CHAPTER 2

LITERATURE REVIEW AND THEORECTICAL BACKGROUND

Rice production is considered as a key to alleviate poverty and anti-hunger in Cambodia (FAO, 2013). According to (FAO, 2013), Cambodia rice in natural resources such as land, water, favorable climate condition and geographical position, which reflect the powerful comparative advantages for pushing rice production and standard of living for Cambodian farm households (FAO, 2013). Crop production accounts for 54 percent of the sector GDP, which fisheries accounting for 25 percent, livestock for 15 percent and forestry and logging for about 6 percent. Even though only 8 percent of the rice is irrigated, the rice has increased remarkably and converted Cambodia not only self-sufficient in rice, but also an important exporter (FAO, 2013). In the early 1990s, Cambodian rice production has been introduced to new global market. In 1993, agriculture plays a significant role in Cambodian economic growth, contributing to 43-48 percent of the real gross domestic product (GDP) (World Bank, 1995). Rice is the largest single subsector which contributes to Cambodian economic growth the most.

2.1 Concepts and Theories

2.2.1 Production Theory

Production is a process of combining various sources inputs (raw-materials) and converts inputs in order to make output (finished goods). Therefore, production means the creation of goods and services to fulfill human needs and wants. Production function demonstrated the linkage between a quantity of goods and services produced (outputs) or the factors or resources (outputs) used (Coelli, Rao and Battese, 1997). These goods and services were produced by production factors. The production function explains the technical relationship between the inputs and outputs of a production process. A production function determines the maximum output (s) attainable from a given vector of inputs (Coelli, Rao and Battese, 1997).

The factors of production are divided into fixed factors and variable factors.

Fixed factor: A fixed factor of production is the input level that can be used for the long run. For example, Capital is a fixed factor. For this, capital refers to resources such as land, building, warehouse, factory and machinery (Coelli, Rao and Battese, 1997).

Variable factor: A variable factor of production is the input level that can be used for the long run. For instance, raw materials are a variable factor and unskilled labor is also considered as variable factor (Coelli, Rao and Battese, 1997).

Economic analysis of production can be divided into short run production and long run production analyses as follows:

Based on production theory, in the short run, the Total Product (TP) is the total number of outputs that a firm can be produced which determined the relationship among variable inputs. Total product is the launching for short-run. It is also demonstrated the ability of a firm that can produce based on the law of diminishing marginal returns. Average Product (AP) and Marginal Product (MP) are related to each other which derived directly from total product. Average product is the ability of output per worker, computed by dividing the total product by the number of workers. Marginal product is the proportion in total product getting from a proportion in the number of workers. Marginal product demonstrates how the total production of a firm switch when an additional worker is employed or laid off.

In the short run production, the law of diminishing marginal returns expresses when the number of variable input is not added to a fixed input in long-run; it causes the marginal product of variables slow down which means increases production of a goods needs more and more of the variable input. When we add more variable input; production cost will increase. And as the production cost increases, the price that producer will need higher price. Thus, price increases can reply to a bigger number of output, which is the law of supply. The positive law of supply can be determined according to the relationship among cost of product and output, can be followed the law of diminishing marginal returns.

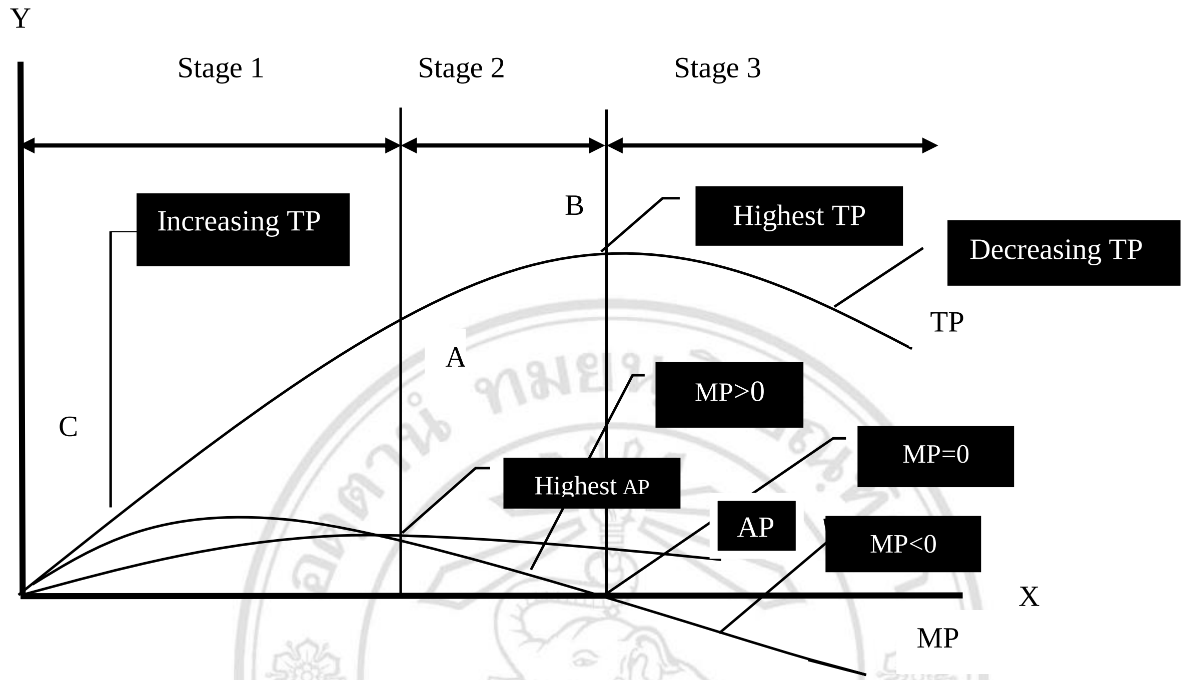

Figure 2.1: TP, AP and MP Curves and Three Stages of Production

Short run production shows three different stages based on the shapes and curves of the three product curves which are total product, marginal product, and average product. At the first stage, an increasing of marginal returns and is presented in (Figure 2.1) the positive slopes of marginal product, total product and average product have gone up. The second stage is launching decline the marginal returns and positive, however flattening curve of total product and negative curve of total product and marginal product curve. The third stage is the last stage and marginal returns decline indicated by the negative curve of marginal product curve of the total product and the average product curve has a negative slope, but average product is positive slope.

