CHAPTER II

LITERATURE REVIEW

2.1.Groundnut Production Systems in Myanmar

Groundnut production was an important production in Myanmar. About 75 percent of production comes from Central Myanmar, mainly Sagaing, Magway and Mandalay divisions (Aye Aye Mon, 2004). Groundnut is grown in a year throughout the country, however, Mandalay division and Magway division are grown the popular largest production areas in Myanmar.

The production of food crops in Myanmar is sufficient to meet domestic requirement, except oilseed crops. The total edible oil consumption is based on the average consumption rate of 4.5 viss per person. Groundnut provides 45 percent of the edible oils, followed by sesame and sunflower.

In Myanmar, the sown and harvested area of groundnut gradually increased from 1990 to 2000(Table 4.2). After 2000, rate of increase was significantly high and 756 thousand hectare was cultivated in 2006-2007.

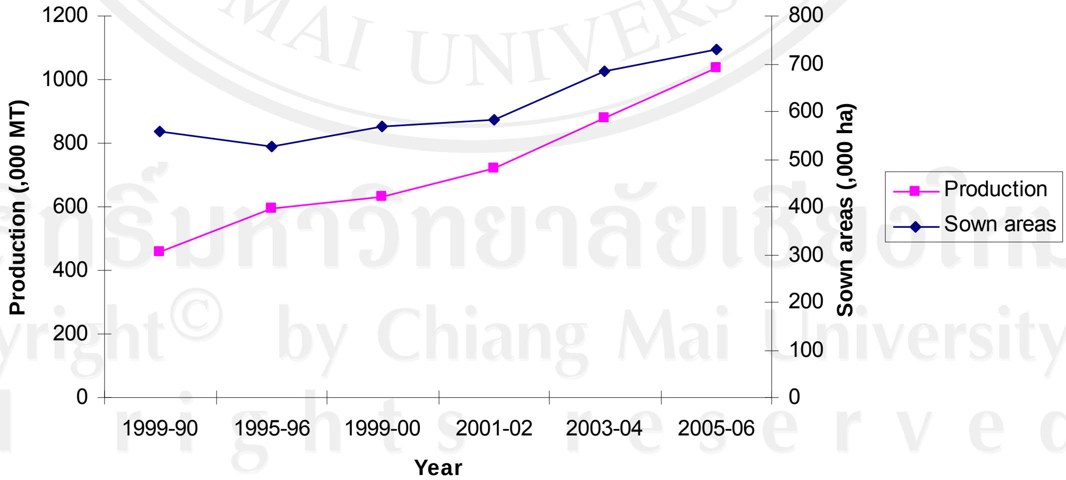

Figure 2.1The sown area, harvest area and production of groundnut in central region of Myanmar.
Source: Central Statistical Organization, 2006

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The productivity of groundnut in Myanmar is still low compared to the Asian countries. The national average yield per hectare has been about 560.20 kg per hectare in 2004 (CSO, 2006). Magway and Mandalay division, major growing areas in Myanmar, during the rainy season in 2004-05, an average yield per hectare was 598.75 kg per hectare for Magway and 470.38 kg per hectare for Mandalay (CSO, 2006).

Thus, groundnut is one of the most important oilseed crops which have been grown both in both rainfed and irrigated areas and there is a need to conduct research on technology transfer mechanisms to improve production.

2.2. Concepts of Technical Efficiencies

Agricultural productivity can be defined as a measure of the efficiency with which an agricultural production system employs land, labor, capital and other resources. Among them, land is the primary and most important factor. Due to the rapid increase in population pressure in recent decades, special attention has been focused on land productivity. It is mainly by increasing yield per unit area that the growing need for food can be met. Productivity may be raised also by replacing the pattern of productivity by more intensive systems of cultivation or by cultivating higher valued crops. Sharif (1996) stated that in developing countries, where land is relatively scarce and labor abundant, yield per unit area is more important while in countries where land is abundant and labor is scarce, yield relative to labor invested may constitute a more suitable measure for determination of agricultural productivity.

