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A Study onPaddy Production in Myanmar

Moe MoeKhine[1]

Abstract

This research is relevant to paddy production in Myanmar. The objectives of the study are to describe states and region of the paddy production and to analyze the best fitted multiple linear regression model for paddy production in Myanmar. This study uses the time series data of yearly paddy production from (2003-2004) to (2020-2021), descriptive procedure, multiple regression analysis to analyze the results. In Myanmar, the results of the study show that almost all of variable such paddy production, sown acres, harvested areas, loan and using pesticide are increased and decreased alternatively year by year. According to the results of the Multiple Regression Model, sown acres and export are found to be the key factors influencing for paddy production in Myanmar. The Ministry of Agriculture should ensure that the extension services offered to paddy producers are effective and adequate to enable increased use of improved farming technologies. Operations of the National Crop and Produce Board should be re-evaluated and redefined so that the benefits of centralized marketing of paddy to majority of paddy producers.

Keywords: Paddy Production, Export, Sown Acres, Multiple Regression.

1. Introduction

Myanmar is an agricultural country. Agriculture is that the backbone of the Myanmar economyMyanmar's agricultural country is often divided into three parts: crop production, livestock, and fishing. The main agricultural product of Myanmar is rice, sugar cane, and dry beans, among other crops that are highly regarded. Surprisingly, Myanmar was once the foremost rice exporter in Asia. Paddy Product is dominated by Myanmar's economy and is extensively interwoven into the social and economic fabric of its people's lives. It's the foremost important crop in Myanmar. The agriculture sector has been traditionally Myanmar's main industry. This main industry has added significant contributions to Myanmar's total gross domestic product (GDP) throughout the years.

Myanmar has enormous land, good water resources, and an appropriate climate for rice farming. A majority of Myanmar's sown area is planned because the rainfed rice crop during southwest monsoon season (June-August), whereas summer seasonal rice farming is between November and February within the lower a part of the country, and within the central dry zone regions, the farming is from January to March. The rice growing within the country takes about 5-6 months. Few sorts of rice are harvested in November-December including theAyeyarwady, Bago, and Yangon region in lower Myanmar.The rice-growing places in Myanmar include rained lowland in late sown and Main area, irrigated lowland, deepwater, and upland. During the monsoon period, rainfed lowland is that the area sown bit late within the usual season.

Agriculture in Myanmar, including livestock, fisheries and forestry, accounts for roughly (43)percent of GDP, and employs nearly (70) per cent of the labor pool (Haggblade et al., 2013). thanks to its abundant natural resources (land and water) and enormous labor pool, agricultural growth in Myanmar might be a serious driver of economic process and rural incomes forinstance, the typical farm size in Myanmar is (2.57) hectare, which is that the second largest amongthe Southeast Asian countries after Thailand. The govt of Myanmar hasgiven attention to the eventof the agriculture sector, which is one ofthe 'sevenkey pillars

[1]Lecturer, Department of Statistics, University of Co-operative and Management, Sagaing

supporting and enabling inclusive and sustained economic growth' (Ministry of Agricultural and Irrigation, 2015, p.1).

Depending on the variety of Aemahta and high-quality double cropping rice, low-grade rice cost between K(68,000) and K(80,000)per sack. FirstJanuary in Yangon's wholesale market Premium Pawsan prices that between K(100,000) and K(125,000) per sack depending on producing areas (Myaungmya, Pyapon and Shwebo). The Myanmar Rice Online MyRo system, an online registration system for warehousing rice, has been enforced by the MoC and the Myanmar Rice Federation is responsible for managing rice exports, with a focus on maintaining domestic stock and price stability. The primary purchasers of rice, Indonesia, the Philippines, Malaysia, Belgium, Cameroon, Slovenia, Italy, Croatia, Bulgaria, and the Ivory Coast from Myanmar during the week (The Global New Light of Myanmar).

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. 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 usually 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%)(Agricultural Extension Division, 2013).

Myanmar exported more than (790,000) MT in 2011, Thailand, Vietnam, India, Pakistan, Brazil, Cambodia, Uruguay, Myanmar, Argentina and China, rice exporting countries. Those countries were If Myanmar exports(1.5) million MT of rice during this financial time, it'll catch Uruguay, Cambodia and Brazil and reach fifth place. Myanmar's rice exports total further than (100,000) MT a month. It exported almost (700,000). The Ministry of Commerce (MOC) reported that MT was worth US$ (260.315) million from April 1 to October. The MRF has plans to export rice from its reserves. What are the plans? The projected exports for MOC will amount to (1.5) million MT.

In 2011-12, Myanmar exported over (800,500.75) percent of the MTs of rice were exported to Africa, Bangladesh, Indonesia, and the Philippines.In January, a memorandum of understanding was signed between Myanmar and Indonesia on exporting (200,000) MT of Myanmar rice in a year. Myanmar has the implicit to come the Asia's "coming profitable frontier" if it takes advantage of its natural coffers. Targeted markets for white-rice sales are Africa, Indonesia and the Philippines. Myanmar has committed to selling (200,000) items. MT of white. The state food agency of Indonesia, Bulog, offers rice.