The production function states physical out of a production showing the highest number of outputs a company can make based on given the number of inputs that it might construct as the following:

$$Q = f(x_1, x_2, x_3, x_4, \dots \dots . x_n) \quad (1)$$

where,

Q is the quantity of output

$x_1, x_2, x_3, x_4, \ldots \ldots . x_n$ is the quantity of the ith variable inputs

The production function with a single variable input is a special case. It confirms no examination of the possibilities of inputs. However, many experiments are conducted to demonstrate how the output differences with variations in a single output. If production function an analysis if useful, it should be applicable to such special cases as well as to more general cases. General cases may provide evidence on the discrimination power of the criteria for choosing an empirical production function (Coelli, Rao and Battese, 1997).

The production function with two or more variable inputs needs to employ the production function as Cobb-Douglas function.

1) Cobb-Douglas Function

In economics, the Cobb-Douglas production function is broadly used to indicate the relationship between output and input. It was found by Knut Wicksell (1851 - 1926) and continuously developed by Charles Cobb and Paul Douglas in 1928 (Coelli, Rao and Battese, 1997).

If the hypothesis has given two variable inputs, which are X_1 and X_2 and single output is Y. A Cobb Douglas function can be written as:

$$y = Ax_1^{b_1}x_2^{b_2} \tag{2}$$

Taking a natural logarithm,

$$lny = lnA + b_1 lnx_1 + b_2 lnx_2 \tag{3}$$

2) Translog Function

The translog function is a generalization of the Cobb – Douglas production function. It is useful for complicated production function (Coelli, Rao and Battese, 1997).

A translog function can be written as:

$$lny = b_0 + b_1 lnx_1 + b_2 lnx_2 + \frac{1}{2}b_{11}(lnx_1)^2 + b_{12}lnx_1 lnx_2 + \frac{1}{2}b_{22}(lnx_2)^2 \tag{4}$$

where, b_0, b_i and b_{ij} $(i = 1,2)$ is estimated variables.

3) Technical Change Measurement

Time series data can be conducted, the rate of technical change in an industry may be estimated by including a time-trend variable in an econometric production function. Therefore, the Cobb Douglas production in equation (3) can be written as:

$$lny = b_0 + b_1 lnx_1 + b_2 lnx_2 + b_t t \quad (5)$$

Where t is a time trend (t=1, 2,…, T). b_t is estimated, provides an estimated of the annual percentage change in output resulting from technological change.

The translog production function in equation (4) can be adjusted in a similar manner to account percentage change. However, since the translog second-order approximately, we usually introduce both t and t^2 into the equation to obtain

$$lny = b_0 + b_1 lnx_1 + b_2 lnx_2 + \frac{1}{2} b_{11}(lnx_1)^2 + b_{12} lnx_1 lnx_2 + \frac{1}{2} b_{22}(lnx_2)^2 + b_t b_{tt}^2 \quad (6)$$

2.2.2 Theories of Economic Growth

There are different factors which define economic growth of a country. The quality of labor force, natural resources, financial resources, capital, technology, and the institutional are included in economic activities. At the beginning of economic growth theories in the 1950s and 1960s found that the basic problem for many developing countries was clearly capital arrangement in achieving economic growth. These theories were focus on the crucial for those countries to fulfill the financial gap, saving gap, trade gap, and technology gap.

Agriculture is considered as the foundation of industrial growth and development because agriculture provides various labor forces for industrial production. Therefore, the crucial backbone of growth and development of any society should be started with agricultural production. Furthermore, development of agriculture based on heavy modernization and mechanization of agriculture, industrial development is a key to improve labor skills and knowledge for agricultural development (Anthony, 2010).

1) The Solow-Swan Model

The process of economic growth depends on the shape of the production. We initially consider the neoclassical production function (Barro and Martin, 2004).The output in economy is the summation of consumption and gross investment; saving is gross investment. The model can be written as:

$$Y(t) = C(t) + I(t) = C(t) + S(t) \tag{7}$$

where, $Y(t)$ is the total output in the economy at time t

$C(t)$ is consumption at time t

$I(t)$ is gross investment at time t

$S(t)$ is saving at time t

Let s is the saving rate, thus $1 - s$ is fraction of output consumed. The condition of saving rate is between zero and one($0 \leq s \leq 1$).

$$S(t) = sY(t) or\ I(t) = sY(t) \tag{8}$$

$$C(t) = (1 - s)Y(t) \tag{9}$$

The delta (δ) represents depreciation rate its condition between zero and one ($0 < \delta < 1$).

$$\dot{K}(t) = I(t) - \delta K(t) = sY(t) - \delta K(t) \tag{10}$$

where, $\dot{K} = \frac{dK(t)}{dt}$ stock of physical capital is changing over time