Agricultural technologies are vital to agricultural development, although it cannot be transferred directly as is commonly done for industrial technology. Also it can't be transferred from one region to another region because of its biological nature and sensitive change to different ecological conditions. Each country has developed local agricultural research and is trying to find appropriate technologies for their local conditions. In addition, new technologies should be transferred through extension workers to the farmers. As a result, the role of extension workers becomes more important in the diffusion of technology to the farmers in agricultural research.

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Technical efficiency is defined in terms of distance to a production frontier. Technical efficiency is defined as the ability of a firm to obtain maximal output from a given set of inputs. A simple ratio of output to input provides a measure of productivity. An increase in this ratio from one time period to another demonstrates improvement in the efficiency of the process. One firm is more technically efficient if it produce higher than another firm at the same level of input usage and technology.

Technical efficiency is a purely physical notion that can be measured without resource to price information and without having to impose a behavioral objective on producers, cost, and revenue. Technical efficiency is a measure of how well the individual transforms inputs into a set of outputs based on a given set of technology and economic factors (Kumbhakar and Lovell, 2000).

There are two concepts in measuring technical efficiency; input-oriented measures and output-oriented measures. The measurement of technical efficiency assumes that multiple inputs are used to produce a single output, and output-oriented technical efficiency is defined relative to a production frontier.

Technical efficiency in terms of microeconomics of production is the maximum attainable level of output for a given level of production inputs, given the range of alternative technologies available to the farmer. A technically efficient firm produces the maximum possible output from the inputs used, given locational and environmental constraints, and it minimizes resource inputs for any given level of output (Kibaara, 2005).

Efficiency analysis is conducted not only at the farm level but also at the household level of a country. Technical inefficiency obtained in this manner is a *relative* measure where the production frontier is defined by the farmers' plots included in its estimation. The determinants of inefficiency are then analyzed using farmer-specific explanatory variables that are expected to influence it.

For the input-oriented measures, Farewell (cited by Coelli. Tim., 1998) illustrated that the use of two inputs (X_1 and X_2) to produce a single output (Y) allows a particular technology to isoquant. In Figure 1(a), the isoquant II' represented fully efficient firms. If firm produce a unit of output at the A point on X_1/X_2 line with certain quantities of input, the distance BA is the represented amount of all inputs proportionally reduced without affecting the output as ratio BA /OA, which shows the

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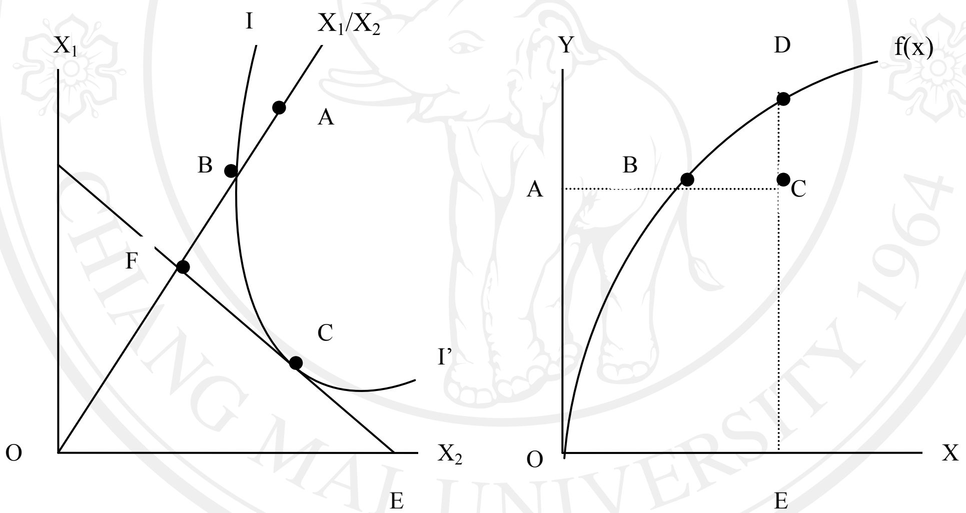
percentage by which all inputs need to be reduced to achieve technically efficient production. Therefore, technical efficiency (TE) of a firm can be measured by the ratio as TE = OB/ OA, between zero and one in value and then gives the degree of technical inefficiency of the firm as (1- TE) or BA/OA. A value of one shows that the firm has full technical efficiency in which point A lies on the efficient isoquant (Coelli.Tim., 1998). For the output-oriented measures, it can be illustrated using one input (X) and one output (Y). In Figure 1(b), the output-oriented measure of TE would be EC/ED. It will take a value between zero and one. The value of one indicates the firm is fully technically efficient.



