

ESTIMATING TECHNICAL EFFICIENCY AMONG SMALLHOLDER POTATO PRODUCERS IN WELIMADA, SRI LANKA

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Abstract

The objective of this research was to estimate the technical efficiency and identify determinants associated with technical inefficiency of potato farms in the Welimada area. To calculate the technical efficiency and to identify the determinants of technical inefficiency, the Stochastic Production Frontier Model was used. Collection of farm level data commenced through interviews from February to March 2016 from 100 farmers in the study area. The study results indicated that output could increase by 28% without additional inputs and available technology at the farm level. Farmers with better education, experience, and training in potato farming who apply both organic and inorganic fertiliser and employ more family labour tend to be more efficient. The direct positive relationship between farm size and technical efficiency indicated the potential of improving potato yield by further expanding the cultivating area or consolidating land.

Key Words: *Potato Farms, Sri Lanka, Technical Efficiency, Welimada Area*

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BACKGROUND AND SUBJECT

Potato is one of the most preferable cash crops for farmers in the up-country farming system in Sri Lanka, because this crop is most adaptable to natural features of the region such as soil condition, rainfall pattern, temperature, and humidity. Moreover, potato is one of the major food items in the country's food basket. It contains vitamins and minerals, carbohydrates, proteins and dietary fibre, and thereby contributes to a balanced and nutritive food.

According to Department of Census and Statistics (2014), the annual per capita consumption of potato is 4.8 kg. Approximately 25,000 farmers, particularly in the up-country farming system, depend on potato cultivation for their livelihood (Bandara and Thiruchelvam, 2008). Almost all the farmers are smallholders having a land area less than one acre, and in 2014, 4,929 ha were devoted to potato cultivation in the country.

Since mid-1990s, this sector experienced a series of policy reforms under the economic liberalisation measures and regional trade agreements, of which, the South Asian Free Trade Agreement (SAFTA) and the Indo-Sri Lanka Free Trade Agreement were more influential to the country's potato sector (Epaarachchi et al., 2002). Specifically, trade liberalisation measures and the FTA allowed traders to import potato from low cost producing countries such as India and Pakistan. Subsequently, potato production of Sri Lanka declined significantly until 2010. For instance, during 2004 to 2010 period, domestic potato production declined from 81,544 tons to 51,348 tons. This is 37% of reduction (Department of Census and Statistics, 2014). The self-sufficiency ratio in potato production also declined from 74.4% to 40.8% during the period from 2004 to 2014. During the same period, the area under potato cultivation was declined by 10.3%, from 5,495 ha to 4,929 ha and imports of potato showed a drastic increased 322% from 28,010 MT in 2004 to 118,220 MT in 2014.

This indicates that the lower cost of potato imports makes farmers reluctant to continue potato farming due to difficulties in earning an income sufficient to cover the production cost. This overall trend put the livelihood of farmers living in this specific geographical region and mostly poor and smallholders, in jeopardy. Additionally, it has increased the burden on country's food import bill. Thus, identification of a viable option to increase domestic potato production and decrease cost of production is of paramount importance to upgrade the income of impoverished farmers, to achieve higher self-sufficiency rate, to reduce country's potato import bill, and thereby reduce increasing weight on country's trade balance.

Within this context, increasing the potato cultivation extent is difficult due to lack of suitable land for potato production in the country, particularly in the up-country farming system. Therefore, increase of per unit production is the viable option to increase

domestic potato production. According to Coelli (1996), technological innovation and the more efficient use of existing technologies are the main strategies of achieving higher level of output in agriculture. However, in the short run, application of new technological innovations is not often applicable and cost-effective to smallholder and resource poor farmers.

Specifically in developing countries, most new agricultural technologies have only been partially successful in improving productivity owing to the institutional barriers, lack of capital, lack of technical know-how, and familiarity with traditional agricultural practices (Binam *et al.*, 2004 as quoted by Karunaratna, 2014). Since a majority of farmers in the country are resource-poor smallholders, application of high-cost new technologies such as new machineries, agro-chemicals, and new imported seed varieties are extremely difficult. Conversely, farmers do not use existing technology efficiently, and therefore a gap exists between actual and potential per-unit production. This gives rise to an opportunity to increase per-unit production by upgrading the technical efficiency in potato farming without adding additional resources. It supports the widening of farmers' net income if market prices do not fall significantly due to increased supply and seasonality of the harvest.

