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Technical efficiency and food security of cucumber farmers in Phulpur upazila of Bangladesh

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ABSTRACT

Low productivity of cucumber is mostly due to the inability of the farmers to utilize the available technologies to the full scale. Profitability and Stochastic Frontier Analysis (SFA) were used to estimate profitability and technical efficiency, and 'Modified' OECD scale was used to measure calorie intake level of the 60 cucumber farming households from Sorchapur and Nakagau villages under Phulpur upazila of Mymensingh district. The study indicated that cucumber cultivation is profitable agribusiness, but many of the cucumber farms have shown technical inefficiency problems. The socioeconomic analyses showed that 50% of the respondents were aged between 30-45 years, 55% households have medium family size, 60% of them were illiterate and 71.67% respondent's primary occupation was agriculture. The average cucumber cultivated area was 50.18 decimal. The profitability analysis showed that the average ha^{-1} season^{-1} yield was 45290 kg, total cost of production was estimated Tk 509847; while the gross margin and net return were Tk 231877 and Tk 169503, respectively. The study also showed that on an average, the mean technical efficiency of cucumber was 0.7367 which represents that 26.33% inefficiency existed in the study area. About 11.67% of the sample households consumed an average of 1539.24 kcal person^{-1} d^{-1} which indicate they were ultra poor (<1600 kcal). About 15% of the sample households consumed an average of 1797.13 kcal person^{-1} d^{-1}, they were in the hard-core poor group and 20% of the households consumed an average 2077.53 kcal person^{-1} d^{-1}, they were in the absolute poor group (1805 - 2122 kcal). Besides the three poor groups, about 53.33% of the sample households consumed an average 2346.69 kcal person^{-1} d^{-1}, and they were non-poor. These findings suggest that providing training to farmers to be technically efficient would significantly improve cucumber production in the research location, and that the government should formulate appropriate food security policies for rural areas.

Keywords: Bangladesh, cucumber production, food security, profitability, technical efficiency

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1 Introduction

Agriculture is the largest employment sector in Bangladesh. In keeping with Quarterly Labour Force Survey 2015-16, it employs 41% of the full proletariat and comprises 14.74% look after the country's GDP (BER, 2017). The performance of this sector has a remarkable impact on most important macroeconomic objectives like employment generation, poverty alleviation, human resources development and food security. Improving agricultural productivity to fulfill the strain of an expanding population, in spite of an increasingly volatile climate, is one in every of the foremost challenges Bangladesh is facing. Food security and adequate nutrition are among the essential needs of each person (Osmani et al., 2016). Accordingly FAO, food security involves four dimensions; availability, accessibility, food utilization and stability. Bangladesh has made commendable progress over the past 40 years in achieving food security, despite frequent natural disasters and increase (WB, 2016).

Vegetables are considered jointly of the foremost important groups of food crops thanks to their high nutritive value, relatively higher yield and better return. Vegetables provide dietary fiber necessary for digestion and health and combating malnutrition, furthermore as curing some diseases like anemia, blindness, scurvy, goiter, etc. Vegetables are necessary for physical and mental growth that helps to extend efficiency of labor and span of working life. Moreover, vegetables are the foremost inexpensive and rich sources of vitamins. In Bangladesh, a decent number of vegetables are grown throughout the year, both in winter and summer seasons. Vegetable is a vital crop-subsector within the total agricultural exports of Bangladesh (Karim, 2008). Cucumber plays a vital role to congregate the vegetable shortage during the scarce period, which eventually helps to enhance the undernourishment problem in Bangladesh. It absolutely was found useful against human constipation and improvement in digestion. It's used as a cooling food in summer (Maurya et al., 2015). A fresh Cucumber provides vitamin B complex, niacin, iron, calcium, thiamine, fibers and phosphorus. Besides, it's one in every of the very low-calorie vegetables; provide just 15 calories per 100 g. It's a superb source of potassium, a vital intracellular electrolyte. 100 g of cucumber provides 147 mg of potassium, but only 2 mg of sodium (USDA, 2019). Cucumbers contain unique antioxidants in moderate ratios like *beta*-carotene and α-carotene, vitamin-C, vitamin-K vitamin-A, zeaxanthin, and lutein. It helps in checking weight gain and high pressure level. The Cucumber originates from Southern Asia. However, it's grown all told of the countries within the world. Quite 50% production of Cucumber comes from Asia. Turkey, Iran, Uzbekistan, Japan and Iraq, were considered as foremost Cucumber producing countries in Asia (Khan et al., 2015). In Bangladesh it's grown as a crop. There's a scope for cultivation of cucumber within the cultivable land during summer season.