$K(t)$ is physical capital at time t

The model assumes that inputs (labor and capital) in the production and technology is knowledge of producing processes. It can be written in a very general form as:

$$Y(t) = F[K(t), L(t), A(t)] = \tilde{F}[K(t), A(t)L(t)] \tag{11}$$

where, $A(t)$ is technology at time t

$L(t)$ is labor at time t

Substitute equation (10) and (11), we get:

$$\dot{K}(t) = s\tilde{F}[K(t), A(t)L(t) - \delta K(t)] \quad (12)$$

The labor changes over time due to population growth at constant exogenous rate ($n \geq 0$). g represents the rate of technological progress

$$\frac{\dot{L}(t)}{L(t)} = n$$

$$\frac{\dot{A}(t)}{A(t)} = g$$

The neoclassical production function has three properties. The first must be positive and diminishing marginal product for each input.

$$\tilde{F}_L[K(t), A(t)L(t)] = \frac{\partial \tilde{F}[K(t), A(t)L(t)]}{\partial L(t)} > 0 \quad (13)$$

$$\tilde{F}_K[K(t), A(t)L(t)] = \frac{\partial \tilde{F}[K(t), A(t)L(t)]}{\partial K(t)} > 0 \quad (14)$$

$$\tilde{F}_{LL}[K(t), A(t)L(t)] = \frac{\partial \tilde{F}[K(t), A(t)L(t)]}{\partial L(t)^2} < 0 \quad (15)$$

$$\tilde{F}_{KK}[K(t), A(t)L(t)] = \frac{\partial \tilde{F}[K(t), A(t)L(t)]}{\partial K(t)^2} < 0 \quad (16)$$

Constant return to scale is the second property of production function which means output increases λ times as input rises λ times.

$$\tilde{F}[\lambda K(t), \lambda A(t)L(t)] = \lambda Y(t) \ \forall \lambda > 0 \quad (17)$$

Lastly, Inada conditions are assumption of production function to stable an economic growth path.

$$\lim_{K \to \infty} \tilde{F}_K[K(t), A(t)L(t)] = \lim_{K \to \infty} \tilde{F}_L[K(t), A(t)L(t)] = 0 \quad (18)$$

$$\lim_{K \to 0} \tilde{F}_K[K(t), A(t)L(t)] = \lim_{K \to 0} \tilde{F}_L[K(t), A(t)L(t)] = \infty \quad (19)$$

The Inada conditions illustrate unit elasticity of substitution. The marginal product of input will be zero when it has no labor or capital.

2) Ramsey Model

The Ramsey model deeply illustrates consumer behavior of maximizing aggregate utility due to their decisions on savings and consumptions which invest in capital accumulation on firms change over time; therefore, it is more efficiency than Solow-Swan model because the Solow-Swan model assumes saving rate is constant over time. This model assumes that labor force supplied in the market equals the population and labor supply is monotonous because of falling or increasing wage. The production based on two inputs such as labor and capital and has no growth over time. The production function can be written as:

$$Y_t = F(K_t, L_t) \tag{20}$$

where, K_t is capital at time t

L_t is labor at time t

Y_t is output at time t

In closed economy, the output is equal to consumption plus saving, and saving equals investment added to the capital stock; hence, the production can rewritten.

$$Y_t = F(K_t, L_t) = C_t + \frac{dK_t}{d_t} \tag{21}$$

where, C_t consumption at time t

This model also supposes that physical capital is not depreciated and production function is homogenous of degree. The equation (21) is converted to per capita term by dividing both sides with labor.

$$y_t = f(k_t) = c_t + \frac{dK_t}{dt}\frac{1}{L_t} \tag{22}$$

where, $y_t = \frac{Y_t}{L_t}$ is output per labor t

$c_t = \frac{C_t}{L_t}$ is consumption per labor at time t

$k_t = \frac{K_t}{L_t}$ is capital per labor at time t

The total derivative with respect to time is added in the equation (22), so we obtain:

$$\frac{dk_t}{dt} = \frac{dK_t}{dt}\frac{1}{L_t} - nk_t \text{or} \frac{dk_t}{dt} = \frac{\dot{K}_t}{L_t} - nk_t$$

(23)

where, $n = \frac{\dot{L}_t}{L_t}$ is population growth

The equation (26) is substituted into the equation (23); so, we obtain:

$$y_t = f(k_t) = c_t + \dot{k}_t nk_t \tag{24}$$

The equation (24) reveals that capital per capita remains constant by more investment.

The model also supposes the economy initiates some capital to get production off the ground and the production function per capita has to be strictly concave and follow Inada condition.

$$f(0) = 0, f'(0) = \infty, f'(\infty) = 0 \tag{25}$$

2.2.3 Theories of Rice Production and Forecasting Model

The Autoregressive Integrated Moving Average Model (ARIMA) is developed by Box and Jenkins. Box and Jenkins (1976) linear time series model was used. ARIMA is the most general class of models for forecasting a time series. The Box-Jenkins approaches consist of three steps, identification, estimation, and diagnostic checking (Box and Jenkins, 1970). These steps can be explained in detail as the following:

1) Identification

Identification of the model for ARIMA (p, d, q) is based on the concept of using the techniques for determining the value of p, d and q. These values are defined by using autocorrelation function (ACF) and partial autocorrelation function (PACF) (Biswas and Bhattacharyya, 2013). The autocorrelation (rk) condition between -1 and 1(-1<rk<1). The autocorrelation can be written as:

$$r_k = \frac{\sum_{i=1}^{n-k}(x_i-\bar{x})(x_{i+k}-\bar{x})}{\sum_{i=1}^{n}(x_i-\bar{x})^2} \tag{26}$$

where, $\bar{x}$ is the average of the n observations.