The literature in the field also support the rationality of increasing per unit production in farming through increasing efficiency, specifically in developing countries (Bravo-Ureta and Pinheiro, 1993; Amara *et al.*, 1999; Wilson, 1998; Amarasinghe and Weerahewa, 2001; Ahnad and Ahmad, 2006; Maganga, 2012; Karunaratna, 2014; Prasanna and Shiratake, 2014). Amara *et al.* (1999) estimated the technical efficiency among potato farmers and examined the farmers' attitude towards technological innovation in Quebec by employing a deterministic frontier production function. The study has also examined impact of adoption of conservation technologies and farming experience in improving technical efficiency. Specifically, results reveal that progressive farmers or farmers in the higher efficiency region are more likely to invest in conservation practices. Using cross sectional data for the 1992 crop year, Wilson (1998) estimated technical efficiency in United Kingdom main crop potato. The study has explained variations in the technical efficiency by taking into account some managerial and farm characteristic variables. Particularly, the results have revealed the positive impact of irrigation facilities and the storage of potato after harvest on technical efficiency while revealing the negative impact of variables related to the number of years of experience of growing potatoes, small scale farming practice and chitting of seed potatoes.

In terms of Sri Lanka, Galabada *et al.*, (2014) attempted to find out the level of protection and competitiveness in the potato sector of Sri Lanka using primary data

collected through a field survey. The results have revealed existing opportunity in improving resource use efficiency in potato farming. Amarasinghe and Weerahewa (2001) estimated the technical efficiency of potato production in Badulla district. This study has emphasised the need to provide rural education and extension services, and to propagate modern techniques of production. However, there are no sufficient studies in the field in Sri Lanka although there is a continuing widening gap between domestic potato production and demand. Therefore, this paper aims to determine the extent to which the potato production can increase using existing resources and existing technology in Sri Lanka.

The above objective was realised via achieving following specific objectives:

- 1) Identify the socioeconomic status of smallholder potato producers,
- 2) Identify the factors influencing the potato production function,
- 3) Estimate the technical efficiency among smallholder potato producers,
- 4) Identify the determinants of level of technical inefficiency of potato producers in the main potato producing area of the country, and
- 5) Examine special features of the progressive farmers who are in the higher technical efficiency region and make appropriate policies to enhance the potato production in the country.

METHODOLOGY

Technical Efficiency

Technical efficiency is used to estimate the capacity of a farmer to achieve the maximum output with given and obtainable technology. In this study, stochastic production frontier model developed by Battest and Coelli, (1995) and widely used in efficiency analysis was used to estimate the technical efficiency for each potato farm. A potential advantage of this approach is the capability of accommodating the random variations in the model. Therefore, the estimate is more consistent with the potential harvest under “normal” working conditions (Pascoe et al., 2003). The general specification of the model is as follows (Eq. [1]):

$$Y_i = f(X_i, \beta) \exp(V_i - U_i) \quad \text{Equation [1]}$$

Where Y_i represents the output of the i -th farm, X_i represents the vector of different inputs used, and β represents a vector of unknown parameters to be estimated. V_i 's are assumed to be independently and identically distributed as $N(0, \sigma^2)$. This is associated with random factors such as random errors, errors in observations, and measuring of data, which are not under the control of the farm (Battest and Coelli, 1995); for example, measurement errors in production, weather etc. U_i is the non-negative random

variable (one sided error term), which associated with inefficiencies of individual farmer.