Poverty and food insecurity are prime disquiet within the recent times in Bangladesh (Rahman et al., 2013). Sustainable development and food security in poor countries cannot achieve the long-term without qualified local individuals and institutions (Beyant, 2005). The basic elements of food security are the provision of food, access to food and utilization of food. Availability may be a function of domestic production, imports, food aid and therefore the stock of food. Considering these, domestic production is important in ensuring food availability at household levels. In spite of considerable achievements in food availability through cereal production in Bangladesh, food security at individual level remains a challenging issue of the government of Bangladesh. Irrespective of the rise in food production and its availability, food insecurity furthermore as poverty remains a key problem mainly; due to the dearth of buying power and thus access to food particularly for the poorest of the poor. In keeping with the most recent survey results, the poverty rate has dropped to 24.3%; the poverty rate in rural areas was 26.4%, while urban poverty was 18.9% (BBS, 2017). This rate of extreme poverty is 12.9%, compared to 17.6% six years ago (BBS, 2017). An outsized fraction of households limit their consumption to a little number of food groups, namely cereals (primarily, rice), oil or fat, vegetables, and fish. The consumption of this food basket is insensitive to poverty status, that is, households across all poverty strata consume an analogous mixture of food groups. In general, while households' consumption of meat products, milk, and eggs is proscribed, higher income groups are more likely to consume fruits and meat products (Rabbani, 2014). It is clear from different evidences that Bangladesh is on the proper path thanks to reduce poverty and attain food security for its citizens. Irrespective of the exciting increase in cereal production, about one fifth of the population remains living in below poverty and is severely undernourished. For giving emphasis on efficient cucumber production and food consumption status of the farm households; some research questions should be answered. The research questions can provide the direction to maneuver on the way of set the objectives and reach to the goal. The research questions of this study were: What are the costs, return and profitability of cucumber production? What quantity is that the technical efficiency of cucumber farmers? And is there food insecurity among the cucumber cultivating farmers within the study area? On the premise of the research questions, this research was focused on to investigate the socioeconomic characteristics of sample households, determine the profitability of cucumber production, estimate technical efficiency of cucumber farmers, and determine the food security of cucumber producing households.

2 Materials and Methods

Primary data were collected for this research. Data were collected from 60 cucumber farmers from Sorchapur and Nakagau villages under Phulpur upazila of Mymensingh district in January to March 2019. Multi-stage sampling procedure was accustomed select households for data collection. A semi-structured interview schedule was accustomed obtain farm and household level information. Both tabular and econometric techniques were accustomed analyze the data. To see the profitability of cucumber farmers every cost and return item was included. The profit are often calculated by the following formula,

$$\Pi = TR - TC \quad (1)$$

where, Π, TR and TC designate profit, total return, and total cost, respectively. TC is the summation of all costs, whereas the total return can be calculated by multiplying price with quantity of output.

$$TR = P \times Q \quad (2)$$

where, P = Price of output (Tk) and Q = Quantity of output (kg).