About (70%) of the total population resides in rural areas where their main livelihoods depend on agriculture. Myanmar's main food export items were pulses and rice. Myanmar is ricing surplus country for which it can sufficiently provide rice for domestic consumption and export. To provide sufficient rice for domestic consumption in line with food security for increasing population and enhancing income by exporting of rice surplus, the successive Myanmar governments generally have attempted to develop the country's rice economy. By exporting goods, a country not only promotes economic growth but also generates the foreign exchange earnings necessary for imports of capital and intermediate items that contribute to its debt servicing scores and domestic product. (Lord 1991)

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 labor and hire labor. It supplies food stuff to his family and provide the better utilization of land, labor, and capital. In addition to this it reduces pressure on cereal as well as it gives a much higher return.

1.1 Objectives of the Study

The objectives of the study are:

1. to describe the states and region of paddy production in Myanmar and
2. to analyze the best fitted multiple linear regression model for paddy production in Myanmar.

1.2 Materials and Methods

This paper is based on the secondary data and information received from reliable sources such as Statistical Yearbooks and Myanmar Agricultural Statistics. Descriptive methods and multiple regression were used to study the pattern of production of paddy in Myanmar. Based on the time series data of production, sown acreage and export for paddy were used to fit the models.

1.2.1 Multiple Regression Model

Multiple regression analysis is a method of taking into account simultaneously the relationship between all the variables when two or more independent variables are to be used in making estimates of the dependent variable. The use of two or more independent variable regression analysis is an extension of the basic principles used in two-variable regression analysis. It is necessary to determine the equation for the average relationship between the variable.

In the linear equation that represents the multiple regressions model is

$$Y_i = \beta_0 + \beta_1 X_{i1} + +\beta_2 X_{i2} + \cdots + +\beta_k X_{ik} + \varepsilon_i$$

Where Y_i = the dependent variable in the i^{th} trial of observation

β_0 = constant in the regression equation, which indicates the value of Y when all $X_k = 0$

$\beta_1, \ldots, \beta_k$ = regression coefficients associated with each of the X_k independent variable

X_{ij} = value of the j^{th} independent variable in the i^{th} trial, or observation, associated with the process of sampling.

ε_i = the random error in the i^{th}trial or observation, associate with the process of sampling.

1.2.2 Model Adequacy Checking

The model checked the assumptions of multiple linear regression method are fulfilled. Analysis of residual is an effective way to discover several types of model adequacy. Also, normal plot is used to test linear and normalassumptions. Other testing that is multicollinearity, linearity, normality and etc. Test of presence of multicollinearity refers to

the existence of high (perfect) linear relationship among regressors. Therefore, the variance inflation factor (VIF) and Durbin-Watson statistic were applied in this study. The general rule of thumb indicates multicollinearity problem for corresponding variable if the value of VIF is greater than 10. If Durbin-Watson statistic is not around 2, the autocorrelation exists.

1.3 Scope and Limitations

Yearly time series data on paddy production in Myanmar for the period of (1999 to 2020) are used in this study. The require data are obtained from the Myanmar Agricultural Statistics.

2. Empirical Review

Jena (2015) analyzed a prediction on Rice production in India through multivariate regression analysis. This paper aims to forecast the production of rice in advance and examine the interdependence between various factors that affect rice production. They have been utilized to research the degree of interdependence between factors and therefore the estimation of production multivariate correlation analysis and multivariate analysis. India can envision a more prosperous agrarian system that involves an increased rice production. More man power should be directed towards rice production.

Nugrahani et al (2021) studied modeling of rice production in Indonesia using Robust Regression with the method of moments (MM) estimation. The objective is to establish the MM estimation regression model for predicting rice production in Indonesia and identify the key factors that have a significant influence.The robust regression model of method of moments estimation on rice production in Indonesia shows that the increase in the amount of harvested area and population will increase the amount of rice production, while the land area is affected by plant pests and rainfall will reduce the amount of rice production.

Musaba and Mukwalikuli (2019) described Socio-economic factors affecting rice production among smallholder farmers in Lukulu District, Western Zambia. Samples were collected using a random and purposeful method from (120) individuals living in Lukulu district of Western province of Zambia. The analysis was carried out using descriptive statistics and econometric analysis. The results indicated that rice yields could be enhanced by farmers who were given access to production resources such as land, seed, fertilizers, labor, extension services, and line planting. The study area had a higher rice output with male farmers than female farmers, suggesting that there may be gender-specific effects on rice production.

