependent variable y is related to the independent variables$x_1, x_2, \dots, x_k$and an error term u is called the multiple regression model. Multiple regression models take the following form.

$$y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k + u_i \qquad (3.6)$$

In the multiple regression model, $\beta_0, \beta_1, \dots, \beta_k$are the parameters and u_i is a random variable. The error term accounts for the variability in y which is not captured by the linear relationship between y and the independent variables. The assumptions of error term u_i are all still true under the multiple regression model.

One of these assumptions is that *E(u) = 0.* This implies the following relationship.

$$\hat{y} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k \qquad (3.7)$$

This is called the Multiple Regression Equation.

3.8.2 Model Assumption

Just as with the simple regression model, several assumptions are making about the multiple regression. These assumptions are the behavior of the error terms u. These are the following assumptions about the multiple regression model;

$$y = b_o + b_1X_1 + b_2X_2 + ... + b_kX_k \tag{3.8}$$

1. The error term u is a random variable with expected value of zero; $E(u) = 0$. Implication: For the given values of the independent variables. The expected value of the dependent value is

$$E(y) = \beta_0 + \beta_1X_1 + \beta_2X_2 + \cdots + \beta_kX_k \tag{3.9}$$

The linearity between the dependent and the independent variables is correct.

2. The variance of u is denoted by σ^2 and is the same for all values of the independent variables. Implication: The variance of y equals σ^2 and is the same for all values of the independent variables.

3. The values of u are independent. Implication: The size of the error for a particular set of values for the independent variables is not related to the size of the error for another set of values for the independent variables.

4. The error u is normally distributed random variable reflecting the deviation between the value of y and the expected value of y. Implication: The dependent variable is also a normally distributed random variable.

3.8.3 Estimated Multiple Regression Equation

If the values of $\beta_0, \beta_1, \dots, \beta_k$ are known, the previous equation is used to calculate the mean of value of y at the given values of $X_1, X_2, \dots, X_k$. In general, these parameter values will not know and will have to estimate them from sample data. Using this sample, an estimated multiple regression equation can develop which takes the following form

$$\hat{y} = b_0 + b_1X_1 + b_2X_2 + \cdots + b_kX_k \tag{3.10}$$

Where, $b_0, b_1, \dots, b_k$ are the estimated value of the parameters $\beta_0, \beta_1, \dots, \beta_k$ and $\hat{y}$ is the estimated value of the dependent variable. The estimation procedure for multiple regression is nearly identical to simple regression. The least squares method is used to come up with our "best" fit.

3.8.4 Least Squares Method

The least squares method is used to develop the estimated regression equation. This same approach is used to develop the estimated regression multiple regression equation. The least squares criterion is

$$min \sum_{i=1}^{n}(y_i - \hat{y}_i)^2 \qquad (3.11)$$

Where;

y_i = the observed value of the dependent variable for the i^{th} observation

$\hat{y}_i$ = the estimated value of the dependent variable for the i^{th} observation

n = the number of observations

The estimated values of the dependent variable are obtained from the estimated multiple regression equation.

$$\hat{y} = b_0 + b_1X_1 + b_2X_2 + \cdots + b_kX_k \qquad (3.12)$$

The least squares method uses sample data to provide the values of which $b_0, b_1, \ldots, b_k$ which minimize the sum of squared residuals.

3.8.5 Testing of Significance

The significance tests of the simple regression model were the t test and the F test. In the simple regression model, these tests always generated the same conclusion. If the null hypothesis was rejected, concluded that $\beta_0 \neq 0$. In multiple regression, the F test and the t test have different determinations.

The F test is used to determine whether there exists a significant relationship between the dependent variable and the entire set of independent variables in the model; thus the F test is a test of the regression's overall significance.

If the F test shows that the regression has overall significance, the t test is then use to determine whether each of the individual independent variables is significant. A separate t test is used for each of the independent variables, thus the t test is a test for individual significance.

3.8.6 Test for the Significance of Overall Multiple Regression Model

The overall F-test is used to test for the significance of overall multiple regression model. The ANOVA method examine the null hypothesis that all the β value are zero against the alternative that at least one β is not zero. The multiple regression model is defined as

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \cdots + \beta_kX_k + \varepsilon \qquad (3.13)$$

The hypothesis for F test takes the following form

Null Hypothesis - : $\beta_0 = \beta_1 = \beta_2 = \cdots = \beta_k = 0$

(There is no linear relationship between the dependent variable and the independent variables)

Alternative Hypothesis : At least one $\beta_j \neq 0$

(Linear relationship between the dependent variable and at least one of the independent variables)

If the null hypothesis is rejected, it is conclude that one or more of the parameters in the model is not equal to zero. Thus, the overall relationship between the dependent variable y and the independent variables $x_1, x_2, \dots, x_k$ is significant. However, if the null hypothesis is not rejected, we conclude that there is an overall significant relationship and our regression does not significantly to explain the variation in the dependent variable.

This ration of mean square regression to mean square error follows the F distribution when the assumption that the residents are normally distributed is valid and the null hypothesis is true. The ratio of F- statistic;

$$F = \frac{MSR}{MSE}$$

where; the MSR is the mean square due to the regression which is equal to

$$MSR = \frac{SSR}{k}$$

where; the MSE is the mean square of error which is equal to

$$MSE = \frac{SSE}{n - k - 1}$$

where; n – k – 1 is the degrees of freedom and k is the number of independent variables.

The decision rule for the F-test takes the following form;

Reject the null hypothesis if : $F > F_{\alpha,k,n-k-1}$

Do not reject the null hypothesis if : $F \leq F_{\alpha,k,n-k-1}$

where; $F_{\alpha,k,n-k-1}$ is based on F the distribution with k degrees of freedom in the numerator, n – k – 1 degrees of freedom in the denominator, and a probability of α in the upper-tail of the probability distribution.

3.8.7 Test for Individual Partial Regression Coefficient, $\boldsymbol{\beta_j}$

An individual partial regression coefficient, β_j in the multiple regression model is tested to determine the significance of the relationship between x_i's and y. For any parameter β_j the hypotheses take the form.

Null Hypothesis : $\beta_j = 0$

Alternative Hypothesis : $\beta_j \neq 0$

The t statistics for $\hat{\beta}_j$ is simple to compute given $\hat{\beta}_j$ and its standard error:

$$t = \frac{\hat{\beta}_j}{se\,(\widehat{\beta_j})}$$

The decision rule for this test takes the following form:

Reject the null hypothesis

if : $t < -t_{\alpha/2, n-k-1}$ (or) $t > -t_{\alpha/2, n-k-1}$

3.8.8 Standard Error of Estimate

It shows how to choose an unbiased estimator of σ^2 , which can obtain unbiased estimators of Var $(\widehat{\beta_j})$. Because an unbiased estimator of σ^2 is the sample average of the square errors: $n^{-1} - \sum_{i=1}^{n} \varepsilon_i{}^2$.

Nevertheless, the error can be written as $\varepsilon_I = y_i - \hat{\beta}_0 - \hat{\beta}_1 x_{i1} - \cdots - \hat{\beta}_k x_{ik}$. It replace each β_j with its OLS estimator, the $\varepsilon_I = y_i - \hat{\beta}_0 - \hat{\beta}_1 x_{i1} - \cdots - \hat{\beta}_k x_{ik}$. It seems natural to estimate σ^2 by replacing in the general ε_i with the $\hat{\varepsilon}_i$. The unbiased estimator of σ^2 in the general multiple regression case is

$$\hat{\sigma}^2 = (\textstyle\sum_{i=1}^{n} \varepsilon_i{}^2)/n - k - 1 = \frac{SSR}{n-k-1}$$

The positive square root of $\hat{\sigma}^2$, denoted $\hat{\sigma}$, is call the standard error of the regression. The standard error of the regression is an estimator of the standard deviation of the error term. This estimate is usually reported by regression packages, although it is called different things by different packages. The σ^2 is also called the standard error of the estimate and the root mean squared error.

3.8.9 The Coefficient of Multiple Determination, $\boldsymbol{R^2}$

The coefficient of multiple determinations is defined as:

$$R^2 = \frac{\sum(\hat{y}_i - \bar{y})^2}{\sum(y_i - \bar{y})^2} \tag{3.14}$$

The numerator of the middle term is the explained sum of squares, or the sum of squares due to regression, SSR, as it is sometimes called. The denominator is the total sum of squares SST. The subscription on R^2 indicates the y is the dependable variable and $x_1, x_2, \ldots, x_k$ one independent variable.

Therefore, it can be written as:

$$R^2 = \frac{SSR}{SST}$$

The coefficient of multiple determination what proportion of the total variability in y, the dependent variables is explained by the independent variables. That is the percentages of the total variation of the dependent variable that can be explain by the explanatory variables. The value of R^2 will be between zero and one, where $R^2 = 0$, the regression model cannot explain anything about the variation in the department variable or the estimated model of the data. The case of $R^2 = 1$ represents a perfect fit of the estimated model of the data. A high value of R^2 shows good fit and a low value of R^2 shows a poor fit.

3.8.10 The Adjusted Coefficient of Multiple Determination, $\bar{R}^2$

A measure that recognized the number of independent variables in the regression model is called the adjusted coefficient of multiple determination and is denoted by $\bar{R}^2$.

$$\bar{R}^2 = \frac{\Sigma(y_i - \hat{y})}{n-k-1} \Big/ \frac{\Sigma(y_i - \bar{y})}{n-1} \tag{3.15}$$

Reporting the adjusted R^2 is extremely important in comparing two or more regression models that predict the same dependent variable but have a different number of independent variables.

3.9 Multicollinearity

Due to Ragnar Frisch (1934), the term multicollinearity is meant the existence of exact, or a perfect, linear relationship among some or all explanatory variables of a regression model. There are several sources of multicollinearity. As Montgomery and peck (1982) note, multicollinearity may be due to these factors. (1) The data collection method employed, such as sampling over a limited range of the values taken by the regressors in the population. (2) Constraints on the model or in the population being sampled. (3) Model specification, for example, adding polynomial terms to a regression model, especially when the range of the x variable is small. (4) An over determined model.

Multicollinearity problem arises when one of the independent variables is linearly related to one or more of the other independent variables. Such a situation violates one of the conditions for multiple regression. Specially, multicollinearity occurs if there is a high correlation between two independent variables, x_i and x_j if the correlation coefficient r_{ij} between x_i and x_j in the multiple linear regression model is high, multicollinearity exist. Multicollinearity is a problem of degree.

Any time two or more independent variables are linearly related, some degree of multicollinearity exists. If its presence becomes too pronounced, the model is adversely affected. The presence of multicollinearity creates many problems in use of multiple linear regression model.

The most direct way of testing for multicollinearity is to produce a correlation matrix for all variables in the model. If a correlation is greater than 0.7 or less than - 0.7, the independent variables are highly correlated. If a correlation is less than 0.5, it can be concluded that multicollinearity is not problem. Another way to detect multicollinearity is use to value of Tolerance. If the value of Tolerance is not less than 0.1, it can be said that there is no multicollinearity problem in this study.

The third way to detect multicollinearity is to use the variance inflation factor (VIF).m The VIF associated with any x-variable is found by regression it on all the other x-variables. The resulting R^2 is then used to calculate that variable's VIF. The VIF for any x_i represents that variable's influence on multicollinearity.

The VIF for any independent variable is a measure of the degree of the multicollinearity contributed by that variable.