(a) Input-oriented measure (b) Output-oriented measure

Figure: 2.2 Input and output-oriented technical efficiency measures.

Source; Coelli.T, 1998

To measure the technical efficiency in practice, a production frontier function has to be estimated from sample data using either a non –parametric piece-wise firm technology or parametric function, such as the Cobb-Douglas form, fitted to the sample data (Farrell, 1957, cited in Coelli, 1998).

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2.3. Stochastic Frontier Production Function

Stochastic Frontier Production Function (SFA) is the most commonly used method to estimate the efficient frontier and calculate the firm's technical efficiency relative to it. The SFA requires a functional form to be specified for the frontier production function.

Aigner, Lovell, and Schmidt (1977) (cited in Coelli, 1998) independently proposed a stochastic frontier production function in which the error term has two components, one accounts for random effects and the other accounts for technical inefficiency. In sample terms, the stochastic frontier approach amounts to specifying the relationship between output and input levels using two error terms. One error terms is the traditional normal error in which the mean is zero and the variance is constant. The other error term represents technical inefficiency and may be expressed as a half-normal, truncated normal, exponential, or two-parameter gamma distribution. Technical efficiency is subsequently estimated via maximum likelihood of the production function subject to the two error terms.

This model can be expressed as follows;

$$Y_i = f(x_{i\,;}\beta)+e_i \qquad where,\ i= 1,2,....,N \qquad (1)$$

Where, Y_i= the output level of the ith sample firm,

$f(x_i\,;\,\beta)$ = a suitable function such as Cobb-Douglas or translog production functions of vector, x_i, of inputs for the ith farm and a vector, β, unknown parameter.

e_i= composed error term which can be defined by

$$e_i = (v_i - \mu_i) \qquad (2)$$

Where, v_i = independently and identically distributed (i.i.d) are assumed as normal random variables which zero mean and unknown variance, σ_v^2

μ_i = non-negative unobservable random variables are assumed to account for technical inefficiency in production and are often assumed to be i.i.d. exponential or half-normal random variables.

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The random effects can be represented by f(x) e^{v}. The index of technical efficiency can be modified to:

$$e^{-u} = Y / f(x)e^{v} \quad (3)$$

The parameter of the stochastic frontier production function can be estimated using either the maximum-likelihood (ML) method or a variant of the Corrected Ordinary Least Square (COLS) (Richmond, 1974 cited in Coelli, 1998). The ML is the preferred method for estimation of the parameters of stochastic frontier models. The ML estimator is asymptotically more efficient than the COLS estimator when the contribution of technical inefficiency effects to the variance terms is large. Technical inefficiency effects have been frequently assumed in empirical applications that it has the half normal distribution.