The partial autocorrelation function of the dependent time series is used to decide which autoregressive or moving average component could be used in the model. The partial autocorrelation can be written as:

$$r_{kk} = \frac{(r_k - \sum_{j=1}^{k-1} \phi_{k-1,j} r_{k-j})}{(1 - \sum_{j=1}^{k-1} \phi_{k-1,j} r_j)} \tag{27}$$

2) Estimation

Estimation of the appropriate values of p, d and q in the model and their statistical significance can be determined by t-distribution. A model has minimum values of Root Mean squared error (RMSE), Minimum Absolute Percentage Error (MAPE), Akaike's information criterion (AIC), Schwarz's Bayesian Information criterion (BIC), Mean Absolute error (MAE), Mean squared error (MSE) Q-statistics and high R-square, can be considered as the best model forecasting (Biswas and Bhattacharyya, 2013).

The Root Mean Square Error (RMSE) is usually used to measure the difference between value predicted by a model and the values actually observed from the environment that is conducted model. The RMSE can be written as:

$$RMSE = \sqrt{\frac{\sum_{i=1}^{n} (X_{obs,i} - X_{model,i})^2}{n}} \tag{28}$$

where X_{obs} is observed values and $X_{model}$is modelled values at time/place i.

R^2 is a statistic that can provide some information about the goodness of fit of a model. The R^2 coefficient of determination can explain how well the regression line approximates the real data points. An R^2 of 1 shows that the regression line well fits the data. The R^2 can be written as:

$$R^2 = 1 - \frac{\sum u_i^2}{\sum y_i^2} \tag{29}$$

$$\bar{R}^2 = 1 - \frac{\sum u_i^2/(n-k)}{\sum y_i^2/(n-1)} \tag{30}$$

Akaike's Information Criterion (AIC) is statistical used with $\bar{R}^2$by taking natural logarithm. The least value of AIC would be considered as the best model forecasting. The AIC can be written as:

$$AIC = \left(\frac{2k}{n}\right) + log\left(\frac{\sum u_i^2}{n}\right) \tag{31}$$

where k is the number of model parameters and $\sum u_i^2$is the residual sum of squares

3) Diagnostic checking

This step is to check whether the selected model appropriates the data based on ARIMA (p,d,q) model in order to find out if they are white noise. If the residuals are white noise the ACF of residuals and the Ljung and Box (1978) statistic will be applied. These may be determined by Ljung-Box statistic under null hypothesis that autocorrelation co-efficient is equivalent to zero. The best appropriate model for selecting when two or more competing models passing the diagnostic checking can be considered as the following criteria multiple R^2, Adjusted R^2, Root mean squared error (RMSE), Akaike's Information Criterion (AIC), Schwarz's Bayesian Information (BIC), Mean absolute error (MAE) and Mean absolute proportion percent error (MAPPE) (Biswas and Bhattacharyya, 2013).

In the time series analysis, there were two main and useful models which combined to be ARIMA; those are Autoregressive (AR) and Moving average (MA) models. These two combines are called Autoregressive moving average or ARMA model; that's best to produce simulation of the time series. AR and MA process of orders *p* and *q*, respectively.

The autoregressive (AR) model is employed to describe a time series in which the current observation bases on the past values. The formula is represented below:

$$Z_t = \sum_{i=1}^{p} \phi_i Z_{t-i} + \varepsilon_t \tag{32}$$

where, Z_t denotes for the value of a stationary time series at time t; ϕ_i is autoregressive parameters; p is number of past values; and ε_i is the independently and distributed error term.

Moreover, the moving average (MA) model is used to a time series process a linear function of the current and previous random errors.

$$Z_t = \varepsilon_t - \sum_{j=1}^{q} \theta_j \, \varepsilon_{t-j} \tag{33}$$

where, θ_j is moving average parameter (*j=1… q)*; q is the number of the past error values included, *t* is time period.

The general formula of autoregressive moving average as always refer to ARIMA (p,d,q) model in which be presented as following:

$$Z_t = \theta_1 Z_{t-1} + \theta_2 Z_{t-2} + \cdots \ldots \ldots + \theta_p Z_{t-p} - \delta_1 \varepsilon_{t-1} + \delta_{t-2} \ldots \ldots .. + \delta_q \varepsilon_{t-q} + \varepsilon_t \tag{34}$$

where Z_t denotes for the value of a stationary time series at time t; ε_t is random error with independently and normally distributed to zero mean and constant variance for t = 1,….,n; θ and δ are coefficients to be estimated.

The general form of the ARIMA (p,d,q) model can be written as:

$$Z_t = C + \theta_1 Z_{t-1} + \theta_2 Z_{t-2} + \cdots + \theta_{t-p} Z_{t-p-d} - \delta_1 \varepsilon_{t-1} + \delta_2 \varepsilon_{t-2} + \theta_q \varepsilon_{t-q} + \varepsilon_t \tag{35}$$

And *d* is the number of times the data are difference to obtain stationary.

2.2.4 Unit root test

The unit root test was conducted in order to avoid of spurious regression problem. All variables need to be stationary at any point we estimate them (Gilbert, Linyong, and Divine, 2013). A non-stationary time series will become stationary after differencing a number of times. A series should be difference or trend stationary. A difference stationary series becomes stationary after successive differencing while a trend stationary series is the number of times if it should be differenced to become stationary (Gilbert, Linyong, and Divine, 2013). A series integrated of order I (n) becomes stationary after differencing n times. There are many tests for determining the existence of unit root. Dickey and Fuller (1979, 1981) established a method for formal testing of non-stationary. The Dickey – Fuller (DF) can be used, if the error term (μ_t) is not correlated and it becomes inapplicable if error terms (μ_t) are correlated. As the error term is unlikely to be white noise, Dickey and Fuller have expanded their testing procedure suggesting an augmented version of the test that incorporates additional lagged term of dependent variable in order to solve the autocorrelation problem

(Gilbert, Linyong, and Divine, 2013). In order to test a series x_t is stationary using the ADF test, the following equation is estimated:

$$\Delta x_t = \alpha + \rho x_{t-1} + e_t \tag{36}$$

The following decision is considered;

If the ADF test statistic is greater than the critical value, then the series is stationary.