Several functional forms estimate the relationship between production inputs and outputs. One of the commonly used functional forms is the Cobb-Douglas production function. The Cobb-Douglas stochastic frontier model is written as follows (Eq. [2]):

$$\ln Y_i = \ln A + \sum_{k=1}^n \beta_k \ln X_{ki} + V_i - U_i \quad \text{Equation [2]}$$

It can simply define as,

$$\ln Y_i = \beta_0 + \beta_1 \ln X_{1i} + \beta_2 \ln X_{2i} + \beta_3 \ln X_{3i} + \beta_4 \ln X_{4i} + \beta_5 \ln X_{5i} + \beta_6 \ln X_{6i} + \beta_7 \ln X_{7i} + V_i - U_i \quad \text{Equation [3]}$$

Where, \ln represents the natural logarithm and the subscript i denotes the i^{th} farmer in the sample ($i = 1, 2 \dots \dots, n$).

- Y_i : the yield of potato (kg)
- X_1 : the area under cultivation (in acres)
- X_2 : labour in man days (per season)
- X_3 : the capital expenditure (Rs.)
- X_4 : the irrigation cost (Rs.)
- X_5 : the seed cost (Rs.)
- X_6 : the fertiliser used (kg)
- X_7 : the pesticide cost (Rs.)

U_i 's are non-negative random variables, called technical inefficiency effects, which assumes to be independently distributed such that U_i is defined by truncation (at zero) of the normal distribution with mean, μ , and variance, σ_u^2 .

Analysis of Factors affecting Technical Inefficiency

Model for technical inefficiency effects denotes the technical inefficiency effects of the stochastic frontier are a function of socio economic and institutional factors. This can be written as follows Eq. [4]:

$$U = \partial_0 + \partial_1 Z_{1i} + \partial_2 Z_{2i} + \partial_3 Z_{3i} + \partial_4 Z_{4i} + \partial_5 Z_{5i} + \partial_6 Z_{6i} + \partial_7 Z_{7i} + \partial_8 Z_{8i} + W_i \quad \text{Equation [4]}$$

Where,

Z_1 : age of the respondent in years

Z_2 : formal educational level of the i-th farm operator in years

Z_3 : household size

Z_4 : farming experience in years

Z_5 : extend of irrigated area

Z_6 : agricultural extension linkage of the i-th farm operator: Dummy variable (1=Yes, 0=No)

Z_7 : agricultural credit access: Dummy variable (1=yes, 0=otherwise)

Z_8 : member of a farm organisation: Dummy variable (1=yes, 0=otherwise)

Z_9 : the ownership of the land: Dummy variable (1=if owned, 0 =otherwise)

W_i : unobservable random variables

Estimate for all parameters of the stochastic frontier and inefficiency model was estimated using Maximum Likelihood (ML) method with the help of computer software FRONTIER 4.1 (Coelli, 1996).

Study Area and Data Collection

The study was conducted in the Welimada Divisional Secretariat (DS) area in the Badulla district of Sri Lanka, considering the highest frequency of potato farms available in the area. Badulla district accounts for 65% of total potato production and 60% of total potato cultivation area: the highest percentages recorded in a single district (District Secretariat for Badulla, 2013); Welimada DS area is the main potato producing area in Badulla district.

Potato is well adapted to climate variables in the region namely rainfall pattern, temperature, soil condition, and humidity, which make ideal conditions for potato cultivation. The area receives an annual rainfall between 1,750 mm to 2,000 mm, mainly from the North East monsoons. The mean annual temperature varies between 16 and 27°C. Cool climates are essential for better growth of potato and these favorable natural conditions for potato cultivation in the district are advantageous to farming in terms of cost of production and per-unit production. These reasons also explain the high density of potato cultivation and relatively high number of farmers in Badulla district, particularly in Welimada; therefore, Welimada area in Badulla district is a suitable location for this study.

In Welimada, small land holding farmers grow potato for commercial purposes and food for their livelihood. The empirical analysis is based on the primary data collected in March and April 2016 concerning the 'maha' season in year 2005. Data for the study were gathered from a random sample of 100 potato farmers which were chosen in the area by adopting the purposive sampling method. The sample was drawn by taking into account the variability among farmers in terms of land size, and purpose of growing in the population captured in the sample (farmers who cultivated potato mainly to the market). They were interviewed by administering a pre-tested semi-structured questionnaire. It is also found that small sample size is a limitation of this study to equitably represent entire population in this region. However, it is evident that a majority of potato farmers in the region is smallholders. To estimate the efficiency, the eight inputs were considered in the Cobb-Douglas production function as stated above. As cited in literature, these eight inputs are the most liable inputs which affect potato production (Ahnad and Ahmad, 2006; Amarasinghe and Weerahewa, 2001; Hossain et al., 2008).