The VIF for any given independent variable x_i is

$$VIF(x_i) = \frac{1}{1-R^2} \tag{3.16}$$

where, ${R_i}^2$ is the coefficient of determination obtained by regression x_i on all other independent variables. Multicollinearity produces an increase in the variation, or standard error, of the regression coefficient. VIF measures the increase in the variance regression coefficient over that which would occur if multicollinearity were not present. In general, multicollinearity is not considered a significant problem unless the VIF of a single x_i measure at least 10 or the sum of the VIF's for all x_i is at least 10.

CHAPTER 4

ANALYSIS OF PADDY PRODUCTION IN THA LONE VILLAGE

In this section, the demographic conditions of rural paddy farmers from Tha Lone village are analyzed by descriptive method and paddy production by using Cobb-Douglas Production Function.

4.1 Profile of The Lone Village, Shwebo Township

Tha Lone Village is located at the north-west of Shwebo Township and it is far from there about 8 miles. This village was surrounded by Zee Gone Lay village in East, Hnamazayit Village and Zee Phyu Gone Village in West, Myin Chin Village and Sate Khon Village in South and Payan Village and Lait Chin Village in North. This village has a total population of 4670 inhabitants distributed in 850 households. Among them, 650 households grow monsoon and summer paddy and their major commercial crop is paddy. They owned 2732 acres of farmland. There are 268 males and 36 females in paddy farmers.

The majority of people living in Tha Lone Village are Burmese. For education, there is a high school for 152 students in this village. The main occupation is farmers. The villagers also grow bitter gourds, eggplants and beans, etc for own consumption and for sale. Tha Lone Village with housing plots are moderately wide and the houses are moderately spaced from one another. The main water supply in the studied area is Kar Boe Dam, which receives water from Tha Phan Sate dam, the biggest dam in the country (personal communication World Fish team Mandalay, May 13, 2019). The earthen ponds in Tha Lone Village receive water from the irrigation channel that comes from Kar Boe Dam. Most households in Tha Lone village have farming as their livelihoods which are mainly based on agriculture.

In addition to agriculture, the villagers also work as dairy farmers in livestock chickens, pigs, cows, goats, sheep, etc. Farmland indicates their social and economic status and it enhance their position in the society. Growing paddy does not make for year-round income and all members of social classes have alternative livelihoods on farm and off farm activities. In so doing, the upper and middle classes choose, based on affordability of financial investment, paddy milling, mechanical or hand weaving on the loom, gardening, paddy marketing, collecting and selling of sand, shop keeping, or commerce.

In paddy farming recess, the lower class goes for fishing, setting traps for eels, mouse trapping and vendoring, weaving on the loom, gathering of firewood, taking any available job, work as a daily-wage earner or working as migrant elsewhere.

4.2 Demographic Characteristics of Paddy Farmer in Tha Lone Village

The descriptive analysis for demographic characteristics of paddy farmers in Tha Lone village, Shwebo township is showed by gender, age, education, number of family members, number of students, income, monthly income, monthly expenditure, land acres and family labour of paddy farmers.

4.2.1 Gender of Households

The gender production of households is divided by males and females. It is shown in the following table 4.1.

Table 4.1 Gender of Household Heads

Gender	Frequency	Percent
Male	268	88.2
Female	36	11.8
Total	304	100.0

Source: Survey Data (2019)

According to the table 4.1, 88.2% of households are males and 11.8% of households are females. Therefore, it can be found that the number of male households are greater than that of females.

4.2.2 Age of Households

The age levels of households are classified into 7 groups such as (21-29), (30-38), (39-47), (48-56), (57-65), (66-74) and (75-95). The paddy farmers by age groups are shown in the following table 4.2.

Table 4.2 Age of Household Heads

Age Group	Frequency	Percent
21-29	4	1.6
30-38	44	14.5
39-47	46	15.1

Age Group	Frequency	Percent
48-56	66	21.7
57-65	86	28.3
66-74	32	10.5
75-95	25	8.2
Total	304	100.0

Source: Survey Data (2019)

According to the results in table 4.2, the age of paddy farmers is categorized into seven groups. The table described the age group between 21 and 29 years (1.6%), the age group between 30 and 38 years (14.5%), the age group between 39 and 47 years (15.1%), the age group between 48 and 56 years (21.7%), the age group between 57 and 65 years (28.3%), the age group between 66 and 74 years (10.5%) and the age group between 75 and 95 years (8.2%). The sample population for this study includes only households 21 years and older. The age group between 57 and 65 years is the largest with 28.3% and the age group between 21 and 29 years is the smallest with 1.6%.

4.2.3 Education of Households

The educational levels of paddy farmers were studied by dividing into four groups such as monastic, primary level, middle level and high level. The table 4.3 shows the educational level of paddy farmers.

Table 4.3 Education of Household Heads

Education	Frequency	Percent
Monastic	180	59.2
Primary	70	23.0
Middle	36	11.8
High	18	5.9
Total	304	100.0

Source: Survey Data (2019)

According to the table above, the educational levels are classified as monastic, primary, middle and high. According to the survey data, 180 paddy farmers are monastic level, its percentage is 59.2%, 23.0% are primary, 11.8% are middle and 5.9% are high educational level. So, it is found that the largest number of household heads are monastic education level and the smallest number of paddy farmers are high education level.

4.2.4 Family Size of Households

The following table describes that the total family number of paddy farmers.

Table 4.4 Family Size of Household Heads

Household Size	Frequency	Percent
1-3	105	34.5
4-6	177	58.3
7-9	22	47.2
Total	304	100.0

Source: Survey Data (2019)

According to the table above, 105 paddy farmers have between 1 and 3 family members, the percentage is 34.5%. One seventy-seven paddy farmers have between 4 and 6 family members which is 58.3%. 22 paddy farmers have 7 and 9 family members, it is 47.2%.

4.2.5 Number of Students of Households

The table 4.5 describes the total number of students of paddy farmers, family in Tha Lone village, Shwebo township.

Table 4.5 Number of Students of Household Heads

No. of Student	Frequency	Percent
No Student	152	50.0
1	95	31.3
2	48	15.8
3	8	2.6
5	1	0.3
Total	304	100.0

Source: Survey Data (2019)

As shown in the table 4.5, 152 paddy farmers do not have student and the percentage is 50.0%, 95 paddy farmers have only one student, it is 31.3%, 48 paddy farmers have two students, it is 15.8%, 8 paddy farmers have three students and the percentage is 2.6%. And then, least of paddy farmers have five students, it is 0.3 percent. The largest No student family is the largest number and its percentage is 50.0 percentage.

4.2.6 Income of Households

The table 4.6 shows that the net income of paddy farmers.

Table 4.6 Income of Households

Income (′000Kyats)	Frequency	Percent
1400-3000	44	14.5
3000-4600	91	22.9
4600-6200	101	33.2
6200-7800	41	13.5
7800-9400	22	7.2
9400-11000	4	1.3
11000-14000	1	0.3
Total	304	100.0

Source: Survey Data (2019)

In the table 4.6, the net income of 14.5% of paddy farmers are between 1400 kyats and 3000 kyats, the net income of 22.9% of paddy farmers are between 3000 kyats and 4600 kyats, the net income of 33.2% of paddy farmers are between 4600 kyats and 6200 kyats, the net income of 13.5% of paddy farmers are between 6200 kyats and 7800 kyats, the net income of 7.2% of paddy farmers are between 7800 kyats and 9400 kyats, the net income of 1.3% of paddy farmers are between 9400 kyats and 11000 kyats and the net income of 0.3% of paddy farmers are between 11000 kyats and 14000 kyats.

4.2.7 Monthly Expenditure of Households

In table 4.7 states that the monthly expenditure of paddy farmers.

Table 4.7 Monthly Expenditure of Households

Expenditure (′000Kyats)	Frequency	Percent
20-113	17	5.6
113-206	83	27.3
206-299	91	29.9
299-392	60	19.7
392-485	35	11.5
485-578	10	3.3
578-900	8	2.6
Total	304	100.0

Source: Survey Data (2019)

As the results, it is found that the expenditure of 5.6% of family is between 20 kyats and 113 kyats per month, the expenditure of 27.3% of family is between 113 kyats and 206 kyats, the expenditure of 29.9 % of family is between 206 kyats and 299 kyats per month and the expenditure of 19.7% of family is between 299 kyats and 392 kyats per month, the expenditure of 11.5% of family is between 392 kyats and 485 kyats per month, the expenditure of 3.3% of family is between 485 kyats and 578 kyats per month and the expenditure of 2.6% of family is between 578 kyats and 900 kyats per month.

4.2.8 Paddy Production of Tha Lone Village

The following table shows the paddy production in Tha Lone village.

Table 4.8 Paddy Production

Production (Bushel)	Frequency	Percent
Under1000	168	55.3
1000-2000	78	25.7
2000-3000	31	10.2
3000-4000	15	4.9
4000-7000	12	3.9
Total	304	100.0
Mean	1.7664	
Standard Deviation	1.0754	

Source: Survey Data (2019)

According to the above table, 168 paddy farmers produce under 1000 or 55.3%. 78 paddy farmers produce between 1000 and 2000 baskets or (25.7%). 31 paddy farmers produce between 2000 and 3000 baskets or (10.2%). 15 paddy farmers produce between 3000 and 4000 baskets or (4.9%). Twelve paddy farmers produce between 4000 and 7000 baskets or (3.9%). Based on the production amount of paddy, the paddy production is divided into five groups. Its mean is 1.7664 and the standard deviation is 1.0754. The largest number of paddy growers produce under 1000 bushels of paddy.

4.3 Input Factors for Paddy Production

In the analysis, the required data for this study were obtained from the survey of Tha Lone village. For collecting data, sample survey from the sample households, face to face personal interviews were utilized. The following summarize data is shown in the following table.

4.3.1 The Situation of Land Ownership of Paddy Farmers

The following table shows that the situation of land ownership of paddy farmers.

Table 4.9 Land Utilization for Farming

Land (Acre)	Frequency	Percent
1-10	231	75.9
11-20	55	18.1
21-30	14	4.7
31-40	4	1.3
Mean	7.73	
Standard Deviation	6.936	

Source: Survey Data (2019)

According to the above table, 75.9% of households owned between 1 acre and 10 acres, 18.1% of households owned between 11 acres and 20 acres, 4.7% of households owned between 21 acres and 30 acres and 1.3% of households owned between 31 acres and 40 acres. Its mean is 7.73 and the standard deviation is 6.936.

4.3.2 Family Labour of Farming

The table 4.10 shows that the utilization of family labour of paddy farmers.

Table 4.10 Family Labour of Farming

Number of Labour	Frequency	Percent
1-3	153	50.4
4-6	142	46.7
7-9	9	2.9
Mean	3.63	
Standard Deviation	1.327	

Source: Survey Data (2019)

According to the table result, 50.4% of paddy farmers have between 1 and 3 family labour, 46.7% of paddy farmers have between 4 and 6 family labour, 2.9% of paddy farmers have between 7 and 9 family labour. Its mean is 3.63 and the standard deviation is 1.327.

4.3.3 Capital of Paddy Farmers

The following table shows the capital of paddy farmers.

Table 4.11 Capital for Farming

Capital Use (′000 Kyats)	Frequency	Percent (%)
Under 700	55	18.1
700-1400	82	27.0
1400-2100	55	18.1
2100-2800	21	6.9
Over 2800	91	29.9
Mean	2364631.47	
Standard deviation	2101436.680	

Source: Survey Data (2019)

According to the above table, the capital include fertilizer, seed and machinery of paddy farmers are divided into five groups. It is found that the largest number of paddy farmers invested over 2800 group, its percentage is 29.9%. The average capital of paddy farmers is 2364631.47 and standard deviation is 2101436.680.