Activity budgets (Dillon and Hardaker, 1993) of the cucumber cultivation were prepared using the following algebraic equation:

$$\pi = P_y Y - \sum_{i=1}^{n} (P_{xi} X) - TFC \quad (3)$$

where, π = Net return (Tk ha^{-1}), P_y = Per unit price of the output (Tk kg^{-1}), Y = Quantity of the output (kg ha^{-1}), P_{xi} = Per unit price of i-th inputs (Tk), X_i = Quantity of the i-th inputs (kg ha^{-1}), TFC = Total fixed cost (Tk), $i = 1, 2, 3, \ldots, n$ (number of inputs).

2.1 Technical efficiency analysis

Technical efficiency means the ability of a farm to make highest achievable production with a least amount quantity of inputs, under a given technology. A technically efficient farm will run on its cutting edge production function. Set the relationship of inputs in a particular production function, the farm is technically efficient when it produces on its outer bound production function to obtain the highest possible output, which is practicable under the existing technology (Khan et al., 2010).

Increases in efficiency are based on some socioeconomic and demographic variables. The correctness of the identification of the impact of different variables depends on the functional form of the production technology (whether Cobb-Douglas or Translog), the nature of the random error component (whether stochastic or deterministic), the distribution of the inefficiency component (whether it is half normal or truncated normal or gamma or beta), and the nature of the production function (whether primal or dual) (Rahman et al., 1999). Technical efficiency analysis is required to find out modeled yield estimation. To estimate the modeled yield, technical efficiency (TE) analysis with appropriate functional form (Cobb-Douglas or Translog) needs to be used. In this case, stochastic frontier production function (SFP) was employed. Farrell (1957) was the pioneer of the frontier measure of efficiency, which reflects the actual farm performance and can include all relevant factors of production. Farrell's article on efficiency measurement led to the development of a number of approaches to efficiency and productivity analysis. The Stochastic Frontier Analysis (SFA) and Data Envelopment Analysis (DEA) are the two principal methods to measure farm efficiency. As noted by Coelli et al. (2005), the stochastic frontier is considered more in developing countries, where the data are likely to be heavily influenced by the measurement errors and the effects of weather conditions, diseases, etc. Thus, following Aigner et al. (1977) and Meeusen and van Den Broeck (1977), the stochastic frontier production with two error terms can be modeled as:

$$Y_i = f(X_i, \beta) \exp(V_i - Ui) \quad (4)$$

where, Y_i is the production of the i-th farm ($i = 1, 2, 3, \ldots, n$), X_i is a ($l \times k$) vector of functions of input quantities applied by the i-th farm, P is a ($k \times l$) vector of unknown parameters to be estimated, V_i's are random variables assumed to be independently and identically distributed (N (0, δ_2)) and independent of U_i's and the U_i's are non-negative random variables, associated with technical inefficiency in production assumed to be independently and identically distributed. The first error component V is intended to capture the effects of random shocks outside the farmer's control, measurement error and other statistical noise and the second error component U is intended to capture the effects of technical inefficiency.

Following Battese and Coelli (1993), the technical inefficiency effects, U_i can be expressed as:

$$U_i = Z_i \delta + W_i \quad (5)$$

where, W are random variables, defined by the normal distribution with zero mean and variance σ^2, Z_i is a vector of farm specific variables associated with technical inefficiency and δ is a ($m \times l$) vector of unknown parameters to be estimated. After estimating this model, potential yield estimated from the model. The technical efficiency (TE) shows the farms' ability of maximizing output with a set of given input. The range of TE is 0 to 1. TE = 1 implies that the farm is producing on its production frontier and is said to be technically efficient. Hence, $(1 - TE)$ represents the gap between actual production and optimum attainable production that can be achieved by moving the firm towards the frontier through readjusting inputs (Chavas and Aliber, 1993).

2.2 Empirical Cobb-Douglas frontier production model

Two types of functions namely Cobb-Douglas and Translog dominate the technical efficiency literature.