RESULTS AND DISCUSSION

Socio Economic Status of the Surveyed Farmers

Majority of surveyed farmers (80%) are primarily dependent on agriculture activities for their livelihood and the rest (20%) are dependent on various sources of income such as small and medium business activities, government and private sector employment. The inputs, outputs, and socioeconomic variables of the sample farms were tabulated in Table 1. The mean age of a farmer is 48 years, implying that most farmers are middle aged and economically active. Seventy-seven percent of farmers use their own land for potato farming, while the rest used rented land. Mean output per farm is 5,242 kg per acre. This average output level is closer to the national level data which is 5 MT per acre (Census and Statistical Department, Sri Lanka, 2014). Almost all surveyed farmers were smallholders with landholdings of less than one acre (mean land size – 0.50 acre) (0.2 ha) and with about 15 years of experience in potato farming. Sixty-two percent of farmers used inorganic fertiliser and pesticides in farming, 30% of farmers used a mixture of both inorganic and organic fertiliser, while the rest (8%) practiced only organic farming. Particularly, the farmers use locally available organic manure such as cow dung and poultry manure.

Table 1: Summary of Inputs, Outputs, and Socioeconomic Variables of the Sample Farms

Variable	Definitions	Mean /Frequency*	Std. Err.
Yield (kg/acre)	Production of potato	5,242	187.2735
Cultivated area (acres)	Land use for potato cultivation	0.5049	0.029015
Labour usage (man days)	Total labour to produce potato	21.03	0.458248
Capital expenditure (Rs.)	Machinery cost	7,480	262.363
Irrigation cost (Rs.)	Water supply and management cost	2,635	213.302
Seed cost (Rs.)	Cost of seeds used	46,765	3215.885
Fertiliser cost (Rs.)	Organic and inorganic fertiliser cost	684.25	35.91104
Pesticide cost (Rs.)	Total cost of pesticides used	33,950	1982.773
Age (years)	Age of household head	48.49	9.049242
Education (school years)	Total school years	8.4	0.577
Household size (person)	Total number of family members	4.57	1.148165
Farming experience (years)	Year of cropping of potato	15.6	7.872725
Irrigated area (acres)	Irrigated potato cultivation area	0.2791	0.313672
Extension linkage	If extension officer visit farm 1, otherwise 0	67	0.472582
Agricultural credit access	If the formal sector credit access 1, otherwise 0	38	0.487832
Member of farm organization	If member 1, otherwise 0	85	0.35887
Land ownership	If owned 1, otherwise 0	77	0.422953

Note: The study presents frequency for dummy variables.

Source: Field survey, 2016.

Sixty-seven percent of farmers reported that agricultural extension officers frequently visit their farms. However, only 38% reported that they have access to formal credit market. Rest of the farmers primarily depend on village level money lenders for financial capital requirement in potato farming with a very high interest rate of 36%. Particularly, those money lenders are village level traders who handle the vegetable market in the area. Another important parameter is the educational level of surveyed farmers where a majority (58%) had completed primary education.

Maximum Likelihood Estimates for Parameters of the Production Function

This study first estimated the production function to identify factors influencing the dependent variable —potato yield. Maximum likelihood estimates for parameters of the production function were tabulated (Table 2). It revealed that all variables except labour usage and capital expenditure were significant at 1% level. The coefficient of variable cultivated area is 0.358 and inelastic, indicating 1% increase of land usage for potato cultivation leads to 0.35% increase in yield by smallholder potato farmers.