Aigner, Lovell and Schmidt (1977) (cited in Coelli, 1998) defined the log-likelihood function for the model, defined by equation 4,

$$ln\ (y_i) = x_i \beta + v_i - \mu_i; \quad i=1, 2, \ldots, N \quad \ldots\ldots \quad (4)$$

Where,

Y_i = the production of the *i*-th firm,

X_i = inputs used of the ***i*** th firm,

β = estimated parameters,

v_i= a symmetric error term that shown statistical noise,

μ_i = non- negative random variable.

and in term of two variance parameters,

$$\sigma_s^2 = \sigma_v^2 + \sigma^2 \quad \text{and} \quad \gamma = \sigma^2 / \sigma_s^2$$

Where,

σ_s^2 = Total variance,

σ_v^2 = Variance of measurement error variable

σ^2 = Variance of non-negative random variable

The parameter γ has a value between zero and one ($0 \leq \gamma \leq 1$), where the value of zero indicates that the deviations from the frontier are due entirely to noise, while a value of one would indicate that all deviations are due to technical inefficiency (Coelli, 1998).

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The concept of technical efficiency using stochastic frontier production fuction is illustrated in Figure.2.2. The random error term v allows frontier output values vary around the deterministic production frontier Y= f(X).

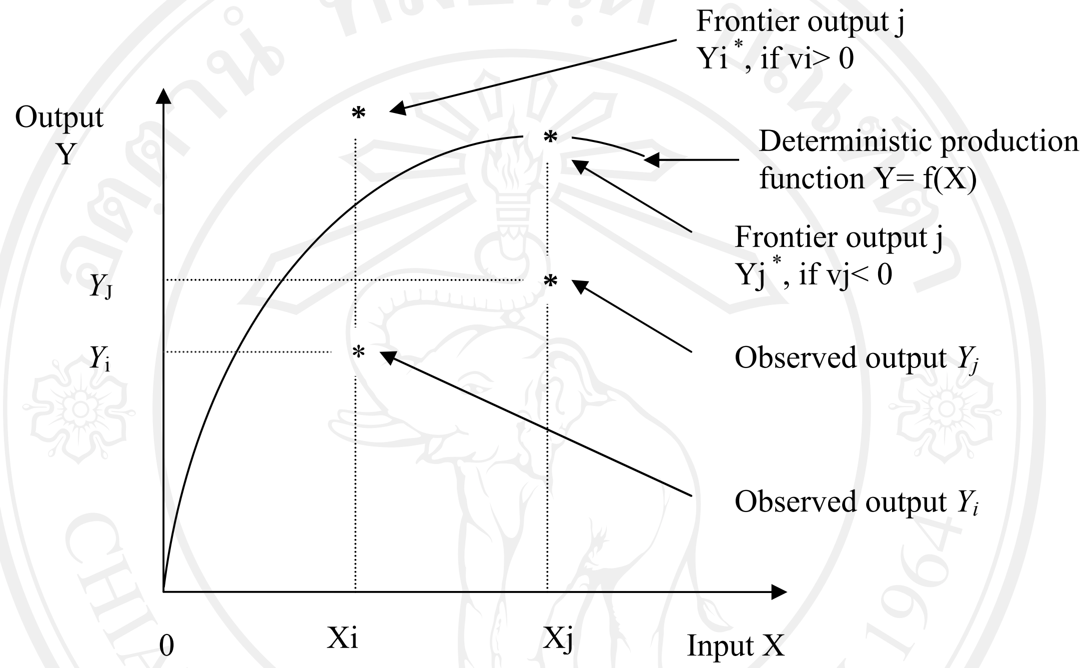

Figure 2.3 Stochastic frontier production functions.

There are two approaches to estimating the inefficiency models. These may be estimated with either a one-step or two-step process. For the two-step procedure the production frontier is first estimated and the technical efficiency of each farm is derived. These are subsequently regressed against a set of variables, Zi, which are hypothesized to influence the farms' inefficiency. A problem with the two-stage procedure is the inconsistency in the assumption about the distribution of the inefficiencies. In the first stage, the inefficiencies are assumed to be independently and identically distributed in order to be a function of a number of farm specific factors, and hence are not identically distributed unless all the coefficients of the factors are simultaneously equal to zero (Coelli, Rao and Battese, 1998). For the one step procedure, the most commonly used package for estimation of stochastic production frontier in the literature is FRONTIER 4.1 (Coelli, 1998).