If the ADF test statistic is less than the critical value, the series is non-stationary.

If the series is non-stationary at the level form, then the test is applied successively on the differenced series until it becomes stationary. The test has three variants:

$$\Delta Y_t = \alpha Y_{t-1} + U_t \qquad \text{(No intercept term)} \tag{37}$$

$$\Delta Y_t = \beta_t + \alpha Y_{t-1} + U_t \qquad \text{(Intercept Term)} \tag{38}$$

$$\Delta Y_t = \beta_1 + \beta_t + \alpha Y_{t-1} + Ut \qquad \text{(Intercept + Trend)} \tag{39}$$

where,

$\alpha = (\rho - 1)$: null hypothesis is that $\alpha = (\rho - 1) = 0$ (Non-stationary data (root =1))

if α > Mackinnon statistics conclusion that time series data is stationary data is stationary or I(d) = I(0) otherwise rejected null hypothesis is that $\alpha = (\rho - 1) = 0$ or $[\rho - 1]$ because if α has a statistics significance at any level then $\alpha \neq 0$ ($\rho \neq 1$).

if α <Machinnon statistics conclusion that time series data is non-stationary or I(d) = I(d) as well as accepted null hypothesis is that $\alpha = (\rho - 1) = 0$ or $[\rho - 1]$ because if α has not a statistics significance at any level then $\alpha = 0$ ($\rho = 1$).

The ADF-Test was used for unit root test when found that higher order autocorrelation in time series data. Before uses ADF-Test should be checked dw. Statistics from DF- Test equation (38) and (39)

$$\Delta Y_t = \beta_1 + \beta_t + \alpha Y_{t-1} + \beta_i \sum_{i=1}^{m} \Delta Y_{t-1} + \varepsilon_t \tag{40}$$

When added term ($\beta_i \sum_{i=1}^{m} \Delta Y_{t-1}$) in equation (40) then t-statistics value of α before Y_{t-1} to be changed as well as all t-statistics value of them to be changed too. So ADF-Test corrects for higher order serial correlation by adding lagged differenced terms on the right-hand side. The hypothesis test for unit root in time series data by ADF-Test method as same as the DF-Test method and same conclusion about time series data is stationary or non-stationary (Chaiboonsri et.al, 2008). Stationary or non-stationary can be concluded by defining null hypothesis for ADF as:

H_0: $\delta = 0$ (it has unit root)

H_1: $\delta < 0$ (it has no unit root)

The critical value of t-statistics would be able to determine whether the null hypothesis for ADF is rejected or accepted.

2.2.5 Co-integration and Error Correction Model

Co-integration is the statistic manipulation of the existence of long run relationship between the variables which are individually non-stationary at their level form but stationary after difference (Gujarati, 1995).

When all variables are accepted to be stationary, ARDL is introduced to estimate a long-run and short-run relationship effect could be explored by determined the size of coefficient of the differenced variables; whereas, long-run effect could be found by estimating the lagged of explanatory variables. Therefore, ARDL for long-run relationship can be written as:

$$\Delta Y_t = \alpha + \sum_{i=1}^{p} \beta_i \, \Delta Y_{t-i} + \sum_{i=0}^{q} \delta_i \, \Delta X_{t-i} + \lambda_1 Y_{t-1} + \lambda_2 X_{t-1} + \varepsilon_t \tag{41}$$

F-test would be used to test an existence of long run relationship among variables. To determine whether it has the long-run relationship; two sets of asymptotic critical value is computed. In order to keep the test work appropriately; two crucial assumptions would be concluded. Firstly, it assumes that all variables are I(0) while the second assumes that all variables are I(1).

The hypothesis can be written as:

H_0: has not the long run relationship or co-integration among the variables

H_1 : has the long-run relationship or co-integration among the variables

In order to determine the results whether there is reject or accept null hypothesis, there conclusion can be derived from F-test results. If the calculated F-statistics is greater than the upper bound critical value, mean null hypothesis is rejected. There is a long-run relationship among the variables. If the calculated F-statistics is less than the lower bound critical value, null hypothesis is accepted. The result can be concluded that there is not long-run relationship among the variables. However, the result is inclusive when the value of computed F-test falls between the lower and upper bound critical values.

In order to examine the short run relation of the model above, Error Correction Model (ECM) would be employed. Error correction can explains the speed of adjustment towards the long run equilibrium. If the variables accept the existence of co-integration, then the conventional Vector Error Correction Model (VECM) is estimated using Ordinary Least Square (OLS) to confirm short run dynamic and long-run equilibrium. ECM can be written as:

$$\Delta Y_t = \alpha + \sum_{i=1}^{p} \beta_i \, \Delta Y_{t-i} + \sum_{i=0}^{q} \delta_i \, \Delta X_{t-i} + \lambda EC_{t-1} + u_t \qquad (42)$$

The speed of adjustment is determined by estimating the value of λ. It is known as coefficient of adjustment and usually statistically negative sign. It can explain the economic adjustment to be recovered in the short run period if any shock would be occurred. It also provides vital information about economic recovery to long-run as equilibrium and the steady state.

2.2 Previous studies

Rice industry has become a major sector in driving economic growth and creating job opportunities for the people in many countries around the world, essentially for developing countries. Most of the research has been conducted by many academic studies and economists for non-government organization such as the Food and Agriculture Organization of the United Nations (FAO), the International Bank for Reconstruction, Development (World Bank), and the United Nations Development Programme (UNDP), and the International Rice Research Institute (IRRI). Many academic studies have investigated the factors that impacted on rice product and economic growth as well as forecasting the rice production in the period of time by using a variety of both classical multivariate regression and advanced modern econometric approaches, such as VAR model, ARMAX model, system of equation approach, autoregressive distributed lag model, co-integration test, error correction model, and the generalized method of moment (GMM) model, advanced time-series models (seasonal ARIMA and conditional volatility models), time-series fussy, and stochastic frontier model (methods of efficiency measurement and data envelopment analysis). The explanatory variables are selected and used according to the limited data.