The stochastic production function for the sample cucumber farmers was specified as:

$$\ln Y = \ln \alpha + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + b_7 \ln X_7 + b_8 \ln X_8 + (V_i - U_i) \quad (6)$$

where, Y = yield of cucumber (kg ha^{-1} season^{-1}), α = parameters, b = coefficients, X_1 = seed (g ha^{-1}), X_2 = urea (kg ha^{-1}), X_3 = TSP (kg ha^{-1}), X_4 = MoP (kg ha^{-1}), X_5 = insecticides (Tk ha^{-1}), X_6 = irrigation (Tk ha^{-1}), X_7 = labor (man-days ha^{-1}), X_8 = macha (Tk ha^{-1}), $i = 1, 2, 3, 4 \ldots$, $(V_i - U_i)$ = disturbance term.

2.3 Technical inefficiency effect model

The technical inefficiency effect in equation were defined as:

$$U_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 \quad (7)$$

where, U_i = inefficiency, δ_0 = parameter, Z_1 = age, Z_2 = education of farmers, Z_3 = family size, Z_4 = experience, and Z_5 = access of training. To assess the calorie intake level of the sample households, the consumption data of the households of seven days was measured by the per person per day calorie intake level, each food item which was consumed by the family members of the sample households converted through standard value of 100 gm each food item. For the calculation, 'Modified' OECD scale was used, that is; a scale that equals one for the first adult, 0.5 for each additional person older than 14 and 0.3 for each person of 14 years or younger (Hagenaars et al., 1994).

3 Results and Discussion

3.1 Socioeconomic characteristics

Socioeconomic characteristics of the farmers often affect their production plan. In this study, the age groups of the selected sample farmers are classified into four categories according to the working age classification of Bangladesh Bureau of Statistics (BBS, 2015). These categories: age between 25 to 29 years of old, age between 30-45 years old, age between 46-65 years old and above 65 years old. Age classification of sample cucumber farmers were presented in Table 1. It was found that 8.33% of the respondents belonged to the age group of 25-29 years. About 50% of the respondents were belonged to age group of 30-45 years, about 38.33% of the respondents were belonged to age group of 46- 65 years and the rest 3.34% of the respondents belong to age above 65 years. This information implies that the half of the sample farmers were in active age group of 30-45 years indicating that they provided more physical efforts for cucumber farming. A family size has been defined as the total number of persons of either sex living together and having meals from the same kitchen under the administration of a single head of the family. The farm family includes husband, wife, sons, unmarried daughters, parents, brothers etc. The national average family size of Bangladesh is 4.53 members (BBS, 2010). Table 1 also represents that the average family size of the cucumber farmer was 5.9 which is more than the national average. It shows that 55% of the respondents belong to medium family size.

Educated farmers can have better access to the relevant technical information for improved production and can make rational economic decisions. Education helps a person to effectively understand the production requirements and implement the knowledge correctly. It makes a man more capable to manage the scarce resources and earn maximum profit. Education of farmers also helps them to manage their earnings efficiently on their family consumption, children's education, housing and other expenditures. The respondents were classified as: Illiterate (no schooling), Primary (from grade 1 to 5), Secondary (from grade 6 to 10) and higher secondary (above grade 10). It is observed from Table 1 that about 60% of the respondents were illiterate. About 23.33% had primary level; about 16.67% had secondary level of education in the study areas. Occupation is one of the most important attributes of socioeconomic characteristics. People adopt various kinds of activities for their livelihood. It was observed that farmers involved in various kinds of occupation such as farming, service, business, driving etc. The great majority of the respondents (71.67%) were involved in agriculture as their primary occupation. Besides agriculture, business, service, day-laborer and driver were 15%, 6.67%, 3.33% and 3.33%, respectively (Table 1).

Cucumber cultivated area may vary in different locations on the basis of physical and socioeconomic conditions. The average size of cucumber cultivation area was 50.18 decimal. Table 1 shows distribution of the cucumber cultivation areas. The majority of cucumber cultivated area sizes were in 10-40 decimal which represents about 56.67% of the sample farmers. The socioeconomic status of a household is measured by income level. In the study, it was found from Table 1 that 30.00 % of the farmers were included in annual household income level of Tk 100001-150000. About 20% of the farmers were included in annual household income level of Tk 75001-100000.