4.4 Cobb-Douglas Production Function for Paddy Production

A Cobb-Douglas production function models the relationship between production output and production inputs factors. It is used to calculate ratios of inputs to one another for efficient production and to estimate technological change in production methods. The Cobb- Douglas production function model is demonstrated on the basis of primary data which is collect Tha Lone Village. Sample of 304 paddy farmers are used in this study. The model is constructed by using three independent variables such as land, labour and capital. Paddy production is used as dependent variable. To fit the model, land labour and capital are used as independent variables.

In constructing the model, the variables are noted as

YIELD = Paddy-production

LAND = Land

LAB = Labour

CAP = Capital

Cobb-Douglas production function takes the following form

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k + \mu_i$$

The log-transform this model is

$$\ln Y_i = \ln \beta_1 + \beta_2 \ln X_{2i} + \beta_3 \ln X_{3i} + \mu_i$$

$$= \beta_0 + \ln \beta_1 + \beta_2 \ln X_{2i} + \beta_3 \ln X_{3i} + \mu_i$$

where, $\beta_0 = \ln \beta_1$

The Cobb-Douglas production function is given as;

$$\ln PRCP = \beta_1 + \beta_1 \ln LAND + \beta_3 \ln LAB + \beta_4 \ln FER + \mu$$

Where, μ is disturbance term and unknown parameters β_1, β_2, β_3, and $\beta_4$in Cobb-Douglas production function is estimated by using the Statistical analysis. The calculated results are described in the Cobb- Douglas production function of paddy production in the following.

Table 4.12 Result for Cobb-Dougals Production Function of Paddy Production

	B	t	Sig.
(Constant)	3.849	7.710	0.000
Ln LAND	0.955***	21.523	0.000
Ln LAB	0.076	0.763	0.446
Ln CAP	0.081**	2.298	0.022
F - ratio	193.589***		
R	0.812		
R^2	0.659		
Adjusted R^2	0.659		

Source: Survey Data (2019)

Note: (* = Significant at 10% level, ** = Significant at 5% level, *** = Significant at 1% level)

The result of Cobb-Douglas production function of paddy production was shown in table. The p value is determined by the F- statistics and it can be concluded that the overall regression is significant at 1% significance level. The value of coefficient of determination $R^2$was 0.659. It shows that the proposed model explained 65.9% variations in the log of paddy production as a result of variations in the logs of land, labour and capital. The regression equation for paddy production is

$$\ln Y_i = 3.849 + 0.955 \ln LAND + 0.076 \ln LAB + 0.081 \ln CAP$$

The values of the coefficients indicate the elasticity of various inputs to the outputs. The coefficient of land is significant at 1% level respectively. The coefficient of land was positive and significant. Paddy production elasticity of land, labour and capital were 0.955, 0.076 and 0.081 respectively. The results shows that a one percent increase in land is associated with a 0.955 percent increase in paddy production holding labour and capital constant. Each additional labour is associated with a 0.076 percent increase in paddy production holding land and capital. And then, capital is associated with a 0.081 percent increase in paddy production holding land and labour constant.

Cobb-Douglas production function model was used to check a study on paddy output due to a various input. The model is defined independent variables such as land and capital but labour is not used as this variable is not significant collected with paddy production. Paddy production is defined as dependent variable. Therefore, Cobb-Douglas production function is recomputed without labour. The calculated results are described in the Cobb- Douglas production function of paddy production in the following.

Table 4.13 Return for Cobb-Douglas Production Function of Land and Capital

	B	**t**	**Sig.**
(Constant)	3.849	7.710	0.000
Ln LAND	0.955***	21.523	0.000
Ln CAP	0.081**	2.298	0.022
F - ratio	193.589***		
R	0.812		
R^2	0.659		
Adjusted R^2	0.659		

Source: Survey Data (2019)

Note: (* = Significant at 10% level, ** = Significant at 5% level, *** = Significant at 1% level)

The result of Cobb-Douglas production function of paddy production was shown in table. The p value is determined by the F- statistics and it can be concluded that the overall regression is significant at 1% significance level. The value of coefficient of determination $R^2$was 0.659 and it was fine in case of cross section data. It shows that the proposed model explained 65.9% variations in the log of paddy production as a result of variations in the logs of land, labour and capital. The regression equation for paddy production is

$$\ln Y_i = 3.849 + 0.955 \ln LAND + 0.081 \ln CAP$$

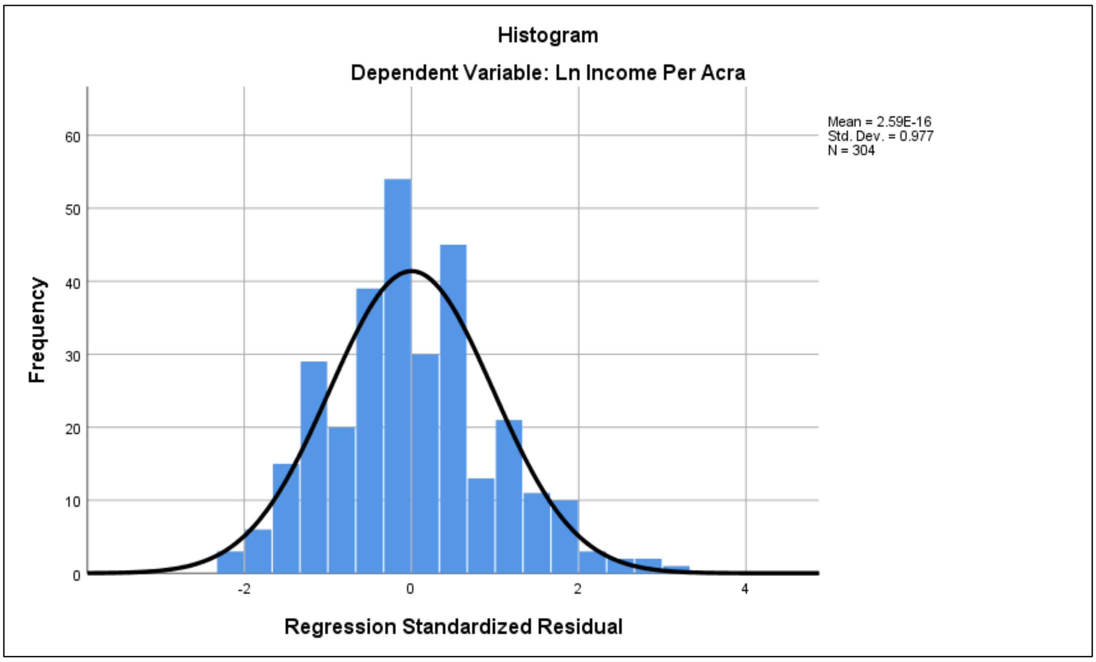
The values of the coefficients indicate the elasticity of various inputs to the outputs. Considering land, the elasticity values indicates that if land under cultivation is increased by 1% yield of paddy would increase by 0.955%. If capital increases by 1% yield of paddy would increase by 0.081%. Use of land mostly depends on condition of crop. Return to scale was estimated by summing production such as land and capital in paddy production. The value of return to scale was which 1.036l which implies the presence of increasing return to scale. It means that increase in paddy output is equal to the input by 1%.

4.5 Testing for the Assumption

To determine the required assumption from Cobb-Douglas production model for paddy production, the following procedures have been used.

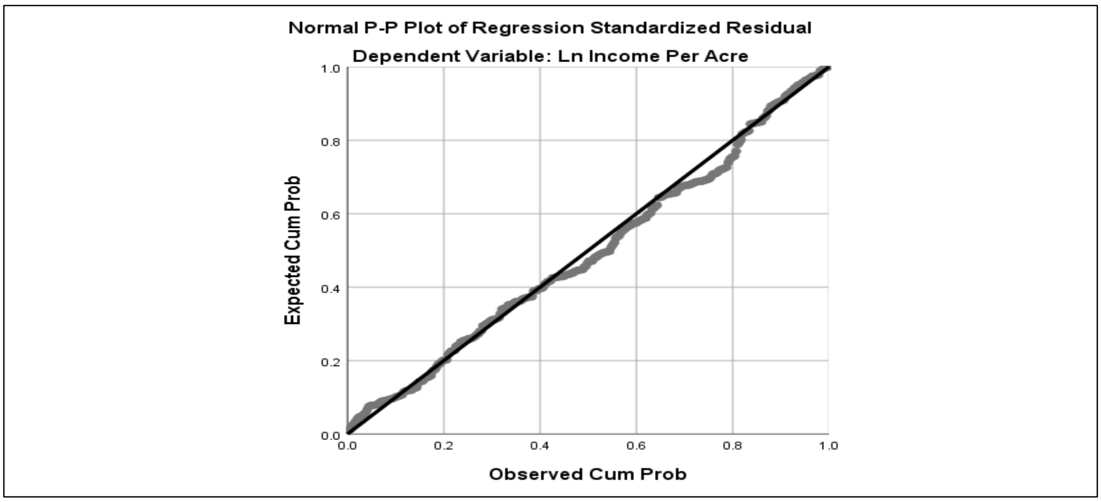
4.5.1 Test for Normality of Disturbances

The first assumption of the Ordinary Least Squares (OLS) model is that disturbances are a normal variable and is normally distributed with mean zero and variance constant. To check whether the disturbances are normally distributed, Histogram and Normal plot of the disturbances of oilseed production can be constructed. The Histogram of disturbances and the Normal plot of disturbances for paddy production are shown in Figure 4.1 and 4.2.



Source: Survey Data (2019)

Figure 4.1 Histogram of Disturbances of Paddy Production



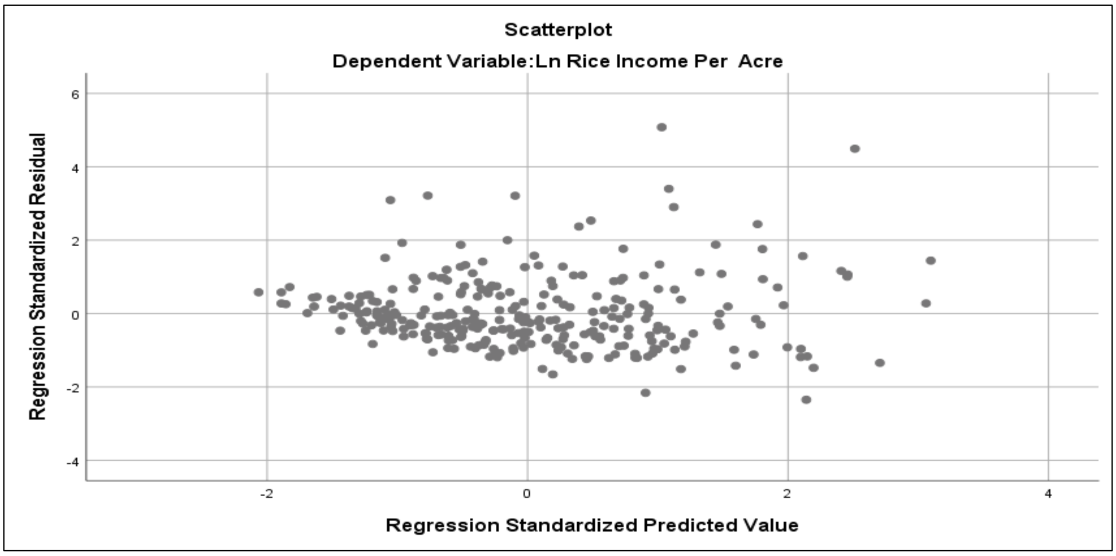
Source: Survey Data (2019)

Figure 4.2 Normal Plot of disturbances for Paddy Production

According to histogram and normal plot, it can be concluded that the normality assumption appears to be generally reasonable.