Table 2: Maximum Likelihood Estimates for Parameters of the Production Function

Variable	Coefficient	Std. Err.	Z	$p> Z $
Cultivated area (acres)	0.358	0.0338	10.58	0.000
Labour usage (man days)	0.072	0.2668	0.27	0.786
Capital expenditure (Rs.)	-0.070	0.0887	-0.79	0.428
Irrigation cost (Rs.)	0.094	0.0164	5.72	0.000
Seed cost (Rs.)	0.484	0.1006	4.81	0.000
Fertiliser cost (Rs.)	0.206	0.0535	3.86	0.000
Pesticide cost (Rs.)	0.023	0.0070	3.35	0.001
Constant	1.303			
Log likelihood	15.397			
Number of observation	100			

Source: Authors estimation using Frontier 4.1.

However, land is one of the limiting factors in the area in increasing the potato yield due to numerous reasons. The variable irrigation cost, which indicates the water supply and water management cost of potato farming, significantly affects potato yield. Specifically, farmers in the survey area depend on rainwater for potato farming and thus have to adopt water supply and water management techniques during heavy rain and dry

periods. The coefficient of variable seed cost is positive and inflexible, implying that increase of seed cost lead to an increase in per-unit potato yield. Particularly, cost of improved seed varieties is relatively higher than other locally available varieties. However, although those varieties contribute to high yield, they may increase management cost in the field in terms of disease control, water management, and fertiliser usage.

Moreover, coefficients of variables fertiliser cost and pesticides cost are positive and statistically significant. Particularly, most farmers use organic and inorganic manure in potato farming as they differentiate the varieties among local and improved varieties. However, the coefficient of pesticide cost is positive but highly inelastic. Results further emphasised the insignificant effect of total labour usage and machinery cost on the potato yield.

Frequency Distribution of Technical Efficiency among Potato Farmers

The study secondly estimated the technical efficiency scores at farm level. The estimated results on technical efficiency score provided clear evidence of the difference between actual and potential potato production. Table 3 presents the estimated mean potato production efficiency scores of potato farms at different scale of efficiency levels.

Table 3: Technical Efficiency Estimates

Efficiency Score Range	Mean Efficiency Score	Std. Dev.	Frequency
0 – 20	-	-	0
21-40	0.306	0.0600331	2
41-60	0.553	0.0072902	22
61-80	0.701	0.0598112	44
81-100	0.908	0.0645236	32
Mean	0.727	0.0156231	100

Source: Author estimations.

Determination of technical efficiency for individual farm and for the whole area is important due to several reasons. It indicates the possibilities of either increasing the total production of potato using the same inputs, decreasing the amount of inputs required to obtain the current level of potato production, or the potential for a mixture of both these processes, which would be achieved by filling the gap between the best producer and other producers. The results presented in Table 3 reveals that the mean

efficiency score of potato production was 0.72 for smallholder potato farmers. The difference between the actual (72%) and potential (100%) efficiency score indicate that the smallholder potato farmers could increase the output by 28% without additional inputs at the farm-level. Increase in the potato production efficiency from the actual level (0.72) to potential level (1.00) is attainable by adopting technology and techniques used by best potato farmers in the area.

Determinants of Technical Inefficiency and Special Features of Progressive Farmers in the High Efficiency Region

Inefficiency model was estimated to identify the determinants associated with technical inefficiency. The maximum likelihood estimation of determinants of technical inefficiency is tabulated in Table 4. It shows that the sign of the variables i.e. age, education, household size, farming experience, irrigated area, and land ownership are negative; this indicates that increasing these negative factors can lead to reduce the technical inefficiency. However, two variables — member of farm organization and irrigated area— have positive signs and these results contradict with the expected sign. According to the farmers' view, these contradictory results are due to the poor attention of farmer organisations in the activities of enhancing farm productivity and agro-ecological conditions, particularly the soil condition in the area.