Shadfar and Malekmohammadi (2013) mentioned that the structuring state intervention policies to boost rice production by multinomial logistic and ordinal regression application and multicollinearity cautiousness. The aim is to structure state interventions policies to develop production of rice in Iran; developing two indexes to measure level of rice production development dichotomous and categorical level. Taking multicollinearity, appropriate treatment by calculation Tolerance and Variance Inflation factor is performed. This is to test the fitness of the model by real data from the field, and to evaluate the state intervention policies and plans, the model's fitness must be tested using real data from the field. This requires additional analysis to identify potential casual relationships among productive factors that may impact the development of Iranian rice production.

Norddin et al. (2019) indicated multiple linear regression model of Rice Production using conjugate gradient methods. Through the analysis of paddy production, planted area human population, and domestic consumption, this research aims to develop regression models for rice production in Malaysia. Data was collectedfrom the Department of Statistics Malaysia's website andIndex Mundi between 1980 and A positive correlation was found between household size, household income per adult equivalent; micro credit, and yield among farmers. The collected data were analyzed using least square method and conjugated gradient. The results show that the conjugated gradient methods could produce a good regression equation with acceptable root mean-square error value.

Kadiri and Eze (2015) described that the effects of paddy Rice production on the welfare of farmers and the determinants of the achievements of paddy rice farmers in Niger Delta Region of Nigeria. This study looked at the impact of paddy rice production on farmers and the factors that led to the success of Nigerian padder farmers. Three stages of the nine-state region included 300 rice farmers, who were chosen for a multistage sampling technique to determine their strength in rice production.The results also showed that household size, household income per adult equivalent; micro credit and yield have positive relationship with the of farmers meaning that increase in each one indicating that an increase in each lead to better or more favorable conditions for farmers.

3. Data Analysis of Paddy Production

The following table shows the production of paddy in Myanmar in the year(2012-2013 to 2020-2021)**.**

3.1 The Descriptive Statistics of Paddy Production in Myanmar

Table.1 Production of Paddy by States and Regions (Tons)

	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021
Kachin	590116	591082	608535	613587	625089	618604	648711	676696	701945
Kayah	130801	130412	129378	121783	125126	116516	123848	121612	117285
Kayin	922425	935239	938249	944963	835510	797574	777463	543910	784497
Chin	99988	94818	87633	79279	76442	74240	74401	73194	66300
Sagaing	2956984	2997864	3001919	3040043	3043739	3031521	3731593	2920426	2697059
Taninthayi	436696	387901	378752	377292	368271	349293	345335	338930	330823
Bago	4490040	4518813	4508341	4507480	4359621	4416759	4718568	4685779	4732549
Magway	1423752	1403961	1384285	1380641	1172461	1045173	1109329	975505	885933
Mandalay	874411	866366	825025	768582	884908	933373	1158397	1035520	970797
Mon	1128901	987304	986347	992649	1002058	991410	971714	886594	949068
Rakhine	1584877	1593332	1544086	1516438	1479444	1315421	1295588	1263860	1249950
Yangon	1979300	1990235	1926089	1869616	1775233	1827033	1978475	1973744	1948426
Shan	2187968	2120127	2075817	2049459	1995369	1984759	2053930	2030258	2028770
Ayeyawaddy	7126192	7468213	7119473	7647607	7633001	7827428	8224559	8163486	8202063
Nay Pyi Taw	284151	286437	293320	300898	296560	295386	361677	340210	317239

Source:Myanmar Agricultural Statistics

According to Table (1), the production of paddy in Myanmar (States and Region). In Kachin State, the lowest production of paddy is (590116) tons in (2012-2013)and the highest production of paddy is (701945) tons in (2020-2021).

In Kayah State, the lowest production of paddy is (116516) tons in (2017-2018) and the highest production of paddy is (130801) tons in (2012-2013).

In Kayin State, the lowest production of paddy is (543910) tons in (2019-2020) and the highest production of paddy is (944963) tons in (2015-2016).

In Chin State, the lowest production of paddy is (66300) tons in (2020-2021) and the highest production of paddy is (99988) tons in (2012-2013).

In Sagaing Region, the lowest production of paddy is (2697059) tons in (2020-2021) and the highest production of paddy is (3731593) tons in (2018-2019).

In Thaninthayi Region, the lowest production of paddy is (330823) tons in (2020-2021) and the highest production of paddy is (436696) tons in (2012-2013).

In Bago Region, the lowest production of paddy is (4359621) tons in (2016-2017) and the highest production of paddy is (4732549) tons in (2020-2021).

In Magway Region,the lowest production of paddy is (885933) tons in (2020-2021) and the highest production of paddy is (1423752) tons in (2012-2013).

In Mandalay Region, the lowest production of paddy is (768582) tons in (2015-2016) and the highest production of paddy is (1158397) tons in (2018-2019).

In Mon States, the lowest production of paddy is (886594) tons in (2019-2020) and the highest production of paddy is (1128901) tons in (2012-2013).