3.2 Costs and return of cultivation

Costs and return were calculated from farmer's point of view. Costs were calculated for all the family supplied and purchased inputs used in cultivating cucumber.

The market prices of concerned inputs and output of cucumber are discussed in this section. The cost of

Table 1. Age, family size, education, primary occupation, cucumber cultivated area and annual household income of the respondents

Variable	Group	No. of respondents	Percentage
Age group (yr)	25 - 29	5	8.33
	30 - 45	30	50
	46 - 65	23	38.33
	>65	2	3.34
Family size	Small family (3 to 4)	9	15
	Medium family (5 to 6)	33	55
	Large family (>6)	18	30
Education level	Illiterate (no schooling)	36	60
	Primary(from grade 1 to 5),	14	23.33
	Secondary(from grade 6 to 10)	10	16.67
Primary occupation	Agriculture	43	71.67
	Business	9	15
	Service	4	6.67
	Day-laborer	2	3.33
	Driver	2	3.33
Cucumber cultivated area (decimal)	10 - 20	10	16.67
	21 - 40	24	40
	41 - 60	8	13.33
	61 - 80	11	18.34
	81 - 100	5	8.33
	>100	2	3.33
Annual household income (Tk)	30000 - 50000	3	5
	50001 - 75000	8	13.33
	75001 - 100000	12	20
	100001 - 150000	18	30
	150001 - 200000	8	13.33
	200001 - 250000	4	6.67
	>250000	7	11.67

Table 2. Production cost of cucumber (Tk ha^{-1} $season^{-1}$)

Items of cost	Quantity	Price $unit^{-1}$ (Tk)	Total cost (Tk)
Human labor (man-day)	549	356	195444
Machinery cost (Tk)			9068
Seed (kg)	1.703	27550	46918
Fertilizer			
Urea (kg)	455	17	7735
TSP (kg)	1612	34	54808
MOP (kg)	602	15	9030
Other fertilizers (Tk)			1697
Irrigation cost (Tk)			11780
Macha cost (Tk)			39793
Insecticide cost (Tk)			50926
Marketing cost (Tk)			20274
Total Variable cost (Tk)			447473
Fixed cost			
Land use cost (Tk)			40000
Interest on operating capital†			22374
Total cost			509847

† 10% of total variable cost for 6 months

cucumber production included the costs of human labor, machineries cost, seed, fertilizer, insecticides, irrigation, macha preparation cost, marketing cost, land use cost and cost on operating capital. Human labor was the most important and one of the largest inputs used for cucumber production. Labor was measured in terms of man-day which usually consisted of 8 hours. It can be observed from Table 2 that average wage rate was Tk 356/man-day. The average labor required ha^{-1} was 549 man-days in a season. The total cost for human labor was Tk 195444 ha^{-1} $season^{-1}$. Machineries cost was Tk 9068 ha^{-1}. Seed was another input for cucumber cultivation. On an average seed cost ha^{-1} was Tk 46918. Farmers applied Urea, TSP, and MoP 455 kg, 1612 kg, and 602 kg ha^{-1} $season^{-1}$, respectively. Per hectare irrigation cost, macha preparation cost, insecticides cost and marketing cost were Tk 11780, Tk 39793, Tk 50926 and Tk 20274, respectively. Lease value of the land was consisted as land use cost. Land use cost was calculated at the rate of prevailing cash rental value of ha^{-1} land in the study area. Land rental value was calculated at Tk 40000 ha^{-1} for one six months. Interest of operating capital was calculated by taking into account total variable costs incurred on all field operations. Interest on operating capital (10% of total variable cost for 6 months) was Tk 22374.