2.2.1 Rice Production

Yu and Fan (2009) studied in the topic “Rice Production Responses in Cambodia”, analyzes how Cambodian farmers and the Cambodian government can respond to increasing rice prices. The study estimate rice production responses in Cambodia using data base on the Cambodian Socio-Economic Surveys (CSES) conducted in 2004 and 2007. The findings show that there is huge potential for output expansion in the Cambodian rice sector, and that farmers can response to high price by increasing their use of input such as fertilizers and irrigation. The results also suggest that the Cambodian government needs to design an investment strategy that relaxes constraints in rural infrastructure (e.g., transportation and electricity) in order to increase agricultural production and productivity and boost farmer’s incomes.

Prasanna, Kumar and Singh (2009) studied in the topic “Rice Production in India – Implication of Land Inequity and Market Imperfections”, examines the relationship between farm productivity and farm structure has been analyzed focusing mainly on one channel of transmission of this relationship, input-use pattern in rice production. They hypothesized relationship tested in the study is that land inequality influences access to/use of resources in rice production and in-tern influences productivity. The results indicate that smallholders’ share in inputs like fertilizers, and irrigation has increased over time, but a large number of smallholders still do not have to access to these resources. The findings also indicate that policies like fertilizer subsidy, agricultural credit, and minimum support prices are able to address market imperfections only partially. Hence, for improving productivity and profitability of rice production of smallholders in particular and other farmers in general.

Hussain et al. (1999), conducted research in the topic “Rice and wheat production in Pakistan with effective Microorganisms” attempt to enhance soil quality, improve the production yield, and reduce the inputs of chemical fertilizers and pesticides in agriculture worldwide. The results reveal that effective microorganism applied in combination with fertilizer (NPK), green manure (GM), farm-yard manure (FYM) caused a significant increase in nutrient uptake by the grain straw of each crop. The uptake of NPK by both crops was higher for EM alone than for the controls. A comparative economic analysis of the treatments demonstrated a significant higher net return due to EM. The average net profit from rice and wheat production using EM was $44.90 per hectare and $62.35 per hectare, respectively. The study also indicates that EM can enhance maximum economic yields in a rice wheat rotation and also improve soil productivity when applied with organic amendments.

Sachchamarga and Williams (2004), studied in the topic “Economic Factors Affecting Rice Production in Thailand”, aim to identify and measure the relative magnitude of effect of the key economic factors affecting Thai rice producer planning decision using an econometric model of the area planted to rice in Thailand. The results suggest that area planted to rice in Thailand is more responsive to changes in area planted in previous years, the amount of rainfall, and the availability of agricultural labor than to changes in paddy rice prices. An important implication of the study is that policies to reduce rural labor shortage could do more to enhance the production of rice Thailand than annual adjustment in the level of the guaranteed price of the rice received by producers.

Fatoba, Omotesho and Adewumi (2009), studied in the topic “Economic of wetland rice production technology in the Guinea Savannah of Nigeria”, examine the costs and returns of wetland rice production technology in Nigeria State of Nigeria. The study measure the rate of compliance with the recommended package for the production technology. The study revealed the presence of increasing return to scale for the production technology. The estimated parameters of labor and fertilizer, farm size and level of compliance had the expected positive signs. The coefficients of labor and fertilizer were significant ($p < 0.05$).

Fulginiti and Perrin (1998), conducted the research in the topic “Agricultural productivity in developing countries”, examines changes in agricultural productivity in 18 countries over the period 1961 – 1985. Using a nonparametric, output-based Malmquist index and a parametric variable coefficient Cobb-Douglas production function to examine, whether their estimates confirm results from other studies that have indicated declining agricultural productivity in declining agricultural productivity in LDCs. The results confirm the previous findings, indicating that at least half of these countries have experienced productivity decline in agriculture.

Frisvold and Ingran (1994) studied in the topic "Sources of agricultural productivity growth and stagnation in Sub-Saharan Africa", examines sources of agricultural growth in sub Saharan Africa. Growth in the stock of traditional inputs (land, labor, livestock) remains the dominant source of output growth. Growth in modern input use was of secondary importance, but still accounted for a 0.2-0.4% annual growth rate in three or four sub-regions. Econometric results support earlier studies that suggest that land abundance may be a constraint on land productivity growth. Growth in agricultural exports and historic calorie availability had positive impacts on productivity.

2.2.2 Rice production and Economic Growth

Cao and Birchenall (2013), conducted the research in the topic "Agricultural productivity, structural change, and economic growth in post-reform China", analyses the function of agricultural productivity as a determinant of China's post reform economic growth and sectoral reallocation. Using microeconomic farm-level data, and treating labor as highly differentiated input, the study finds that the labor input in agriculture decreased by 5% annually and agricultural TFP grew by 6.5%.

Anthony (2010), studied in the topic "Agricultural Credit and Economic Growth in Nigeria: An Empirical Analysis", analyzes the impact of agriculture credit on economic growth in Nigeria. The problems of agricultural production in Nigeria and the strategies for agricultural transformation of the economy are discussed. The results indicate that agricultural variables have impacted on economic growth and their contribution to export growth has been encouraging.