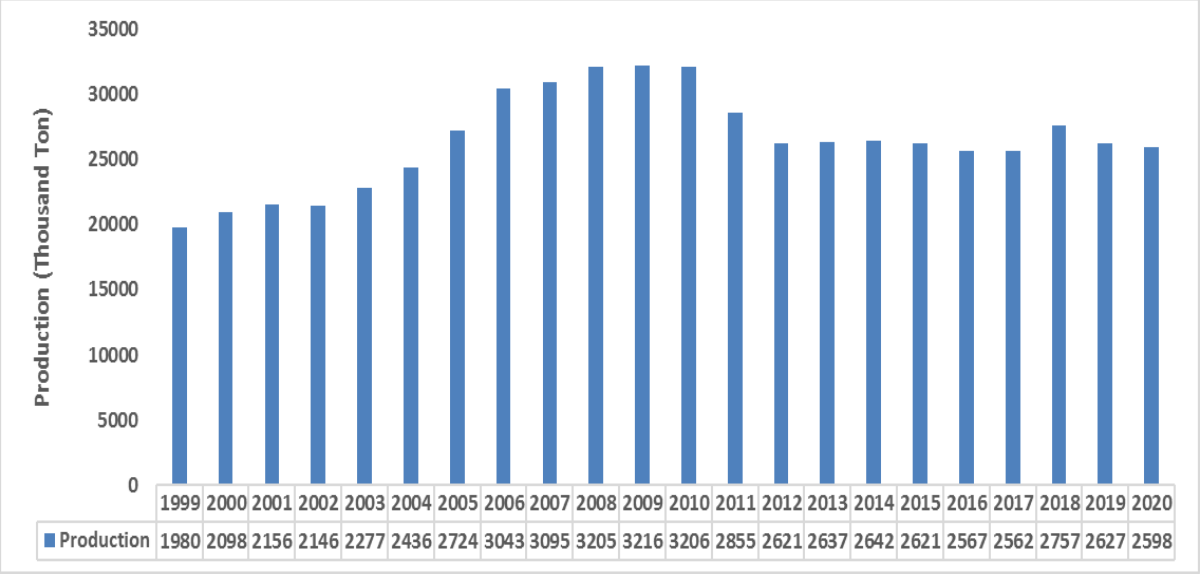
In Rakhine Region, the lowest production of paddy is (1249950) tons in (2020-2021) and the highest production of paddy is (1593332) tons in (2013-2014).

In Yangon Region, the lowest production of paddy is (1775233) tons in (2016-2017) and the highest production of paddy is (1990235) tons in (2013-2014).

In Shan States, the lowest production of paddy is (1984759) tons in (2017-2018) and the highest production of paddy is (2187968) tons in (2012-2013).

In Ayeyawaddy States, the lowest production of paddy is (7119473) tons in (2014-2015) and the highest production of paddy is (8224559) tons in (2018-2019).

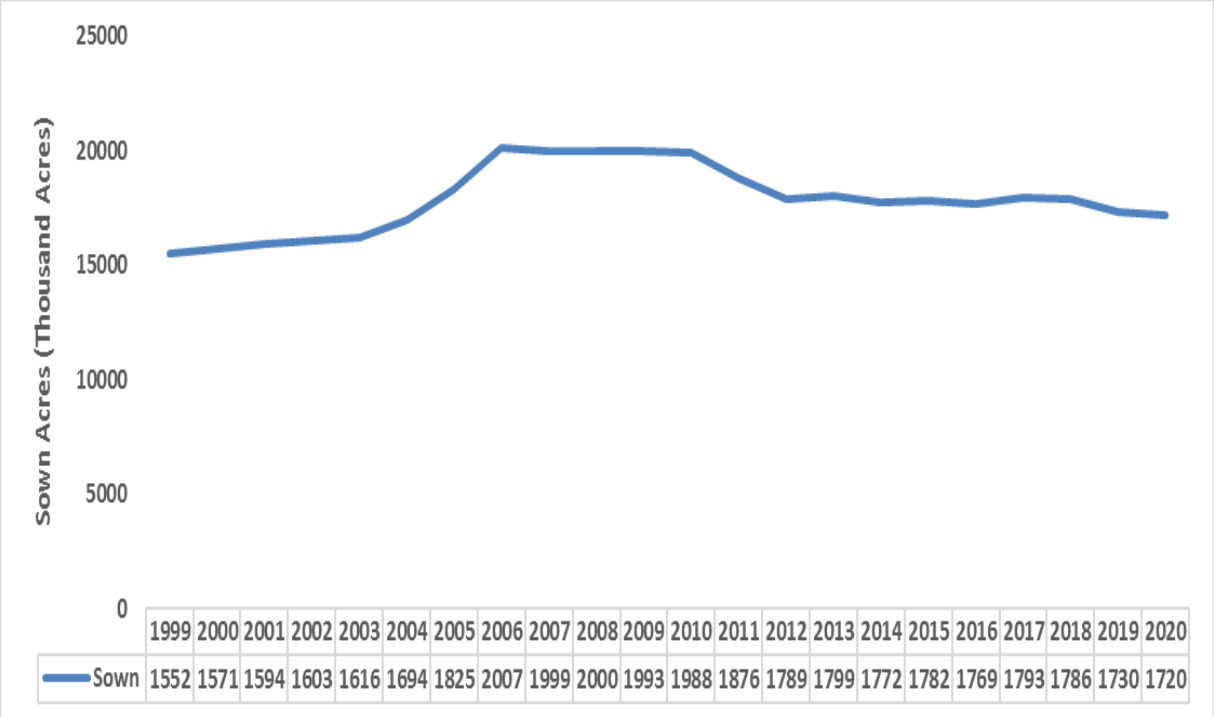
In Naypyitaw, the lowest production of paddy is (284151) tons in (2012-2013) and the highest production of paddy is (361677) tons in (2018-2019).