Table 4: Maximum Likelihood Estimation of Determinants of Inefficiency Model

Variable	Coef.	Std. Err.	Z	<i>p</i> >Z
Age (years)	-0.195993	0.0688266	2.85	0.004
Education (school years)	-1.111084	0.4271846	2.6	0.009
Household size (persons)	-0.7151841	0.298608	-2.4	0.017
Farming experience (years)	-0.1264285	0.0514972	-2.46	0.014
Irrigated area (acres)	1.883955	0.6085245	3.1	0.002
Extension linkage	0.380585	0.7627228	0.5	0.618
Agricultural credit access	0.3194238	0.4004086	0.8	0.425
Member of farm organization	1.302532	0.6998884	1.86	0.063
Land ownership	-1.455778	0.5983956	2.43	0.015
Constant	-16.78379	2.610997	-6.43	0.000

Source: Authors estimation based on survey data.

Negative sign of variable, age indicates that younger farmers are more likely to be technically inefficient than older farmers. This was further proved by the variable

farming experience, which indicates more experience in potato farming leads to a reduction in technical inefficiency in potato farming. These results corroborate with Coelli and Battese (1996)'s study findings with respect to Indian farmers. Years of schooling negatively and significantly affects technical inefficiency. Education improves farmers' managerial skills and increase the ability to perceive. These results also corroborate with Amarasinghe and Weerahewa (2001)'s study findings with respect to farmers in Badulla district of Sri Lanka. The variable household size was also negative and significantly influenced in reducing the technical inefficiency. Increase household size leads to increase usage of family labour, particularly additional family labour available in potato farming, and would lead to better resource management at their farms. This result questions the skills of hired workers in proper resource management at the farm level because maximum likelihood estimates for production function indicates the insignificant effects of total labour usage to potato yield. The positive coefficient of variable irrigated area implies that increase of irrigated area leads to increase technical inefficiency. According to farmers' views, more water availability in the field leads to higher prevalence of disease, creates troubles in proper resource management at the farm level, and finally, loses a considerable amount of output.

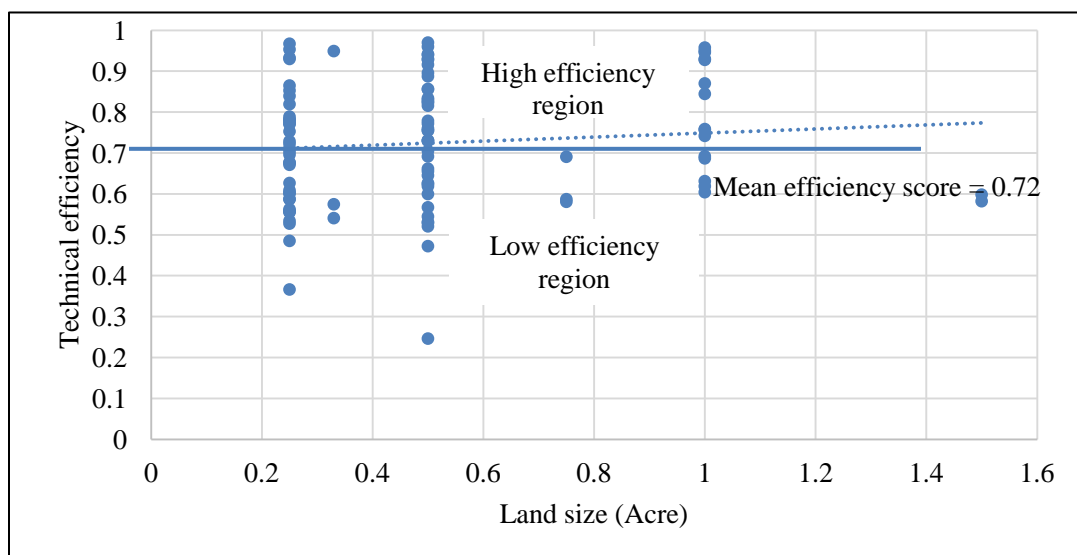
Variables agricultural extension linkages and agricultural credit access (formal sector) are positive but do not have statistically significant effects on technical inefficiency. These imply the ineffectiveness of country's agricultural extension network and poor contribution of formal credit sector in reducing the technical inefficiency in potato farming and thereby increase the farm yield. Specifically, the survey data reveals that a majority of farmers rely on local moneylenders (informal sector) for their financial capital requirement in potato farming. Moreover, variable land ownership is negative and statistically significant. It indicates that land title is important variable to the farmers in reducing technical inefficiency in potato farming. Variable membership in farmer organization is positive implying a negative impact of farmer organisation in improving the technical efficiency among smallholder potato farmers. This result suggests the farmer organisation to rethink their functions at farm level.