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FRONTIER estimates all of the parameters in one stage to overcome the inconsistency. The inefficiency effects are defined as a function of the farm specific (as in the two-stage approach) but they are then incorporated directly into the maximum likelihood estimation (MLE). The specification has been widely applied. The specification has also been altered and extended in a number of ways. The series of data is applied not only in cross-sectional data, but considered for panel data and time varying technical efficiencies, and so on.

Letting u be the technical inefficiency error term, technical efficiency is estimated as the ratio of the expected value of the predicted frontier output conditional on the value of *u* to the expected frontier output conditional on the value of *u* being 0;

And then, average level of technical efficiency was estimated as;

$$E(u) = -\sigma_1\sqrt{\frac{2}{\pi}} \quad (5)$$

Jondrow et al.,(1982) and Kalirajian and Flinn(1983) had developed a specification for the expected firm- specific inefficiency, $E(U_i)$, conditional on the random disturbance, V_i. A frontier model was first estimated using the MLE or COLS method. The residuals from this frontier were used to isolate the inefficiency part from the random error.

The expected firm-specific inefficiency can be written as;

$$\varepsilon(Ui/\varepsilon i) = \sigma^* \left[\frac{f(\varepsilon i\lambda/\sigma)}{1-F(\varepsilon i\lambda/\sigma)} - \frac{\varepsilon i\lambda}{\sigma} \right] \quad (6)$$

Where f(.) and F(.) are respectively the standard normal density function and cumulative distribution estimated at $(\varepsilon i.\lambda/\sigma)$.

Where,

$$\lambda = \sigma_u/\sigma_v$$

$$\sigma 2 = \sigma 2_u + \sigma 2_v \quad \text{and}$$

$$\sigma^* = \sigma_u\sigma_v/\sigma$$

The variance ratio parameter is estimated by

$$\gamma = \frac{\sigma 2_u}{\sigma 2_u + \sigma 2_v}$$

The term e_i is computed by

$$e_i = \ln Y_i - [\ln \alpha_0 + \sum i\alpha_i \ln X_i]$$

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The standard normal density function was give by

$$f((u_i / e_i) = \frac{1}{1-F} * \frac{1}{\sqrt{2\pi\sigma *}} \exp\left\{ \frac{-1}{2\sigma *^2} [ui + \frac{\sigma^2 u_i \varepsilon_i}{\sigma^2}]^2 \right\}$$

Where; $u_i \geq 0$

The technical efficiency of the firm I was then directly given by e^{-u} or technical inefficiency given by $(1-e^{-u})$

$$TE_{(i)} = \frac{Y_{i\,(actual)}}{f(x_i, \beta)} = \exp(-u_i) \qquad (7)$$

Where Y_i =an actual output obtained by farm i ;

$f(x_i, \beta)$=a maximum possible output (on frontier) of farm i.

2.4. Researches and studies relating to technical efficiency

Aye Aye Khin (2002) analyzed the farm-specified technical, allocative and economic efficiencies of the sample sugarcane farmers in Pyinmana, Tatkone and Yedashe townships. The application of urea fertilizer, the total labor and draught power used by the farm from land preparation to transporting to the sugar-mill and the farmers' experience in sugarcane cultivation were the most important explanatory variables in frontier estimate. All sample farmers were not fully economically efficient in sugarcane production. About 40-70% of all sample farmers achieved moderate economic efficiency in sugarcane production. Therefore, the results pointed out the encouragement for reaching optimal allocation of resources in their farms was necessary to improve their income and welfare.