Source: Myanmar Agricultural Statistics

Figure.1 Paddy Production in Myanmar

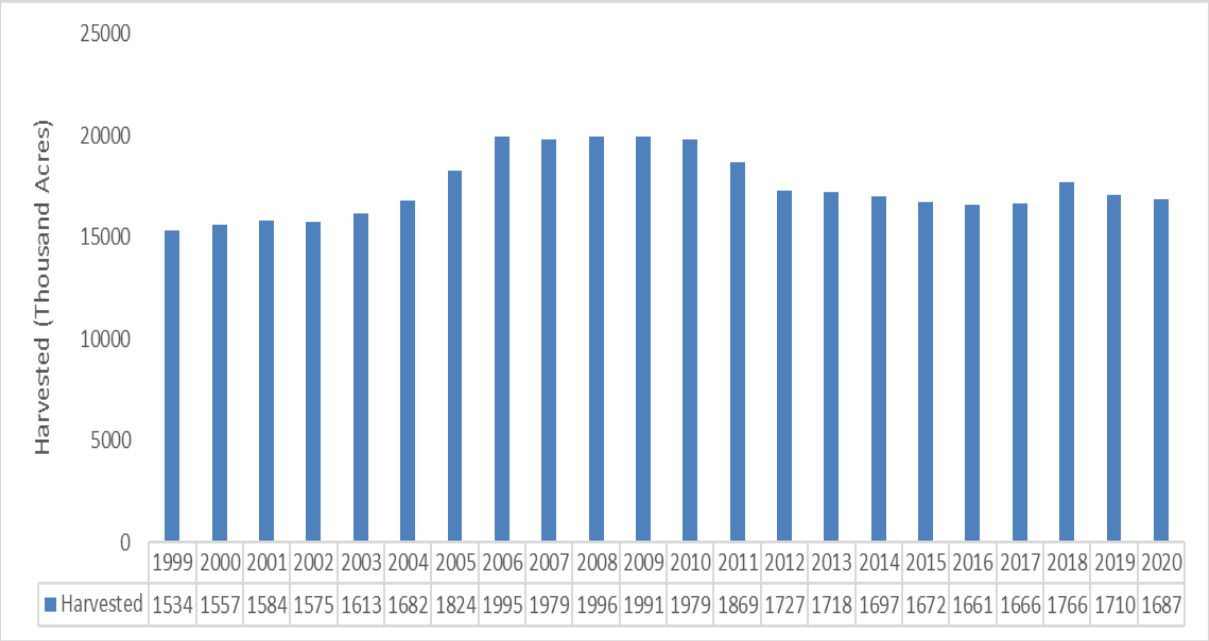
According above the figure, highest paddy production is (32165.8) tons in (2009) and the second highest is (32065.1) tons in (2010). The lowest of paddy production is (19808) tons in (1999). Therefore, production increased and decrease alternatively gradually from (1999 to 2020).