4.5.2 Testing for Equal Variance (Homoscedasticity)

Another basic assumption of the multiple regression model is homoscedasticity. In the presence of heteroscedasticity the regression coefficients become less efficient. Heteroscedasticity can often be detected by plotting the estimated Y values against the disturbances. Figure 4.3 present the predicted paddy production on x axis and the disturbance for paddy production on y axis.



Source: Survey Data (2019)

Figure 4.3 Residual Pattern for Heteroscedasticity

The figure can be seen that there is no residual pattern. Therefore, it can be concluded that residuals in paddy production have on equal variance or homoscedasticity.

4.5.3 Detecting Multicollinearity

The problem of multicollinearity, which is a problem of higher correlation among the independent variables in the model, is also assessed. The most direct way of testing for multicollinearity is to produce a correlation matrix for all variables in the model. The correlation matrix for all variables of the multiple regression model of paddy production is as follow.

Table 4.14 Correlation Matrix

	Ln LAND	**Ln LAB**	**Ln CAP**
Ln LAND	1	-0.007	-0.340
Ln LAB	-0.007	1	-0.109
Ln CAP	-0.340	-0.109	1

Source: Survey Data (2019)

According to the correlation matrix, it was found that correlation between log of land and log of labour is -0.007, correlation between log of land and log of capital is -0.340 and correlation between log of labour and log of capital is -0.109 respectively. If a correlation is greater than 0.7, the independent variables are highly correlated. Therefore, it can be concluded that there is no multicollinearity in this problem.

This problem can also be deleted from the value of Tolerance and VIF (variance inflation factor). If the correlation among the independent variables, weak association and the value of the Tolerance is not less than 0.1 and the value of the VIF is not above 10, it is the indication of absence of multicollinearity problem. According to the findings from this study. Tolerance and VIF value of independent variables are shown in following table.

Table 4.15 Tolerance and VIF of Independent Variables

No	**Independent Variable**	**Tolerance**	**VIF**
1	Ln LAND	0.872	1.147
2	Ln LAB	0.986	1.014
3	Ln FER	0.882	1.133

Source: Survey Data (2019)

According to the Table 4.15, among the independent variables, it is found that the collinearity statistics of the value of Tolerance is not less than 0.1. Based on the coefficient, output collinearity statistics, variance inflation factor (VIF) value of each predictor variable is obtained 1.147, 1.014 and 1.133, respectively. Thus, since VIF values are less than 10, there is no multicollinearity in this study.

4.6 Multiple Linear Regression Model for Paddy Production in Tha Lone Village

The multiple regression analysis is applied to investigate the factors of income in households of paddy farmers in Tha Lone Village. To develop the multiple regression model, the log of income of paddy farmers is used as dependent variable and gender, age, education, log of expenditure, family labour, total family member, paddy difficulty and ministry supporting are used as independent variables.

Multiple Regression equation is

$\hat{Y} = \beta_0 + \beta_1 X_1 + \beta_2 X_3 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7$

Y = Log of Income per acre

X_1 = Ln Expense

X_2 = Climate/ Weather Condition

X_3 = Rain Total Yield

X_4 = Capital Difficulty

Table 4.16 Multiple Regression Model of Paddy Production in Tha Lone Village

Model	Coefficient	Standard Error	t test	Sig
(Constant)	14.928	0.060	247.882	0.000
Ln Expense	0.576	0.043	13.299	0.000
Climate/ Weather Condition	-0.144	0.039	-3.683	0.000
Rain Total Yield	0.186	0.000	10.358	0.000
Capital Difficulty	-0.104	0.039	-2.700	0.007
R^2	0.593			
Adjusted R2	0.587			
F-value	87.012			

Source: Survey Data (2019)

Dependent variable: Log of Income per acre

*** denotes significant at 1% level, ** denotes significant at 5% level, * denotes significant at 10% level.

Multiple Regression Equation is

$\hat{Y}$ $=14.028 + 0.576X_1 - 0.144X_2 + 0.186X_3 - 0.104X_4$

Results show that F value is 87.012 that is significantly at p=0.000(<0.01), suggesting that independent variables are significantly. Adjusted R^2 is 0.593. It had been found that the natural log of expenditure, weather condition, rain total yield and capital difficulty are statistically significance at 1 percent level, rain total paddy yield is statistically significance at 1% level.

The regression coefficient between the natural log of income per acre and natural log of expense is 0.576 (t=13.299, p=0.000). There is direct relationship between log of income per acre and log of expenses. It is shows that, log of expense will be increased by 1% the total income of paddy farmers will be increased by 57.6%. It implies that the more increase rice expense of the paddy farmers the more earned for socio-economic of farmers.

The regression coefficient between log of income per acre and paddy production difficulty of weather condition is - 0.144 (t= - 3.683, p=0.000). If weather condition changes increases by 1% the total income of paddy farmers would decrease by 14.4%. This shows that there is negative relationship between log of income per acre and weather condition because climate change can affect crop yield of paddy in the future. So, the income from paddy production is dramatically decreased.

The regression coefficient between log of income per acre and rain total yield is 0.186 (t=10.358, p=0.000). If rain total yield increases by 1% the total income of paddy farmers would decrease by 18.6%.This shows that there is direct relationship between log of income per acre and rain total yield because the more rain total yield the more income.

The regression coefficient between log of income per acre and ccapital ddifficulty is -0.104 (t = -2.700, p = 0.007). If capital investment changes increases by 1% the total income of paddy farmers would decrease by 10.4%.This shows that there is negativet relationship between log of income per acre and capital difficulty. It is show that capital is associated with higher rate of income because capital investment can lead to higher farm productivity and increase income availability of paddy, thereby reducing poverty by raising mean income.

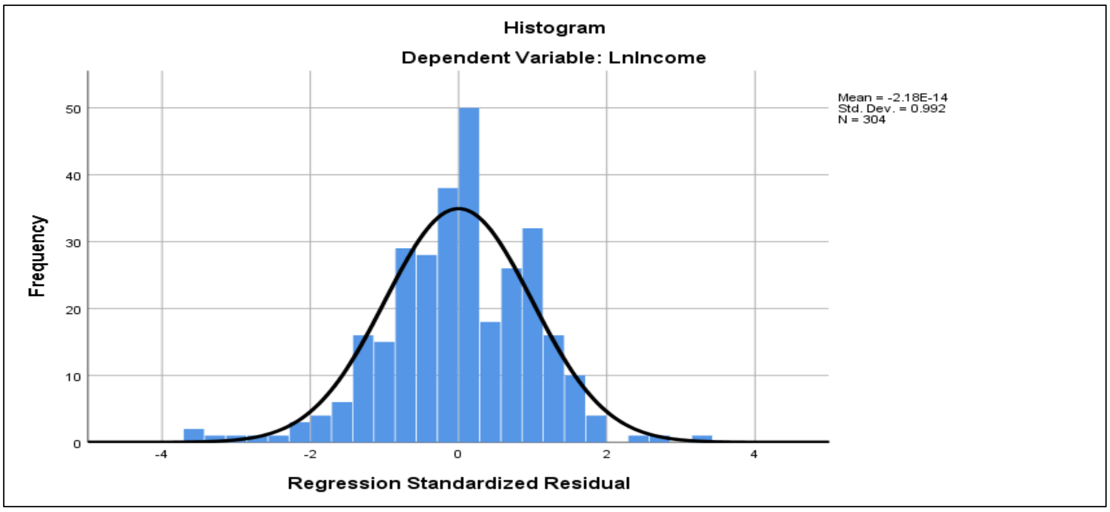
4.7 Testing for the Assumption about Multiple Regression

To determine the violation of required assumption from multiple linear regression models for demographic characteristics of paddy farmer in Tha Lone Village, the following procedures are used.

4.7.1 Testing for Normality of Disturbance

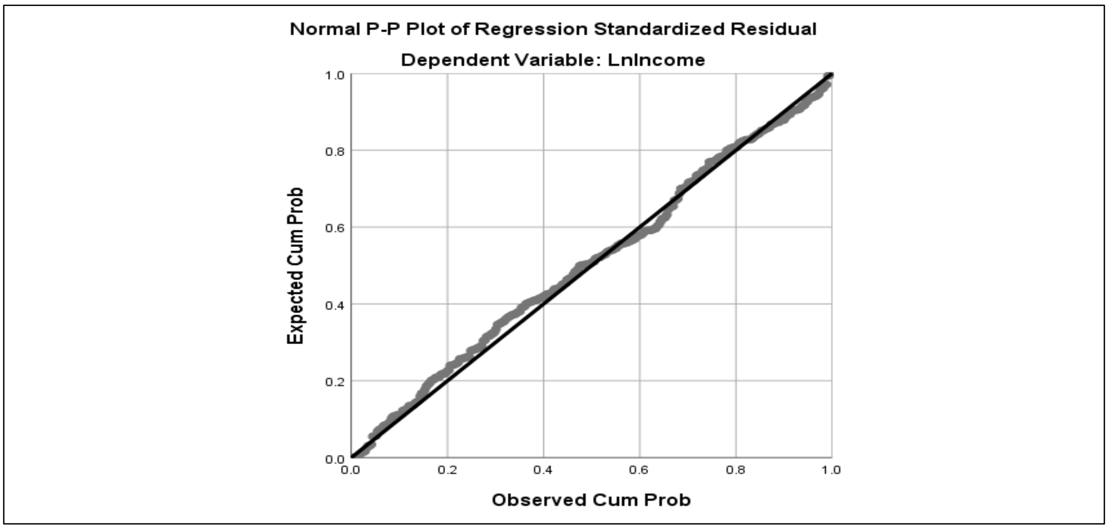
One of the basic assumption is that disturbance are normally distributed with zero mean and constant variance. To check whether the disturbances are normally distributed, histogram, and Normal P-P plot of the disturbances can be constructed. There exists histogram of the standardized residual and Normal P-P plot of the standardized residual for demographic characteristics of paddy farmers in Tha Lone Village, Shwebo Township. These plots are shown in figure 4.4, 4.5.

The histogram in figure 4.5 appears to be pile fashioned. Similarly, The Normal P-P plot is virtually straight line. According to histogram and Normal P-P plot, it can be concluded that the normality assumption appears to be generally reasonable.