Tadesse and Krishnamoorthy (1997) examined the level of technical efficiency in paddy farms of the southern Indian state of Tamil Nadu. The study showed that 90% of the variation in output among animal power and fertilizers had a significant influence on the level of paddy production. The results showed that, with the use of more fertilizers and land, rice production could be increased. The contribution of land in increasing production was more prominent. Farmers were overusing animal power in rice cultivation. The study further indicated that small-sized paddy farms in zone II and medium-sized paddy farms in zone Ill are

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represented by ecologically size-biased production techniques; thus achieving higher technical efficiency.

In carp pond culture in Peninsula Malaysia, technical efficiency was examined the productive performance and its determinants by Iinuma and Sharma and Leaung (1999). The results showed that the mean technical efficiency for sample carp farms was estimated to be 42%, indicating a great potential for increasing carp production in Peninsula Malaysia through improved efficiency. Seed ratio has a significant effect on fish production; therefore, the proper choice of species composition is important to improving productivity in carp polyculture. Because the intensive/ semi-intensive system is found to be technically more efficient than the extensive system, efforts should be made to promote the intensive/semi-intensive carp culture.

Mwakalobo (2000) estimated coffee production levels of different farmers and their efficiency in resource use. The results showed that the farmers displayed inefficient use of available resources used and were using adequate capital-intensive input levels in order to maximize their output. The result showed that the coffee farmers need to improve their resource use efficiency and productivity. This was shown using a Cobb- Douglas production function, using the Ordinary Least Square techniques.

Abdulai, and Eberlin (2001) examined technical efficiency of maize and bean farmers in two selected regions of Nicaragua using farm-level survey data for the 1994–1995 crop year. The results expressed that the average technical efficiency levels are 69.8 and 74.2% for maize and beans, respectively. The maize and beans translog frontier functions show that farmers' human capital represented by the level of schooling, access to formal credit and farming experience represented by age contribute positively to production efficiency, while farmers' participation in non-farm employment tends to reduce production efficiency.

Wiboonpogse and Sriboonchitta (2001) analyzed the factors affecting technical inefficiency jointly with production frontiers estimated using maximum likelihood method by Frontier 4.1. They stated that the technical inefficiency in jasmine rice and in the non- jasmine rice could be significantly improved. To enhance the yield per rai of jasmine and non- jasmine rice, increased use of chemical fertilizer could be achieved by lowering the fertilizer price or providing more credit. They

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recommended using more male labor relative to the total labor to reduce the technical inefficiencies for jasmine rice production. However, to reduce the jasmine and non-jasmine rice technical inefficiencies, besides increasing the male labor, technical training to enhance experience in place of age and education must be added for the short-run. They found that the average technical efficiencies (70%) in both kinds of rice imply substantial gaps for the rice yields improvement by increasing their technical efficiencies.

Rahman (2003) analyzed the profit efficiency by its three components-technical, allocative, and scale efficiency. He provided a direct measure of the efficiency of Bangladesh rice farmers using a stochastic profit frontier and inefficiency effects model. The results indicated that rice farmers have more experience in growing modern varieties, better access to input markets, are located in fertile regions and rice farmers who have less off-farm work tend to be more efficient. The results showed that the average profit efficiency score is 0.77 implying that the average farm producing modern rice could increase profits by about 30% by improving their technical, allocative and scale efficiency.

Binam and Tonye et.al (2004) indicated farm-specific variables causing inefficiencies for smallholder farmers in slash and burn using a stochastic production frontier model. The results showed that distance of the plot from the main access road, the soil fertility index, the credit access and the variable club have a significant impact on technical inefficiency of farmers among farming systems in slash and burn agriculture. Educational level has a significant impact on the technical inefficiency in maize mono cropping systems.

Iraizoz, Rapun, and, Zabaleta, (2003) analyzed separately technical efficiency for Tomato and asparagus production in Navarra (Spain). Both a non-parametric and a parametric approach to a frontier production function are used. The results indicated that both tomato and asparagus production are relatively inefficient, with potential in both cases for reducing input and increasing output. The results estimated measures of technical efficiency were positively related with the partial productivity indices and negatively related with the cultivation costs per hectare although were not obtained for the relation between size and efficiency.