3.3 Profitability of cultivation

3.3.1 Gross return

Gross return is the value of cucumber produced in money terms. This was calculated by multiplying the total amount of production by their respective market prices. Gross return from cucumber production was estimated at Tk 679350 ha^{-1} $season^{-1}$ (Table 3).

Table 3. Average returns from cucumber production ha^{-1} $season^{-1}$

Production	Qty. (kg)	Price kg^{-1}	Value (Tk)
Consumption†	100	15	1500
Sale	45190	15	677850
Total	45290		679350

† Includes gift to relatives and neighbors; Qty = Quantity

3.3.2 Gross margin

Producers generally want to gain maximum return over variable cost of production. A Gross margin is the difference between the gross return and total variable cost. The gross margin of cucumber production was estimated at Tk 231877 ha^{-1} (Table 4).

3.3.3 Net return

Net return (ha^{-1} $season^{-1}$) from cucumber production was calculated by deducting gross costs from gross returns. It can be noted from (Table 4) that per hector $season^{-1}$ net return was Tk 169503.

3.3.4 Return over per taka investment

Net return per Taka invested is the ratio between net return and total cost. Table 4 shows that net return per Taka investment in cucumber farming was 0.33. It means that by spending Tk 100 net return of Tk 33 was obtained.

3.3.5 Benefit cost ratio (BCR)

Benefit cost ratio for cucumber cultivation was determined as ratio of gross return to gross cost. Table 4 reveals that benefit cost ratio (undiscounted) of cucumber cultivation was 1.33 indicating that production of cucumber was profitable. The finding justifies that benefit cost ratio was higher than one, suggesting that there is a potential for more cucumber cultivation in study area.

Table 4. Profitability of cucumber cultivation (Tk ha^{-1} $season^{-1}$)

Particulars	Costs and return†
Yield (Y, Kg)	45290
Gross Return (GR, Tk)	679350
Total variable cost (TVC, TK)	447473
Total fixed cost (TFC, Tk)	62374
Total cost/Gross cost (TC, Tk)	509847
Gross Margin (GM, Tk)	231877
Net Return (NR Tk)	169503
RoI‡ (NR/TC, Tk^{-1})	0.33
$BCR = GR/TC$	1.33

† Tk ha^{-1} $season^{-1}$; ‡ Return over investment; $TC = TVC + TFC$, $GM = GR - TVC$, $NR = GR - TC$

3.4 Technical efficiency analysis

In the way of finding out the yield gap, the stochastic frontier analysis was done to measure technical efficiency and then efficient yield was found out. For that, both the production inputs and socioeconomic characteristics were used in the analysis. The maximum likelihood estimates for parameters of Cobb-Douglas stochastic production function and the technical inefficiency effect for cucumber farmers are presented in the Table 5. The coefficient of labor and the coefficient of urea in the stochastic frontier model were statistically significant at 10% and 5% level, respectively and the coefficient of Macha cost was statistically significant at 1% level.

Table 5. Maximum likelihood estimates for parameters of Cobb-Douglas stochastic production function and the technical inefficiency effect for cucumber farmers

Variables	Parameters	Coefficients	Standard error	p>∣z∣
Intercept	b_0	5.2423*	1.991	0.008
Seed	b_1	0.1096	0.1234	0.374
Urea	b_2	0.2474**	0.0831	0.003
TSP	b_3	-0.193	0.0904	0.033
MoP	b_4	0.007	0.0843	0.933
Insecticides	b_5	0.0314	0.1374	0.819
Irrigation	b_6	-0.0839	0.1522	0.582
Labor	b_7	0.1660*	0.0651	0.011
Macha	b_8	0.4027***	0.1228	0.001
Inefficiency model				
Intercept	δ_0	-5.8540***	1.0948	0
Age	δ_1	-0.102	0.041	0.013
Education	δ_2	-0.0595	0.0674	0.378
Family size	δ_3	0.2999	0.195	0.124
Experiences	δ_4	0.0976	0.0461	0.034
Access of training	δ_5	-1.8444***	0.4972	0
Mean efficiency	0.736			
Log likelihood	4.26			
Prob>chi^2	0.00			