Lessons learnt from Progressive Farmers in Higher Efficiency Region

The efficiency score of each individual potato farmer indicates the production of each farmer in contrast to his or her potential output for a given input level. The high and low efficiency regions for potato farmer were defined based on the mean efficiency score of the total sample, which is 0.72 (Table 3). Results further explain that 50 farmers were above the mean efficiency score of the total sample (0.72) (Figure 1). This indicates that half of the farmers remain in the low efficiency region. Increased potato production efficiency among potato farmers in low efficiency region could be achieved by adopting the technology and techniques used by progressive farmers in high efficiency region.

This study also identified several specific techniques and technologies adopted by farmers in the high efficiency category: land management by adopting soil conservation techniques (75%), relatively higher application of cattle, goat, and poultry manure (55%), paying more attention to proper water management at the field (79%), and increased utilisation of household labour (64%).

Figure 1: Relationship between Land Size and Farm Level Technical Efficiency



Source: Field survey, 2016.

In addition, the study realised that the gross income of efficient farms is significantly higher than inefficient farms. For instance, average income earned from potato farming by farmers in the higher efficiency region is Rs. 531,780 per acre and it is considerably higher than the earnings of farmers in the low efficiency region which is Rs. 419,360. It indicates that higher demand and marketing value for potato produced by farmers in the higher efficiency region along with relatively higher farm productivity. The farmers' profile for farms in the high efficiency region is more satisfactory than in the low efficient region with respect to education level, farming experience, type of fertiliser used and usage of family labour. Particularly, the farmers on these high efficiency region farms are better educated, more experienced in potato farming, use organic and inorganic fertiliser, and have more usage of family labour. Thus, it is possible to conclude that the efficient farms would be the efficient model for inefficient farms. It would also support setting the targets and find weaknesses of the current technology.

Thus, the relatively high technical efficiency of farmers in high efficiency region indicates their capacity for high levels of potato production while managing local

resources at the farm level. The relationship between farm size and farm level technical efficiency also confirmed a positive relationship implying the possibility of increasing technical efficiency among potato farmers through increasing the average level of farm size in the area (Figure 1). Thus, it could be suggested that farmers can be encouraged to convert partial amount of cropland into potato cultivation because of the limiting factor of suitable land in the area.

CONCLUSIONS AND RECOMMENDATIONS

This study estimated the technical efficiency and determinants associated with technical inefficiency of potato farms in Welimada, which is the typical area for potato cultivation in the country. The Stochastic Production Frontier Model was used to calculate technical efficiency and identify determinants of technical inefficiency.

Results of the study indicated a considerable output gap between actual (0.72) and potential (1.00) outputs of potato farming in the surveyed area, indicating that output can be increased by 28% without additional farm level inputs. The study also concluded that those farmers with better education, experience, and training in potato farming, who apply both organic and inorganic fertiliser, and employ more family labour, tend to be more efficient. Specifically, employment of more experienced hired workers may lead to proper resource management at farm level. Therefore, these variables are important in increasing technical efficiency. The direct positive relationship between farm size and technical efficiency indicated that potato yield could be increased by further expanding the cultivating area or converting other land for potato farming.

Findings of this study are beneficial to farmers who do not understand the production technologies or inputs that strongly influence potato yield. It also facilitates policy makers to formulate appropriate policies on how they should focus on institutional and socioeconomic factors to fill the gap between high and low technical efficiency performance, thereby enhancing potato production in the country.

Moreover, in addition to aforementioned factors that determine the technical inefficiency, further studies are necessary to concentrate on marketing, farm extension, rainfall data, and general policies, which could be important to explain the productivity and inefficiency of potato farming in the country. Further, it would help to formulate appropriate policies to enhance potato production while improving the economic welfare of potato farmers in Sri Lanka.

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