Gilbert, Linyong and Divine (2013), studied in the topic “Impact of Agricultural Export on Economic Growth in Cameroon: Case of Banana, Coffee and Cocoa”, analyzes the quantity of the contribution of agricultural exports to economic growth in Cameroon. This paper employs an extended generalized Cobb Douglas production function model, using food and agricultural organization data and World Bank Data from 1975 to 2009. All variables confirm co-integration and as such the conventional vector error correction model is estimated using the Engle and Granger procedure. This study demonstrates that the agricultural exports have mixed effect on economic growth in Cameroon. Coffee export and banana export has a positive and significant relationship with economic growth.

Hegde and Hegde (2013), conducted the research in the topic “Assessment of Global Rice Production and Export Opportunity for Economic Development in Ethiopia”, examines rice export in Ethiopia will influence the economic development, the study employs secondary source for analyses and prove hypothesis, rice production will positively correlated with economic development.

Sanjuang Lopez and Dawson (2010) studied the contribution of agricultural exports to economic growth in developing countries. Co-integration technique is applied to analyze the relationship between Gross Domestic Product and agrarian and no agrarian export by using the data set of 42 underdeveloped countries. The study found that there existed long run relationship and the agriculture export elasticity of GDP was 0.07 and the non-agriculture export elasticity of GDP was 0.13.

Dawson (2005) examined the contribution of agricultural export to economic growth in less developed countries. Two models are used in his analysis; the first model explores the agricultural production function for both agricultural and non-agricultural exports as inputs. The second model based on economy model i.e. agricultural and non-agricultural. The study uses fixed and random effects to estimate in each model using a panel data of sixty two less developed countries for the period 1974 – 1995. The results reveal the role of agricultural exports in economic growth.

Aurangzeb (2006) studied the relationship between economic growth and exports in Pakistan using analytical framework developed by (Feder, 1983). To test the hypothesis of economic growth rises up as export extends by using time series data from 1973 to 2005. The results of the study indicate that an export sector has significantly higher social marginal productivities. Therefore, the study concludes that an export sector pushes economic growth in Pakistan.

Kwa and Bassoume (2007) conducted the research in the topic “”, examines the linkage between agricultural exports and sustainable development. The study provides the case studies of different countries that have involved in agricultural export. Nadeem (2007) provided the empirical analysis of the dynamic influences of economic reforms and liberalization of trade policy on the performance of agricultural exports in Pakistan. The study examines the effect of both domestic supply side factors and external demand on the performance of agricultural exports. The main findings of the study is that export diversification and trade openness contributed more in agricultural domestic side factors performance. The results suggest that agricultural export performance is more elastic to change in domestic factors.

2.2.3 Forecasting Rice Production

Aliet. al (2013), studied in the topic “Forecasting Production of Food Grain Using ARIMA Model and its Requirement in Bangladesh”, the study forecasts the food grain requirement and its production in Bangladesh, using time series ARIMA model in different order predict accurate values and forecast the future amount of food grain in different years.

Biswas and Bhattacharyya (2013), conducted the research in the topic “ARIMA Modeling to Forecast Area and Production of Rice in West Bengal”, employs time series ARIMA model in order to give a comprehensive image of current situation of rice production in West Bengal. ARIMA model was developed for individual univariate series of both area production of rice in West Bengal since independence. The study also applies Box and Jenkins linear time series model, which involves auto-regression, moving average, and integration, termed as ARIMA (p, d, q) model.

Akter (2013), studied in the topic “Forecasting of Rice Production in Bangladesh”, analyses an appropriate model using seven contemporary model selection criteria that could best explain the growth pattern of rice production in Bangladesh during the time periods 1971-72 to 2004-05. It appeared from the study that the best fitted model for rice production in Bangladesh was quadratic linear and cubic model.

Iqbal, et al. (2005), conducted the research in the topic “Use of the ARIMA Model for Forecasting Wheat Area and Production in Pakistan”, to estimate scientifically the accurate future production potentials of this crop on the basis of past trends. The study has been made to forecast the area and production of wheat up to the year 2022, using the ARIMA model to estimate the wheat production in Pakistan. The results demonstrates that production of wheat would be 29,774.8 thousand tons in 2002-22. The scope of higher area and production lies in adequate availability of inputs, educating and training the farming community, soil conservation and reclamation, and essentially the supportive government policies on wheat in the country.

Sivapathasundaram and Bogahawatte (2012), studied in the topic “Forecasting of Paddy Production in Sri Lanka: A Time Series Analysis using ARIMA Model”, to indicate the past, present and future trends of paddy production in Sri Lanka and to develop a time series model to find out the long term trend and estimate for future changes of paddy production for the three leading years. Autoregressive Integrated Moving Average (ARIM) is used to fit the data set which is complementary to the trend regression approach and forecasting of the concerned variables to the near future. The study uses secondary data of the Department of Census and Statistics of Sri Lanka for the period of 1952 to 2010. ARIMA model is applied estimate the rice production in Sri Lanka. The results show based on The Mean Absolute Percentage Error (MAPE) for paddy production is 10.5. The forecasts for rice production during year 2011 to 2013 are 4.07, 4.12 and 4.22 million Mt respectively, and the production for the year 2011 and 2012 is lower than in 2010. However, in the later year 2013 the production is higher.

Badmus and Ariya (2011), conducted the research in the topic “Forecasting Cultivated Area and Production of Maize in Nigerian using ARIMA Model”, to forecasted area and production of maize in Nigeria using Autoregressive Integrated Moving Average (ARIMA) model. The study uses time series data covering the period of International Financial

Statistical (IFS) reports and National Bureau of Statistics (NBS). The result indicates that maize production forecast for the year 2020 to be about 9952.72 tons with upper and lower limits 6479.8 and 13425.64 thousand tons respectively. The model also demonstrates that the maize area would be 9229.74 thousand hectares with lower and upper limit of 7087.67 and 11371.81 thousand hectares respectively by 2020.