Source: Survey Data (2019)

Figure 4.4 Histogram for Residuals

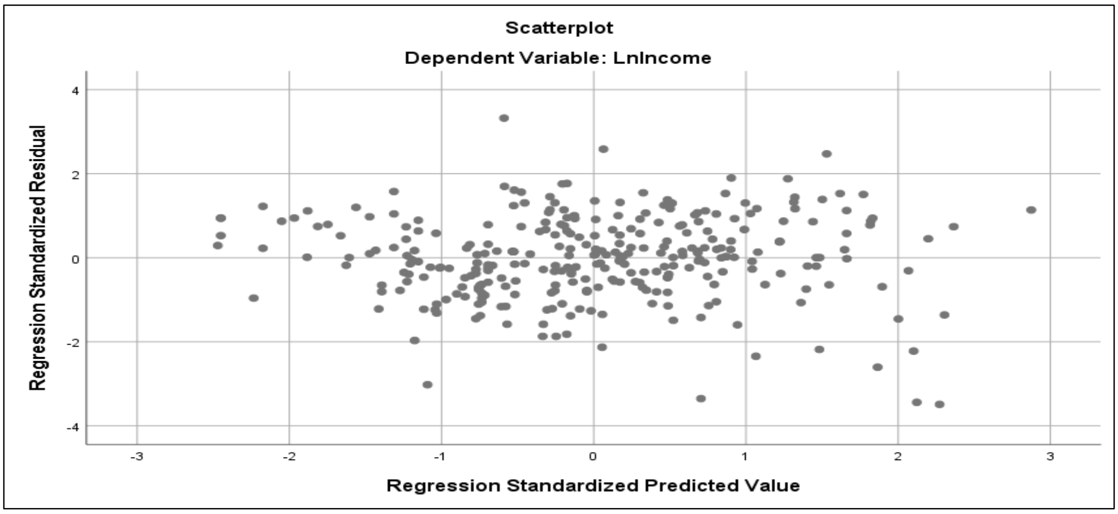


Source: Survey Data (2019)

Figure 4.5 Normal P-P Plot for Residuals of Paddy Production

4.7.2 Testing for Homoscedasticity of Disturbances

The two figures are error plots. The White test is to be used in this study to detect the presence of heteroscedasticity. Another basic assumption of multiple regression models is homoscedasticity. In the presence of heteroscedasticity the regression coefficients become less efficient. Heteroscedasticity can often be detected by plotting the estimated Y values against the disturbances. If any pattern is displayed, heteroscedasticity is likely present. Figure 4.6 represents the predicted value on X axis and the residual value on Y axis.



Source: Survey Data (2019)

Figure 4.6 Residual Pattern for Heteroscedasticity of Paddy production

The figure shows that heteroscedasticity appears to be absent.

4.7.3 Detecting Multicollinearity

Multicollinearity arises when one of the independent variables is linearly related to one or more of the other independent variables. Such a situation violates one of the assumptions for multiple regression. Specifically, multicollinearity occurs if there is a high correlation between two independent variables.

Table 4.17 Tolerance and VIF of Independent Variables

No	Independent Variable	Tolerance	VIF
1	Ln Expense	0.901	1.110
2	Climate	0.859	1.165
3	Rain Total Yield	0.863	1.159
4	Capital Difficulty	0.884	1.132

Source: Survey Data (2019)

To detect multicollinearity is to use the variance inflation factor (VIF). It is measured the degree of multicollinearity contributed by independent variable. In the multiple regression model, the VIF for age, log of monthly expenditure, climate, rain total yield and capital difficulty are 1.110, 1.165, 1.159 and 1.132 respectively. The sum of VIF for these independent variables is 8.085. Since the sum of the VIF is less than 10, then it is concluded that multicollinearity is not serious problem in the multiple regression model for paddy production.

CHAPTER 5
CONCLUSION

This chapter presents on the conclusion of the study based on relevant suggestions, recommendations and other necessary factors for the further study will be described in this section.

5.1 Findings and Discussion

Myanmar is agricultural country and agriculture sector is the backbone of its economy. Agriculture sector accounting for more than 26 percent of GDP and 70 percent of the population resides in rural area and all most of them are engaged in agriculture sector. Compared to any other sector within an economy, growth in agriculture productivity has directly involved in raising real incomes of the rural poor and thus reducing poverty. Paddy production can not only provide employment opportunities but also give to diversification in such job opportunities especially in rural areas. Therefore, increase in paddy production is the most important factor in GDP growth and socioeconomic development.

The present study emphasized on the changes of paddy production in the study area. This study was conducted to understand the changes of paddy areas and the operation of cultivation practices such as variety, land preparation, establishment methods, use of chemical fertilizers, weed control method, harvesting method, and paddy yields etc.

Growing paddy is profitable that the producing cost is high since it is in great demand in the paddy market for Shwebo Paw San. Paddy is the most important crop in Myanmar and it is also export it. It is an important product not only local consumption but also for export. Moreover, it is an industrial raw material and has high demand for domestic need as well as foreign exchange earnings. Therefore, the opportunity of employments for the people of this township would be created.

According to research objective (1), in this analysis, 304 paddy farmers from Tha Lone village, Shwebo township, Sagaing region are selected and surveyed with structured questionnaire. The family members of paddy farmers are found between 1 and 9 members. The optimum family numbers and daily worker are highest in this area. The head of plantation of most of the paddy farmer is male and 11.8% is female. It can be found that the age of the paddy farmers is between 57 and 65 years. The proportion of working age is larger than that of dependents in study area. The paddy farmers are mostly monastic school level. It is found that the number of higher educational level farers is low. As a result, it can be concluded that the number of labour force in the study area is high.

The optimum family numbers and daily worker are highest in this area. According to the result, the largest number of paddy farmers owned between 1 acre and 10 acres of farming land. From the data collection, the family labour of paddy farmers is found that most of households have between 2 and 5 family labour. Income of paddy farmers per month are usually between 100 ('000 Kyats) and 1150 ('000 Kyats) in this village. Expenses of paddy farmers per month are usually between 20 ('000 Kyats) and 900 ('000 Kyats) in this village. Thus, the economic condition of the sample paddy farmers in the study area is low income and expenditure.

According to research objective (2), Coefficient of determination $R^2$and F-statistics were 0.659 and 193.589, respectively which indicate the overall goodness of Cobb-Douglas model. Land and capital were observed to affect paddy output significantly. The elasticity value indicates that if land under cultivation is increased by 1%, yield of paddy would increase by 0.955%.

According to research objective (3), Return to scale was estimated by summing production such as land and capital in paddy production. There exists increasing return to scale but its value would increase after efficient use of all inputs, so, increase in paddy output is equal to the input by 1%.

The Cobb-Douglas production function model for paddy production has the error term is normal distributed. And then, the residual in paddy production has an equal variance or homoscedasticity. Finally, there is no multicollinearity problem in this study of paddy production. The Cobb-Douglas production function model for paddy production of Tha Lone village in Shwebo township, Sagaing region is satisfied.

According to multiple regression model, the relationship between the log of monthly income and the log of monthly expenditure for paddy farmers is positive relationship. The relationship between the log of monthly income and the log of monthly expenditure, age of household heads, education of household heads, loan, family size and student size for paddy farmers is negative relationship. If there is more increasing in the log of monthly expenditure for paddy farmers as 1 Kyat, the log of monthly income for paddy farmers is more decreasing in 0.018 Kyats. The income of paddy farmers are depend on log of monthly expenditure, the number of students, loan and ministry supporting, age of household heads, education of household heads, occupation, family size and student size.

The multiple regression model for paddy production has the error term is normal distributed. And then, the residual in paddy production has an equal variance or homoscedasticity. Finally, there is no multicollinearity problem in this study of paddy production. The multiple regression model for paddy production of Tha Lone village in Shwebo Township, Sagaing region is satisfied.

5.2 Conclusion

At present, the socioeconomic status of farmers has been adversely affected by the effects of climate change and natural disasters. Most farmers live on small holdings of land in rural areas and also lack of information on the global supply and demand conditions that affect local paddies. The paddy is mostly declined at the harvest time. They have limited access to crop management knowhow and weather forecasts that impact agricultural operations. Making matter worse, farmers are at the receiving end of an expensive, highly fragmented supply chain with underdeveloped infrastructure.

Largely controlled by unscrupulous middlemen, these value chains plough back only a small share of the consumer paddies to the farmers. As a consequence, most farmers have not been able to break out economic down town they have experience from chronically low productivity, low income and raising indebtedness.

Most landless households are doing temporary migration to seek non-farm jobs. So, the effective ways of improving productivity are required. The production of paddy has the potential for rapid growth by using high yielding varieties including adoption of good agricultural practice (GAP), utilization of good quality high-yielding seeds, application of agricultural inputs such as irrigation water, agro-chemicals and natural fertilizers and promotion of farm machineries utilization as technology intervention.

The government should support the transforming from traditional farming to mechanized farming. Land improvement from the traditional small-scale crop cultivation to modernized large scale agricultural farming should be encouraged by private sector is being undertaken in the existing agricultural land through proper drainage, irrigation and farm roads. There are also needed to support the education and training programs for effective use of pesticides and fertilizer to farmers by local governments. Human resource development program is essential for the productivity improvement. Well qualified person is required to undertake the effective development of research activities, technologies and human resources.

Utilization of good quality seeds is vital to increase paddy production. The government should expand seed production farms and quality seed zones, on-farm demonstration plot for farmers between government agencies and private organizations in order to sufficiently supply locally adaptable seeds and disseminate proven technologies. It is needed to encourage private/ public sector to implement farm machine's rent and share programs to increase better utilization of machines.

The highest used of fertilizer and interest rates push up production costs, and then decrease farmer's income. Farmers cannot use the optimum amount of fertilizers due to limited working capital, insufficient credit amount and higher interest rate in informal credit markets. The use of fertilizer per hectare remains still low.

The successive policies are also required to enhance the paddy production, to create incentive for farmers and also had impact on paddy export at the world market in term of quality and quantity. Several million hectares still remain to be developed in Myanmar. If the sufficient quality and quantity of processing facilities are used in paddy production, Myanmar will return reach to the world's largest exporter of paddy.

5.3 Suggestions and Recommendations

The government should support the paddy farmers in Tha Lone village in Shwebo Township in testing soil to differentiate the types of land. Modern technology should be taking on for superior labour cost control. The policy makers and researcher's considerations of climate change effect on paddy production. Effort should be made by the concern services, agencies to create more awareness about improved variety and adoption of plant protection measures in paddy in the study area. Timely proper guidance to the paddy farmers from the concern person is needed as paddy is perishable crop.

To encourage application of quality seeds by farmers participation in seed production programs which would be promoted by the Department of Agricultural in collaboration with private sectors and other agricultural organizations. To provide training and educational programs for all farmers on seed production, capacities in mechanization and GAP by Department of Agricultural and other concerning institutions. It is needed to coordinate between public and private sectors in order to available combine harvester and machines in time for farmers.

Many factors affecting farm production can be influenced by the government through service delivery and an enabling policy environment. Paddy farmers widely use urea and compound fertilizers for paddy production in both monsoon and dry seasons, but often at inefficient application rates and inappropriate nutrient compositions. Paddy farmers with access to irrigation and working capital or loans can make good money producing dry season rice paddy. But those in drier places without access to working capital have to pick more economically suitable crops, usually pulses and oilseeds.

These recommendations are supported by the experience of Myanmar's efforts to boost its own paddy production, which show that using better quality seed, effective use of fertilizer and better irrigation facilities can lead to a dramatic improvement in paddy production. There is a need for the Department of Agricultural Research (DAR) and the Department of Agriculture (DOA) to implement improved research that helps develop the production and distribution of better-quality seed. The government should also encourage the private sector to invest in the agriculture sector, especially in the rural credit market, where the Myanmar Agricultural Development Bank mainly provides credits at a subsidized interest rate.

5.4 Needs for Further Study

This study focused on the analysis paddy production of paddy farmers in Tha Lone Village. There are many variables to measure paddy production, the highest level completed is only observed. Due to the available data, there is a need for review the empirical evidence of the impact of several determinants on paddy production such as type of settlement, drought prone, irrigation, income, etc.