Source: Myanmar Agricultural Statistics

Figure.2 Sown Acre of Paddy in Myanmar

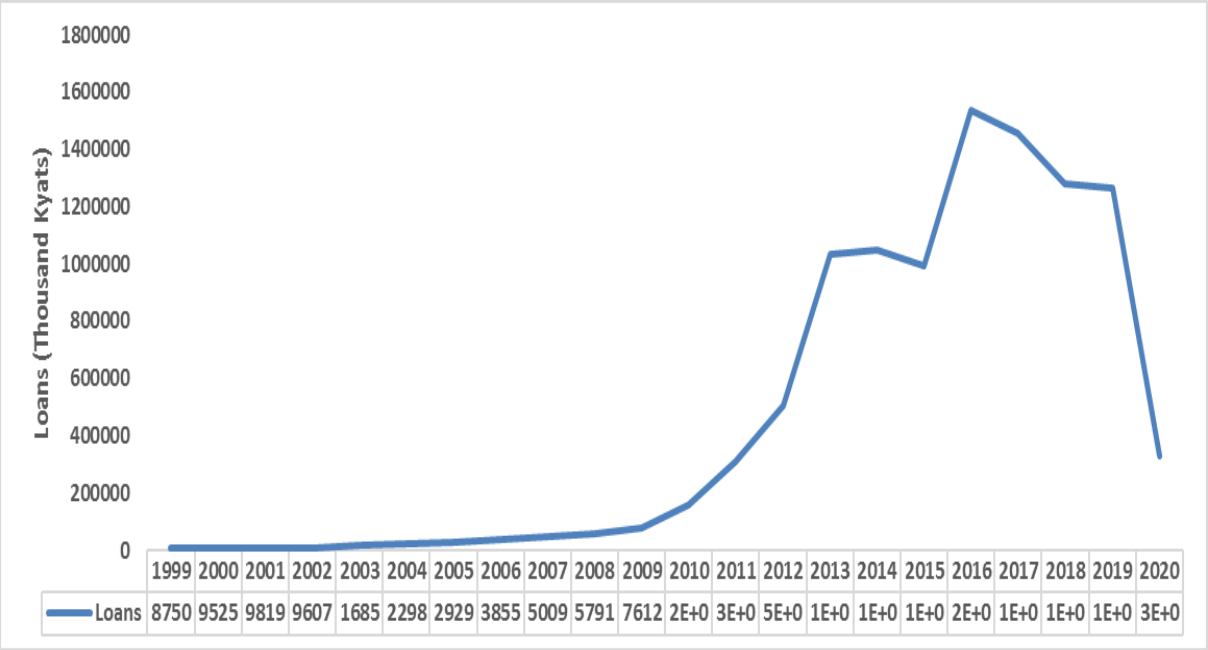
The sown acres of highest paddy production are(20076) thousand acres in (2006) and the second highest is (20001) thousand acres in (2008). The lowest sown acre for paddy production is (15528) thousand acres in (1999). Therefore, paddy production for sown acres is decrease gradually (1999 to 2020).



Source: Myanmar Agricultural Statistics

Figure.3 Harvested of Paddy in Myanmar

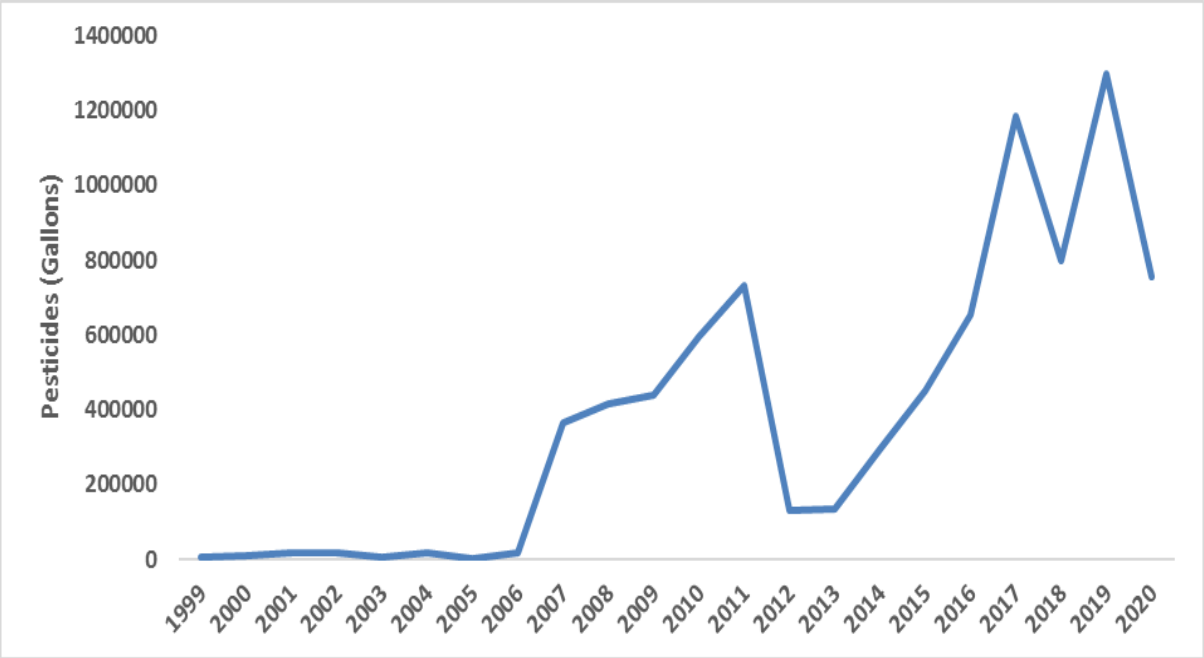
Figure (3) showed that the harvested acres of paddy production are (19960) thousand acres in (2008) and the second highest is (19952) thousand acres in (2006). The lowest harvested acre for paddy production is (15347) thousand acres in (1999). Therefore, paddy production for harvested acres is alternatively decrease and increase (1999 to 2020).