Awal and Siddique (2011), studied in the topic "Rice Production in Bangladesh Employing by ARIMA Model", to estimate growth pattern and also examine the best ARIMA model to efficiently forecasting Aug, Aman and Boro rice production in Bangladesh. The results shows that the best models are ARIMA (4, 1, 4), ARIMA (2, 1, 1), and ARIMA (2, 2, 3) for Aus, Aman, and Boro rice production, respectively. The empirical analysis revealed that short-term forecasts are more efficient for ARIMA models compare to the deterministic models. The production uncertainty of rice could be minimized if production were forecasted well and necessary steps are taken against losses.

Table 2.1: Summary of rice production and forecasting model

Author (s)	Topic	Variable	Methodologies	Results
Iqbal, et al. (2005)	Use of the ARIMA model for forecasting wheat area and production in Pakistan	Dependent: future harvested area and production of rice Independent: past and present harvested area and production of rice	AR and MA OLS	Production of wheat would be 29774.8 thousand tons in 2002-22.
Abedullah, Kouser&Mushtaq (2007)	Analysis of technical efficiency of rice production in Punjab (Pakistan)	Dependent: output rice Independent: age, education, Yield/Acre, Farm size, area, fertilizer (NPK), plant protection cost, irrigation, labor, plant, and plant to plant distance	OLS	Production function indicate that coefficient of pesticide is non-significant probably due to heavy pest infestation while fertilizer is found to have negative impact on rice production mainly because of improper combination of N, P, and K nutrients.

Table 2.1: Summary of rice production and forecasting model (continued)

Author (s)	Topic	Variable	Methodologies	Results
Yu & Fan (2009)	Rice production responses in Cambodia	Dependent: Rice output Independent: paddy yield (wet & dry), labor, fertilizer (wet & dry), irrigation (wet & dry), Irrigated paddy fields, cultivated area, Categorical variable for agricultural loans, distance market, and electricity	OLS	There is huge potential for output expansion in the Cambodian rice sector, and that farmers can respond to high prices by increasing their use of inputs such as fertilizers and irrigation.

Table 2.1: Summary of rice production and forecasting model (continued)

Author (s)	Topic	Variable	Methodologies	Results
Fatoba, Omotesho and Adewumi (2009)	Economics of wetland rice production technology in the Guinea Savannah of Nigeria	Dependent: Rice production Independent: Quantity of wetland , fertilizer, farm size, labor and seed	MLE	The study measure the rate of compliance with the recommended package for the production technology. The study revealed the presence of increasing return to scale for the production technology. The estimated parameters of labor and fertilizer, farm size and level of compliance had the expected positive signs. The coefficients of labor and fertilizer were significant ($p < 0.05$).

Table 2.1: Summary of rice production and forecasting model (continued)

Author (s)	Topic	Variable	Methodologies	Results
Prasanna, Kumar and Singh (2009)	Rice Production in India – Implication of Land Inequity and Market Imperfections	Dependent: Rice output for 18 countries Independent: Land, livestock, machinery, fertilizer and labor	ARDL	The findings indicated that at least haft of these countries have experienced productivity decline in agriculture.
Anthony (2010)	Agricultural credit and economic growth in Nigeria: An empirical analysis	Dependent: growth rate of GDP (GRDP), agricultural output growth and non-oil export Independent: exchange rate, interest rate and credit to the agricultural sector	3SLS	Agricultural variables have impact on economic growth and their contribution to export growth has been encouraging.

Table 2.1: Summary of rice production and forecasting model (continued)

Author (s)	Topic	Variable	Methodologies	Results
Badmus and Ariyo (2011)	Forecasting cultivated areal and production of maize in Nigerian using ARIMA model	Dependent: future harvested area and production of maize Independent: past and present harvested area and production maize	AR and MA OLS	The maize production forecast for the year 2020 to be about 9952.72 tons with upper and lower limits 6479.8 and 13425.64 thousand tons respectively. It also shows that the maize area would be 9229.74 thousand hectares with lower and upper limit of 7087.67 and 11371.81 thousand hectares respectively by 2020.

Table 2.1: Summary of rice production and forecasting model (continued)

Author (s)	Topic	Variable	Methodologies	Results
Sivapathasundaram and Bogahawatte (2012)	Forecasting of paddy production in Sri Lanka: A timer series analysis using ARIMA Model	Dependent: Future rice production Independent variable: past and present rice production	AR and MA OLS	ARIMA (2,1,0) was the most suitable model used as this model has the lowest AIC and BIC values. The Mean Absolute Percentage Error (MAPE) for paddy production was 10.5. The forecasts for paddy production during 2011 to 2013 were 4.12 and 4.22 million Mt respectively, and the production for year 2011 and 2012 was lower than in 2010 and in later year 2013 the production was higher.

Table 2.1: Summary of rice production and forecasting model

Author (s)	Topic	Variable	Methodologies	Results
Biswas & Bhattacharyya (2013)	ARIMA modeling to forecast area and production of rice in West Bengal	Dependent: estimated rice production and cultivated area Independent: cultivated area and rice production	AR and MA OLS	For the series of gross cultivated area ARIMA (2,1,3) model is found to be the best fitted model whereas for the series of production ARIMA (2,1,1) is found to be the best fitted one.
Gilbert, Linyong and Divine (2013)	Impact of agricultural export on economic growth in Cameroon: Case of banana, coffee and cocoa	Dependent: Real Gross Domestic Product (RGDP) Independent: gross domestic fixed capital, total labor force, consumer price index, cocoa export, banana export and coffee export	ARDL and VECM	The agricultural exports have mixed effected on economic growth in Cameroon. coffee export and banana export has a positive and significant relationship with economic growth. However, cocoa export was found to have a negative and insignificant effect on economic growth