Further research on the effect of determinants of paddy production should be carried out to find the different impacts based on the primary data. Moreover, further study should be extended to the other variable such as water, pesticide, higher labour and seed quality etc. If all points of view can be considered, the thesis will be more interested. This study used Cobb-Douglas production function model and multiple regression models. If the other technique is used, the better results can be obtained.

REFERENCES

Abdulai, A. and W, Huffman. 2000. "Structural Adjustment and Economic Efficiency of Rice Farmers in Northern Ghana," Economic Development and Cultural Change 48: 503- 520.

Abiola, O. A., Mad, N. S., Alias, R., & Ismail, A. (2016). Resource-use and allocative efficiency of paddy rice production in Mada, Malaysia. *Journal of Economics and Sustainable Development*, *7*(1).

Aigner, D. J; C. A, Knox Lovel, and P, Schmidt. 1977. Formulation and Estimation of Stochastic Frontier Function Models, Journal of Econometrics 6 (July): 21–37.

Ali, F; A. Parikh, and M. K. Shah, 1994. Measurement of Profit Efficiency Using Behavioral and Stochastic Frontier Approaches, Applied Economics 26 (February): 181–88.

Ali, F; S. C. Kumbhakar, and A. Bhattacharyya. 1992. Price Distortions and Resource-Use Efficiency in Indian Agriculture: A Restricted Profit Function Approach, Review of Economics and Statistics 74 (February): 231–39.

Akhtar, R., & Masud, M. M. (2022). Dynamic linkages between climatic variables and agriculture production in Malaysia: A generalized method of moments approach. *Environmental Science and Pollution Research*, *29*(27), 41557-41566.

Akighir, D. T., & Shabu, T. (n.d.). Efficiency of Resource use in Rice Farming Enterprise in Kwande Local Government Area of Benue State, Nigeria. *International Journal of Humanities and Social Science*.

Amaechina Ebele, C., & Eboh Eric, C. (2017). Resource use efficiency in rice production in the lower Anambra irrigation project, Nigeria.

Antriyandarti, E. (2015). Competitiveness and Cost Efficiency of Rice Farming in Indonesia. *Journal of Rural Problems, 51*(2), 74–85. DOI: 10.7310/arfe.51.74

Asian Development Bank . (2013) : Annual Report 2013

Aurora, S. K., Cao, Y., Bowyer, S. M., & Welch, K. M. A. (1999). The occipital cortex is hyperexcitable in migraine: experimental evidence. *Headache: The Journal of Head and Face Pain*, *39*(7), 469-476.

Avery, P., Besson, D., Garren, L., Yelton, J., Kinoshita, K., Pipkin, F. M., ... & CLEO Collaboration. (1991). Inclusive production of the charmed baryon Λ c+ from e+ e− annihilations at s= 10.55 GeV. *Physical Review D*, *43*(11), 3599.

Ayambila, S. N., Kwadzo, G. T., & Asuming-Brempong, S. (2008). Economics of rice production: an economic analysis of rice production systems in the upper east region of Ghana. *Ghana Journal of Development Studies*, *5*(1), 95-108.

Aye, S. S. (2022). *A Study on Contract Farming of Paddy Production in Myanmar Agricultural Sector* (Doctoral dissertation, MERAL Portal).

Bashir, A., & Yuliana, S. (2019). Identifying factors influencing rice production and consumption in Indonesia. *Jurnal Ekonomi Pembangunan: Kajian Masalah Ekonomi Dan Pembangunan*, *19*(2). https://doi.org/10.23917/jep.v19i2.5939

Bachani, H. G. (2013). *PROFIT OPTIMIZATION THROUGH COBB DOUGLAS PRODUCTION FUNCTION, A CASE STUDY OF JS BANK* (Doctoral dissertation).

Badisha, S. H., Hossain, M. A., Alam, R. & Hasan, M. M. (2018). Credit, tenancy choice, and agricultural efficiency: Evidence from the northern region of Bangladesh. *Economic Analysis and Policy, 57*(C), 22–32. DOI: 10.1016/j.eap.2017.10.001

Banaeian, N., Omid, M., & Ahmadi, H. (2011). Energy and economic analysis of greenhouse strawberry production in Tehran province of Iran. *Energy Conversion and management*, *52*(2), 1020-1025.

Bashir, A., & Yuliana, S. (2019). Identifying factors influencing rice production and consumption in Indonesia. *Jurnal Ekonomi Pembangunan: Kajian Masalah Ekonomi dan Pembangunan*, *19*(2), 172-185.

Basnet, B., Luitel, G., Sah, A., Baral, S., & Ghimire, M. (2022). Analysis of profitability and effect of factors of production in paddy cultivation in Morang, Nepal. *Archives of Agriculture and Environmental Science*, *7*(3), 425-431

Battese, G.E. and T. Coelli. 1995. "A model of Technical Inefficiency effects in a Stochastic frontier production Function for Panel Data", Empirical Economics, 20: 325- 32.

Bonou-gbo, Z., Djedatin, G., Dansi, A., Dossou-Aminon, I., Odjo, C. T., Djengue, W., & Kombate, K. (2017). Biosciences and Plant Biology. *Int. J. Curr. Res. Biosci. Plant Biol*, *4*(5), 9-29.

Calpe, C. (2006). Rice international commodity profile. *Rome: Food and Agricultural Organization of the United Nations*.

Chandio, A. A., Jiang, Y., Gessesse, A. T., & Dunya, R. (2017). The Nexus of Agricultural Credit, Farm Size, and Technical Efficiency in Sindh, Pakistan: A Stochastic

Production Frontier Approach. *Journal of the Saudi Society of Agricultural Sciences*, *18*(3), 348-354.

Chirwa, E. W. 2007. "Sources of Technical Efficiency among Smallholder Maize Farmers in Southern Malawi," AERC Research Paper: African Economic Research Consortium, Nairobi.

David, M. Z., & Daum, R. S. (2010). Community-Associated Methicillin-Resistant *Staphylococcus aureus*: Epidemiology and Clinical Consequences of an Emerging Epidemic. *Clinical Microbiology Reviews*, *23*(3), 616–687. https://doi.org/10.1128/CMR.00081-09

Dawe, D. (2002). The changing structure of the world rice market, 1950-2000. Food Policy, 27(4), 355-370.

Denning, G., Baroang, K., & Sandar, T. M. (2013). Background paper No. 2 rice productivity improvement in Myanmar. Retrieved May, 30, 2014.

Department of Agriculture. (2013). Myanmar Agriculture in Brief. Ministry of Agriculture and Irrigation. Naypyitaw, Myanmar.

Diaz, C., & Tatiana, L. (2020). Socio-economic analysis of aquaculture groups in Hta Naung Wun Village and Shwe Baw Kyun Village in Shwebo Township, Myanmar.

DOA 2013.pdf. (n.d.).

Farrell, M. J. 1957. „„The Measurement of Productive Efficiency,"" Journal of the Royal Statistical Society, ser. A (general) 120: 253–81.

Felipe, J., & Adams, F. G. (2005). " a theory of production" the estimation of the cobb-douglas function: A retrospective view. *Eastern Economic Journal*, *31*(3), 427-445.

Firdaus, R. R., Leong Tan, M., Rahmat, S. R., & Senevi Gunaratne, M. (2020). Paddy, rice and food security in Malaysia: A review of climate change impacts. *Cogent Social Sciences*, *6*(1), 1818373.

Food and Agriculture Organization of the United Nations . (1999a). The Stage of food and Agriculture.

Food and Agriculture Organization of the United Nations . (2006). Rice International Commodity Profile, Markets and Trade Division.

Hayami, Y., & Ruttan, V. W. (n.d.). *INDUCED INNOVATION IN AGRICULTURAL DEVELOPMENT*.

Hayat, U., Khan, K., Liaqat, S., & Xiangyu, G. (2020). Determinants of Rice Productivity in District Nasirabad, Balochistan. *Sarhad Journal of Agriculture*, *36*(2). https://doi.org/10.17582/journal.sja/2020/36.2.567.573

Ida, F. C. (2018). Efficiency analysis of production factors of wetland paddy farming in West Aceh Regency. *Russian Journal of Agricultural and Socio-Economic Sciences*, *81*(9), 424-428.

Ingabire, C., Bizoza, A., & Mutware, J. (2013). Determinants and Profitability of Rice production in Cyabayaga Watershed, Eastern Province, Rwanda. *Rwanda Journal*, *1*(1), 63–75. https://doi.org/10.4314/rj.v1i1.5H

International Rice Research Institute. (1997). IRRI rice facts. P. O. Box 933, Manila, Philippines

International Rice Research Institute. (2007). Rice production course, Rice Knowledge Bank, IRRI. Retrieved from http://www.knowledgebank.irri.org/ rice production.

Islam, M. Z., Begum, R., Sharmin, S., & Khan, A. (2017). Profitability and productivity of rice production in selected coastal area of Satkhira district in Bangladesh. *International Journal of Business, Management and Social Research*, *3*(1), 148-153.

Jondrow, J; C. A, Lovell; I, S, Materov; and P, Schmidt. 1982. „„On the Estimation of the Technical Inefficiency in the Stochastic Frontier Production Function,"" Journal of Econometrics 19 (August): 233–38.

Katuwal, N. (2021). Measurement of Allocative and Technical Efficiency in Using Inputs on Paddy Farming in Golakharka, Ilam. *PSYCHOLOGY AND EDUCATION*.

Kubo, M., & Purevdorj, M. (2004). The future of rice production and consumption. *Journal of Food Distribution Research*, *35*(856-2016-57064), 128-142.

Kyaw, D. (2009). *Rural Household's Food Security Status and Coping: Strategies to Food Insecurity in Myanmar*. Institute of Developing Economies, Japan External Trade Organization.

Kyaw, N. N., Ahn, S., & Lee, S. H. (2018). Analysis of the factors influencing market participation among smallholder rice farmers in magway region, central dry zone of Myanmar. *Sustainability*, *10*(12), 4441.

Kyi, M. S. M. *Analysis of Socio-Economic Conditions In Salingyi Township: A Case Study on Done Taw Village* (Doctoral dissertation, MERAL Portal).

Li, K., Miller, E. D., Chen, M., Kanade, T., Weiss, L. E., & Campbell, P. G. (2008). Cell population tracking and lineage construction with spatiotemporal context. *Medical image analysis*, *12*(5), 546-566.

Kubo, M., & Purevdorj, M. (n.d.). *The Future of Rice Production and Consumption*.

Majumder, M., Mozumdar, L., & Roy, P. (1970). Productivity and Resource Use Efficiency of Boro Rice Production. *Journal of the Bangladesh Agricultural University*, *7*(2), 247–252. https://doi.org/10.3329/jbau.v7i2.4730

MAUNG, Z. N. (2019). *CHANGES OF RICE PRODUCTION SYSTEM IN AYEYARWADDY DELTA OF MYANMAR: A CASE STUDY IN MAWLAMYINEGYUNN TOWNSHIP* (Doctoral dissertation, MERAL Port

Ministry of Agriculture and Irrigation. (2014b). Myanmar Agriculture at a Glance. Naypyitaw, Myanmar

Ministry of Agriculture and Irrigation. (2015). Myanmar Rice Sector Development Strategy. 93pp.

MOALI 2015.pdf. (n.d.).

Myint, P., & Napasintuwong, O. (2016). Economic analysis of Paw San rice adoption in Myanmar. Asian Journal of Agricultural Research, 10, 175-184.