Source: Myanmar Agricultural Statistics

Figure.4 Loan of Paddy in Myanmar

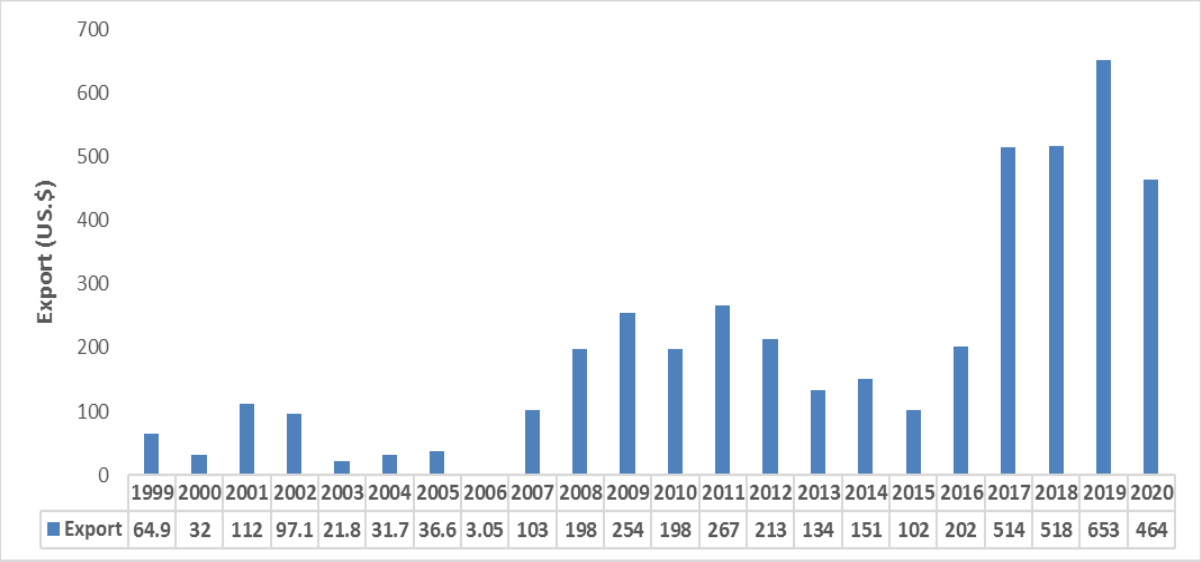
According to the figure (4), loan for paddy production is the highest in (2016) and the second highest in (2017). The lowest loan is (8749.72) million Kyats in (1999). Therefore, loans are gradually increased from (2016) and decrease dramatically in (2020).



Source:Myanmar Agricultural Statistics

Figure.5 Pesticides of Paddy in Myanmar

According to the figure (5), using pesticides is very high in (2019) for pesticides and the second highest in (2017) for pesticides. The lowest paddy production in (2005) for pesticides. And then, pesticides increased dramatically in (2019) and decrease in (2020).



Source: Myanmar Agricultural Statistics

Figure.6 Export of Paddy in Myanmar

According to the figure (6), export for paddy production is the highest in (2019) and the second highest in (2018). The lowest export is (3.05) US. $in (2006). Therefore, exports are gradually increased in (2019) and decrease dramatically in (2020).

3.2 Multiple Regression Model for Paddy Production in Myanmar

Multiple regression analysis is applied to investigatethe factor affecting of total paddy production in Myanmar. To develop the multiple regression model, production of paddyis dependent variable and sown acre and export is employedas independent variables.

Multiple Regression Equation is

$$\hat{Y}_t = \beta_0 + \beta_1 X_1 + \beta_2 X_2$$

Where, Y_t = Yearly Paddy Production

X_1 = YearlySown Acres

X_2 = Ln Yearly Export

Table.2 Results of Multiple Regression Model

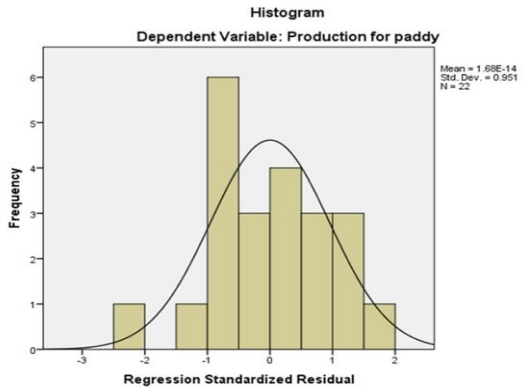
Independent Variable	Unstandardized Coefficient		standardized Coefficient			
	B	Std. Error	Beta	t test	Sig	VIF
Constant	-18443.694	1730.927		-10.655	.000	
Sown Acre	2.432***	.094	.974	25.856	.000	1.004
Ln export	299.789**	109.635	.103	2.734	.013	1.004
Adjusted R square	0.970					
Durbin-Watson	1.518					
F-value	344.063***					