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Kibarra (2005) measured the level of technical efficiency in maize production in Kenya using the Stochastic Frontier Approach. Results indicated that the mean technical efficiency of Kenya's maize production was 49 percent. There was distinct intra and interregional variability in technical efficiency in the maize producing regions. In addition, technical efficiency varied by cropping system; the mono-cropped maize fields have a higher technical efficiency than the intercropped maize fields. The education, age, head and health of the household head, gender of the household, use or non use of tractors and off-farm income were impacted on technical efficiency.

Margono and Sharana (2006) estimated the technical efficiencies and total factor productivity (TFP) growth in industries of Indonesia by using the stochastic frontier model. Data analyzed showed the determinants of inefficiency and TFP growth were related to technological progress. Technical efficiency was estimated with the maximum likelihood method in Frontier software. The results showed that average technical efficiencies could increase in all sectors by 55.87% and the results also identified the factors contributing to technical inefficiencies. The results indicated that annual growth rates of technical efficiencies of all four sectors were affected by the Asian crisis. Moreover, in general, they also indicated that private firms were more efficient than the public firms except for the textile sector, but the age of a firm had no effect on the efficiencies. This indicates that output growth in textiles, chemical and metal or labor are more capital oriented as compared to the food sector.

Khanna (2006) used the stochastic production frontier to estimate technical efficiency using maximum likelihood estimation techniques in irrigation for sugar cane farmers using primary survey data. It revealed that the Cobb Douglas model is the appropriate model to explain the production process. An advantage of the Cobb Douglas production function is that coefficient estimates can be interpreted as measures of elasticity, allowing an analysis of the responsiveness of output to each of the input variables used in the production process.

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Theingyi Myint (2001) measured the technical efficiency and profitability of different farm sizes and different yield levels of irrigated rice farmers in Pyinmana Township. Data on 144 rice farmers were stratified into small, medium, large strata based on farm size. Enterprise budget was used for cost and return analysis of different farm size groups and two yield level groups. Stochastic frontier production function was applied to estimate the technical efficiencies of different farm size groups. From the analysis of enterprise budget, small farm size group was more financially attractive than medium and large farm size groups. In the estimation of stochastic frontier production function, increasing use of not only family labor but also urea fertilizer would lead to increases in the yield level of the small farm size group. In the medium farm size, level of education was negatively and significantly related to technical inefficiency at 55%. Therefore, more educated medium farmers seem to be more technically efficient in irrigated rice production. The large farm size group had the highest technical efficiency score of 0.77 followed by medium and small farm size groups under the present technology.

Production efficiency of high-income and low-income pre-monsoon cotton farmers (2002-2003) in Kyaukse and Meikhtila townships was estimated by Tun Win (2004) through technical efficiency measurement to find out factors affecting the production of cotton. Indicating the mean efficiency of pre-monsoon cotton farmers was 0.67, the result implied that in the short run, there was a scope for increasing cotton production by 33% by adopting the technology and techniques used by the best practice cotton farms.

The profitability and technical efficiency of sugarcane farmers in private sectors of Katha, Hteegyaint and Thabeikkyin townships was examined by War War Shein (2004). The empirical result stated that Thabeikkyin Township was more financially attractive than other townships for both new plant and ratoon. All ratoon farms were more financially attractive than all of new plant farms. The technical efficiency estimates varied from 56% to 100% with a mean value of 77% for new plant and from 52% to 94% with an average of 69% for ratoon. There was a scope for increasing syrup production by 23% for new plant, and 31% for ratoon with the present technology. The study concluded that improvement in technical efficiency was still possible in the private sector. This kind of syrup cottage industry would assist the raw material for syrup-based industry and generate income for private sugarcane farmers.

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