Naung, T. M. *A Study on the Socioeconomic Situations of Mingohn Village, Hlegu Township, Yangon Region* (Doctoral dissertation, MERAL Portal).

Noormansyah, Z., & Cahrial, E. (2020, March). Efficiency of production factors and constraints of organic rice farming at rainfed rice. In *IOP Conference Series: Earth and Environmental Science* (Vol. 466, No. 1, p. 012027). IOP Publishing.

Odjo, T. C., Dossou-Aminon, I., Dansi, A., & Djengue, H. W. (2017). Diversity, Genetic Erosion and Participatory Evaluation of Rice (Oryza sativa L. and Oryza glaberrima Steud) Varieties in Benin. *International Journal of Current Research in Biosciences and Plant Biology*, *4*(4), 147–164. https://doi.org/10.20546/ijcrbp.2017.404.021

Okamoto, I. (2005). Transformation of the rice marketing system and Myanmar's transition to a market economy.

Patil, S. S., Konda, C. R., Amrutha, T. J., & Siddayya, S. (2013). Input use and production pattern of paddy cultivation under leased-in land in Tungabhadra project area. *Karnataka Journal of Agricultural Sciences*, *26*(2), 224-228.

Praneetvatakul, S., Kuwattanasiri, D., & Waibel, H. (2002, January). The Productivity of Pesticide use in rice production of Thailand: A damage control approach. In *Paper* *for the International Symposium on "Sustaining Food Security and Managing Natural Resources in Southeast Asia:*

Praneetvatakul, S., Kuwattanasiri, D., & Waibel, H. (n.d.). *THE PRODUCTIVITY OF PESTICIDE USE*.

Report_Food_Security_and_Nutrition_Information_Scoping_Study_EC_May11.pdf. (n.d.).

Sary, S., Wen, Y., Darith, S., & Chand, N. V. (2020). Factors Influencing the Rice Production of Farmers in Rural South-Eastern Cambodia. *Journal Agrociencia*, *54*(1), 78-95.

Siagian, V., Siregar, H., Fariyanti, A., & Nainggolan, K. (2019, December). Analysis of Factors that Influence the production of wetland rice in Banten Province. In *IOP Conference Series: Earth and Environmental Science* (Vol. 399, No. 1, p. 012073). IOP Publishing.

Sawaneh, M., Latif, I. A., & Abdullah, A. M. (2013, June). Total Factor Productivity of Rice Farming in Selected Southest Asian Countries. In *the International Conference on Social Science Research, ICSSR 2013*.

Subedi, S., Ghimire, Y. N., Kharel, M., Adhikari, S. P., Shrestha, J., & Sapkota, B. K. (2020). Technical efficiency of rice production in terai district of Nepal. *Journal of Agriculture and Natural Resources*, *3*(2), 32-44.

Tun, S. T. Rural Livelihood and Agricultural Reform In Chiba Village, Shwebo Township, Sagaing Region, Myanmar.

Tun, Y., & Kang, H.-J. (2015). An Analysis on the Factors Affecting Rice Production Efficiency in Myanmar. *East Asian Economic Review*, *19*(2), 167–188. https://doi.org/10.11644/KIEP.JEAI.2015.19.2.295

Walker, T. S., Tomlin, K. L., Worthen, G. S., Poch, K. R., Lieber, J. G., Saavedra, M. T., ... & Nick, J. A. (2005). Enhanced Pseudomonas aeruginosa biofilm development mediated by human neutrophils. *Infection and immunity*, *73*(6), 3693-3701.

Ward, M., Smith, G., & Tran, Q. (2016). This Report Contains Assessments of Commodity and Trade Issues Made by Usda Staff and Not Necessarily Statements of Official US Government Policy. USDA Foreign Agricultural Service: Washington, DC, USA, 11.

Win, U. K. (1991). A century of rice improvement in Burma: Int. Rice Res. Inst.

Wong, L. C. Y., & Wai, E. M. A. (n.d.). *Background Paper No.6 Rapid Value Chain Assessment: Structure and Dynamics of the Rice Value Chain in Myanmar*.

Yoshida, S. (1981). Fundamentals of rice crop science. IRRI, Los Baños, Philippines. Fundamentals of rice crop science. IRRI, Los Baños, Philippines.

Zi, B., Duan, B. Y., Du, J. L., & Bao, H. (2008). Dynamic modeling and active control of a cable-suspended parallel robot. *Mechatronics*, *18*(1), 1-12.

APPENDIX (A)

QUESTIONNAIRE
SOCIO-ECONOMICS AND AGRICULTURAL CONDITIONS OF HOUSEHOLDS IN THA LONE VILLAGE

Date ………………....   Questionnaire No. ……………

1. Address

Township……………   Village………………

2. Respondent

(a) Name……………   (b) Age …………

(c) Male/Female…………   (d) Education………..

(e) Occupation…………   (f) Kinship with householder………

3. Head of Household

(a) Name…………   (b) Age………………   (c) Male/Female…………

(d) Education………   (e) Occupation………

4. Family Topics

(a) Number of family

Sir No.	Nam e	Gender	Religion	Relation with Household Head	Ag e	Education	Marital Status	Occupation	Income

(b) Number of Student

Level of Education	No. of Students		Total
	Male	Female	
Primary			
Middle			
High			
University			
Total			

5. Questions concerned with Cultivation/Farming

(a) (1) land owner   (2) tenant   (3) lease   (4) Others

(b) Land Ownership

Farmland (acres)	Yar (acres)	Others	Total

(c) Paddy Cultivation

No.	Type of Paddy	Dura -tion	Cultiva- tion acres	Yield per acre (basket)	Total Yield (basket)	Total income	Total expenses	Net income (one month)

(d) Materials used in cultivation

(1) Human

(2) Cattles

(3) Hand Tractor

(4) Tractor

(5) Rice Trans planter

(6) Harvester

(7) Threshing Machine

(8) Grain Dryer

(e) Condition use of fertilizers and pesticides

(1) Fertilizers

(2) Pesticides

(3) Organic fertilizers

6. Livestock Condition

No.	Animal	Duration	Total Income	Total Expense	Net Income per Month

7. Difficulties of production

- ☐ Capital
- ☐ Labor shortage
- ☐ Insects and viruses
- ☐ Irrigated Farming System
- ☐ Cultivation Technique

□ Weather/ climate condition

8. How type of support does you get from government and other organization?

□ Technical Support

□ Machine

□ Irrigated Farming System

□ Seeds

9. Have the farmers support from Government and NGO?

□ Yes □ No

If have, which type of support?

……………………………………………………………………………………

……………………………………………………………………………………

10. Properties of Sample Households

(a) Car (b) Cycle (c) TV (d) VCD, DVD, EVD

(e) Satellite (f) Radio, Cassette (g) Sewing machine

(h) Transformer (i) Bicycle (j) Rice Cooker (k) Iron

(l) Telephone (m) Others

11. Expenditure

<table>
<tr><td rowspan="2">No.</td><td rowspan="2" colspan="5">Type of Expenditure</td><td colspan="3">Expenses (kyats)</td></tr>
<tr><td>One week</td><td>One month</td><td>One year</td></tr>
<tr><td rowspan="4">1.</td><td colspan="3">Expenses for kitchen</td><td>Price</td><td>Amount</td><td></td><td></td><td></td></tr>
<tr><td>1.</td><td colspan="2">Rice</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2.</td><td colspan="2">Oil</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>3.</td><td colspan="2">Market
(one week)</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="3">2.</td><td rowspan="3">Fruits/
Beverages</td><td colspan="3">Fruits</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="3">Juice</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="3">Beverages</td><td></td><td></td><td></td><td></td></tr>
<tr><td>3.</td><td colspan="8">Shoes/ Clothes</td></tr>
<tr><td rowspan="2">4.</td><td rowspan="2" colspan="2">Education</td><td colspan="3">School fees</td><td></td><td></td><td></td></tr>
<tr><td colspan="3">Books</td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">5.</td><td rowspan="2" colspan="2">Repair Cost</td><td colspan="3">Home</td><td></td><td></td><td></td></tr>
<tr><td colspan="3">Car</td><td></td><td></td><td></td></tr>
</table>

		Cycle			
		Bicycle			
6.	Recreation	Vacation			
		Pilgrim			
		Movies			
		TV			
7.	Social Cost	Compassionate			
		Donation			
8.	Health Cost	Man			
		Children			
9.	Allowance	Man			
		Children			
		Student			
10.	General Expenses	Phone			
		Electric			
		Soap			
		Drinking Water			
		Toothpaste			
		Beauty expenses			
Total					

12. Did you get loan? ☐ Yes ☐ No

If you get loan; describe detail

Name of organization	Amount of loan	Interest	Reason of getting loan	Period

(a) Does income support by getting loan? ☐ Yes ☐ No

If not support, please tick the following:

Less amount	High interest rate	Short loan period	Not use with correctly

13. Housing Condition

(a) Own ☐ (b) Rent ☐ (c) Others ☐

Housing Type	R.C	Brick	Wooden	Bamboo
Toilet Type		Water closet	Normal	No

14. Distance Condition

Distance	Near	Far
School from home		
Shop from home		
Clinic from home		
Hospital from home		

15. Drinking Water

Please tick	Well	Tube well	River	Lake	Others

16. Condition of Cooking

Please tick	Electricity	Wooden	Charcoal	Gas	Others

17. Energy Condition

Please tick	Electricity	Battery	Solar	Generator	Others

18. Garbage System

Please tick	Dust-cart/dustbin	Fire/Underground	River	No Stable	Others

APPENDIX (B)

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.812[a]	.659	.656	.59094

a. Predictors: (Constant), LnCAP, LnFLAB, LnLAND

b. Dependent Variable: LnYIELD

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	202.813	3	67.604	193.589	.000[b]
	Residual	104.765	300	.349		
	Total	307.577	303			

a. Dependent Variable: LnYIELD

b. Predictors: (Constant), LnCAP, LnFLAB, LnLAND

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	3.849	.499		7.710	.000		
	LnLAND	.955	.044	.777	21.523	.000	.872	1.147
	LnFLAB	.076	.100	.026	.763	.446	.986	1.014
	LnCAP	.081	.035	.082	2.298	.022	.882	1.133