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

Table 6. Calorie intake by the households

Categories	No. of households	% of households	Avg. calorie intake †
Ultra poor (<1600 kcal)	7	11.67	1539.24
Hand core poor (1600 - 1804 kcal)	9	15	1797.13
Absolute poor (1805 - 2122 kcal)	12	20	2077.53
Non-poor (>2122 kcal)	32	53.33	2346.69

† Per person per day

This implies that farmers in the study area used labor and urea accurately which helped them to increase the yield of cucumber and those were very important for cucumber production. The coefficients of labor, urea and Macha implies that with a 1% increase in labor, urea and Macha cost the yield increases 0.166%, 0.247% and 0.402%, respectively. On the other hand, the coefficient of seed, TSP, MoP, insecticide and irrigation was not significant. In the technical inefficiency model, farmer's age, education, family size and experiences were not statistically significant. But access to training was statistically significant at 1% level of significance. This indicates that if the farmers can get training their efficiency will increase. The mean efficiency was 73.67% revealed that the farmers were producing cucumber 26.33% lower than frontier production on an average. The yield ha^{-1} can be increased, on an average 26.33% without incurring any additional production cost.

3.5 Food consumption by the households

Generally food consumption data are acquired for three to seven days. Seven-day data were traditionally used as the "gold standard" for authenticating other methods (Willett, 1990). On the basis of the amount of food consumed by the household members during the last 7 days, per capita calorie intake level was measures using standard values of per 100 g food items. Table 6 shows per capita per day calorie intake level of sample households. About 11.67% of the sample households was consumed an average 1539.24 kcal person^{-1} d^{-1}, that indicated they were ultra poor (<1600 kcal). About 15 % of the sample households was consumed an average 1797.13 kcal person^{-1} d^{-1}, they were in the hard-core poor group and 20% of the households consumed an average 2077.53 kcal person^{-1} d^{-1}, they were in the absolute poor group (1805- 2122 kcal).

Beside the three poor groups, about 53.33% of the sample households consumed an average 2346.69 kcal person^{-1} d^{-1}, and they were lucky non-poor. This situation for the cucumber farmers were due to relatively large family size, higher rate of illiteracy and low level of household income in the study area.

4 Conclusions

Food security is the crucial problem for Bangladesh. To advance households' food security situation and standard of living, available resources need to be utilized properly through increasing the efficiency. The present research explored the profitability, technical efficiency and calorie intake level of cucumber farmers with the help of primary data collected from 60 respondents in Phulpur upazila of Mymensingh district in Bangladesh. The profitability analysis showed that the average ha^{-1} season^{-1} yield was 45290 kg. and net return was Tk 169503. The study also showed that on an average, the mean technical efficiency of cucumber was 0.7367. Access to training was statistically significant positively effect to technical efficiency. This indicates that if the farmers can get training their efficiency will increase. About 11.67% of the sample households was consumed an average 1539.24 kcal person^{-1} d^{-1} about 15% of the sample households was consumed an average 1797.13 kcal person^{-1} d^{-1}, and 20.00% of the households consumed an average 2077.53 kcal person^{-1} d^{-1}. Besides the three poor groups, about 53.33% of the sample households consumed an average 2346.69 kcal person^{-1} d^{-1}, and they were non-poor. These findings suggest that cucumber production in the research location would be significantly improved through training the farmers to be technically efficient and government should take necessary steps for ensuring their food security. FAO (2012) suggested that smallholder farmers must be supported to realize their full potential by enabling them to increase their agricultural productivity, promoting their access to markets and services, rewarding their efforts to preserve landscape and ecosystem services and strengthening their resilience to external shocks.

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Conflict of Interest

The authors declare that there is no conflict of interests regarding the publication of this paper.

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