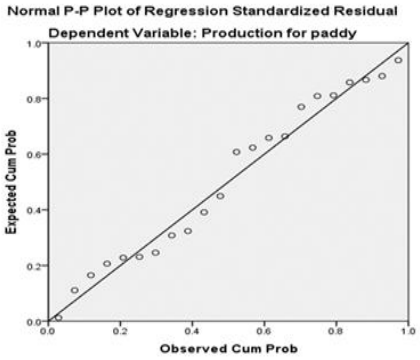
Source:Myanmar Agricultural Statistics

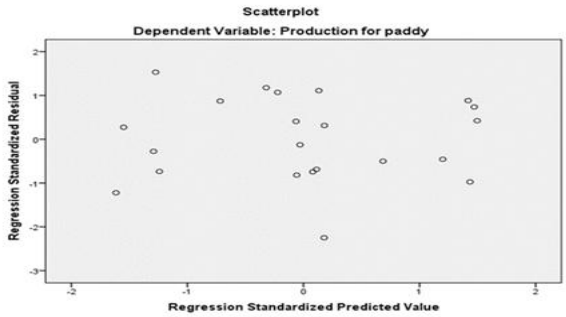
* = Significant at 10% level, ** = Significant at 5% level, *** = Significant at 1% level

Multiple Regression Equation is

$\hat{Y}_i$ = -18443.694+2.432X_1 + 299.789X_2







Source: Own Compilation

The result of the OLS regression analysis is presented in table (2). The result of the regression indicates F-ratio is statistically significant at (1%) level of significance. This indicates the estimated paddy productionthat was adequate for use in prediction and analysis.

The coefficients of multiple determination (R^2) imply that about (97%) of the variation in the paddy production applying explanatory variables in the regression model. The results further signify that the paddy productionis positively influenced by the sown acre at (1%) level of significant and export is (5%) significant.

The error term is normally distributed. The variance inflation factor (VIF) is less than 5, therefore no multicollinearity. $d_u = 1.28 < D = 1.518 < 4 - d_u = 2.72$ thus no autocorrelation at (1%) level. The residual has an equal variance and homoscedasticity.

Values of the coefficient are used to describe the flexibility of different inputs to the outputs.The coefficient of sown acre and export are positive and significant at (1%) and (5%) level, respectively. Paddy production elasticities of sown acre and export were (2.432and 299.789) respectively. The results shows that a unit increase in sown acre is associated with a (2.432) unit increase in paddy production holding export constant. Each additional export is associated with (1) percent increase in export is associated with (2) percent increase in paddy production holding sown acre constant.

4. Findings and Conclusion.

Coefficient of determination $R^2$and F- statistics were (0.97 and 344.063), respectively which indicate the overall goodness of fit model. Sown acre and export were observed to affect paddy output significantly. 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 regression production function modelfor paddy production in Myanmaris satisfied.

This study revealed that, sown acre and export are factors that influence the yield of paddy. At the producer level, the important determinants which can improve paddy production are use of modified paddy seed, use of fertilizer, and education level of farmers. It is usual that, identification of the important determinants of paddy may not improve the paddy production unless the producers incorporate it productivity. Thus, the agricultural sectors in Myanmar, and developmental agricultural workers in each district should help the farmers regarding identified factors. Additionally, the farmers have to incorporate all identified factors to improve the paddy production.

The rice industry in Myanmar is experiencing rapid growth, with mechanization, communications, and investments in new milling facilities being the current trends. Gradually increasing the size of seed system and extension services, as well as finance management, land use permits or water management.The achievement of rice export targets requires the provision of public services and a favorable investment macroclimate that can boost farm productivity, milling efficiency, and trade logistics in both internal and external markets.

Strengthening public private coordination is essential for the future of Myanmar's rice industry, along with institutional innovations to modernize the value chain.The ultimate objective of the upgraded rice value chain is to improve the lives of current and future generations of rice farmers and consumers, particularly those with low incomes in Myanmar.Improving the profitability and sustainability of paddy production depends on the selection of suitable paddy varieties for specific regions systematic use of fertilizer application, weed management and utilization of effective small-scale farming machinery.

3. Suggestion

To encourage increased production of paddy, the government should put in place strategies that keep fertilizer prices low such as subsidizing the input whenever possible, provision of information on cheap sources of fertilizers and waiving import duties on fertilizer imports.The Ministry of Agriculture should ensure that the extension services offered to paddy producers are effective and adequate to enable increased use of improved farming technologies. Operations of the National Cereals and Produce Board should be re-evaluated and redefined so that the benefits of centralized marketing of paddy accrue to majority of paddy producers.

Government should redirect resources from infrastructure development to rural infrastructure improvement. To achieve better labor cost control, modern technology must be utilized. 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 Myanmar.

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