a. Dependent Variable: LnYIELD

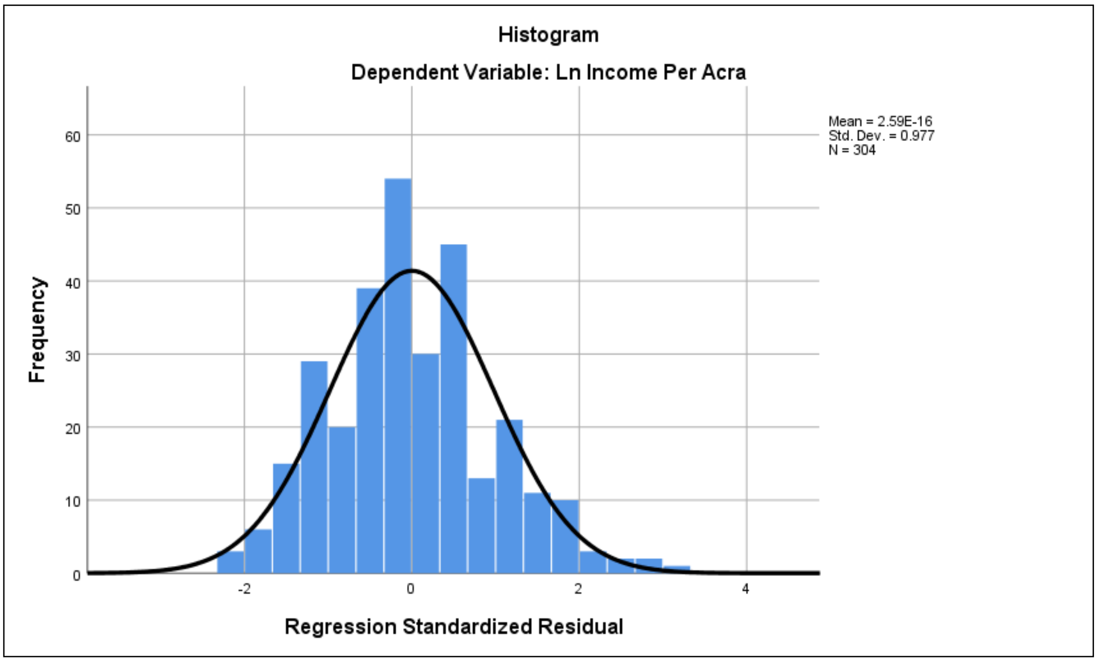
Collinearity Diagnostics[a]							
Model	Dimension	Eigenvalue	Condition Index	Variance Proportions			
				(Constant)	LnLAAND	LnFLAB	LnCAP
1	1	3.818	1.000	.00	.01	.00	.00
	2	.140	5.228	.00	.89	.05	.00
	3	.040	9.771	.02	.02	.93	.02
	4	.002	40.474	.98	.08	.02	.98

a. Dependent Variable: LnYIELD

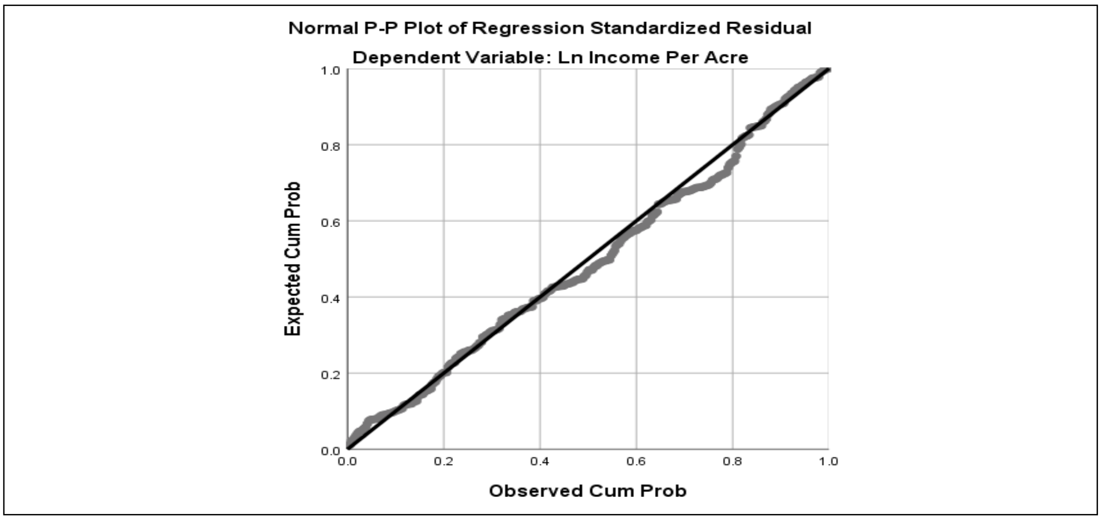
Residuals Statistics[a]					
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	4.8684	8.6933	6.7351	.81814	304
Residual	-7.28529	1.60114	.00000	.58801	304
Std. Predicted Value	-2.282	2.394	.000	1.000	304
Std. Residual	-12.328	2.709	.000	.995	304

a. Dependent Variable: LnYIELD

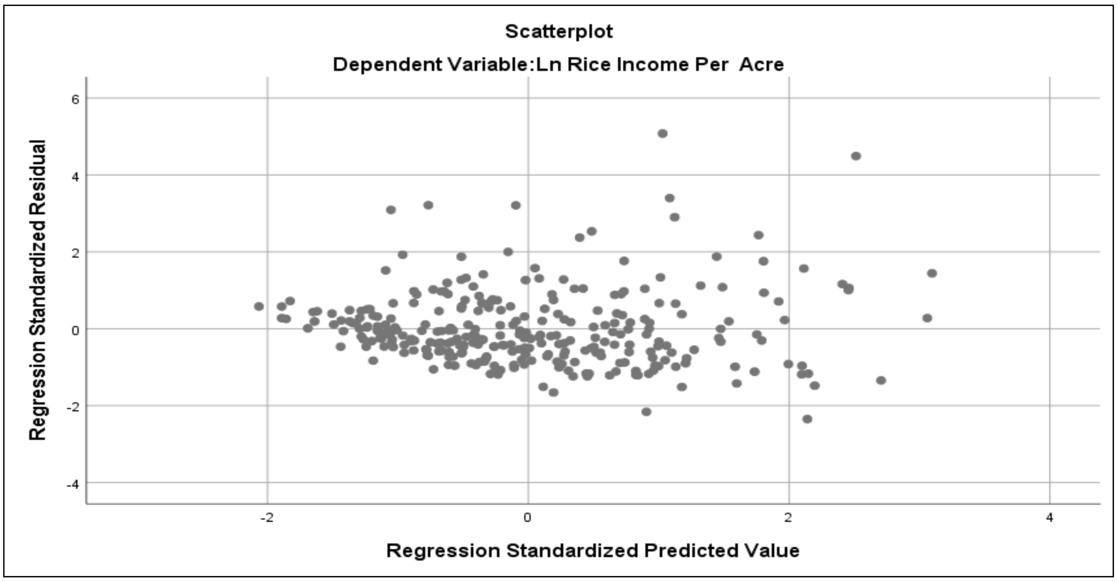
Charts



Histogram
Dependent Variable: Ln Income Per Acra
Mean = 2.59E-16
Std. Dev. = 0.977
N = 304
Frequency
60
50
40
30
20
10
0
-2
0
2
4
Regression Standardized Residual



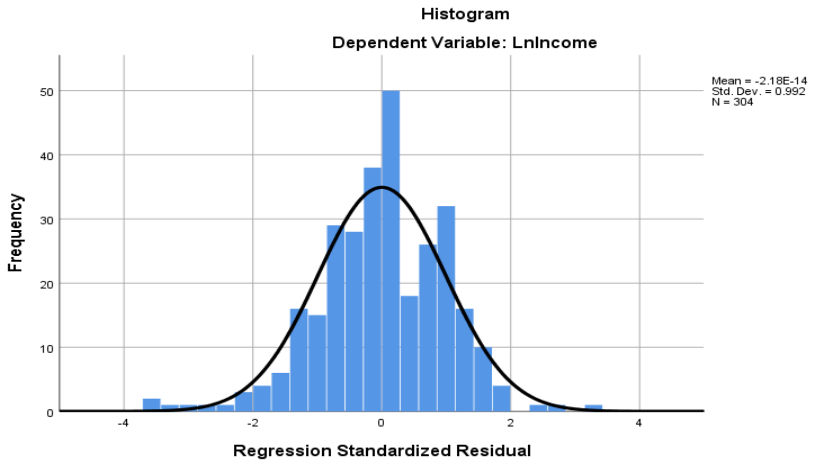
Normal P-P Plot of Regression Standardized Residual
Dependent Variable: Ln Income Per Acre
Expected Cum Prob
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Observed Cum Prob

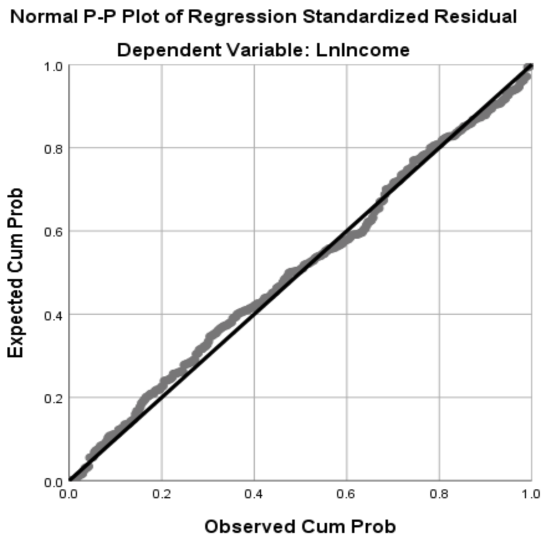


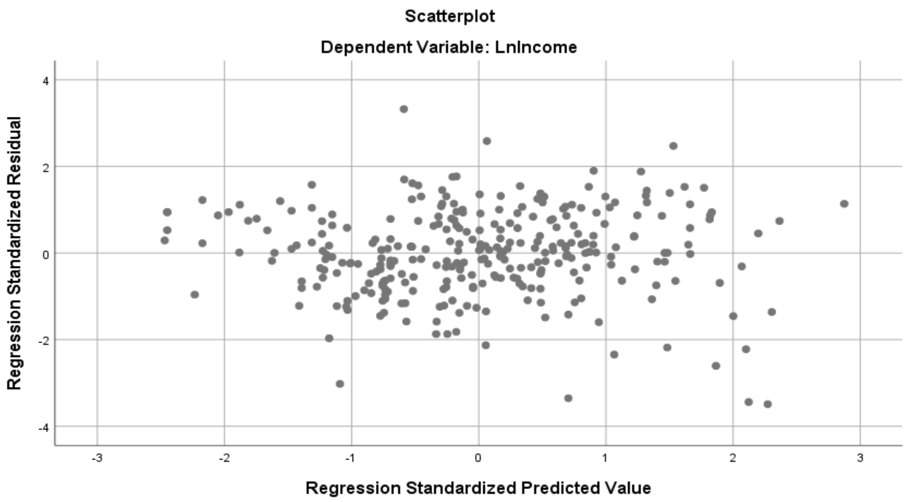
Model Summary[b]				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.770[a]	.593	.587	.31492
a. Predictors: (Constant), Labour Difficulty, Rice Difficulty, Ln Expense, Rain Total Yield, Climate				
b. Dependent Variable: Ln Income				

ANOVA[a]						
Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	43.147	5	8.629	87.012	.000[b]
	Residual	29.554	298	.099		
	Total	72.701	303			
a. Dependent Variable: Ln Income						
b. Predictors: (Constant), Labour Difficulty, Rice Difficulty, Ln Exp, Rain Total Yield, Climate						

Coefficients[a]								
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	14.928	.060		247.882	.000		
	Ln Expense	.576	.043	.518	13.299	.000	.901	1.110
	Climate	-.144	.039	-.147	-3.683	.000	.859	1.165
	Rain Total Yield	.186	.000	.412	10.358	.000	.863	1.159
	Capital Difficulty	-.104	.039	-.106	-2.700	.007	.884	1.132
	Labour Difficulty	-.063	.042	-.058	-1.503	.134	.915	1.093
a. Dependent Variable: Ln Income								


Histogram
Dependent Variable: LnIncome
Mean = -2.18E-14
Std. Dev. = 0.992
N = 304
Frequency
Regression Standardized Residual


Normal P-P Plot of Regression Standardized Residual
Dependent Variable: LnIncome
Expected Cum Prob
Observed Cum Prob


Scatterplot
Dependent Variable: LnIncome
Regression Standardized Residual
Regression Standardized Predicted Value