*Asian Journal of Agricultural Extension, Economics & Sociology*

*38(1): 78-86, 2020; Article no.AJAEES.54574*
*ISSN: 2320-7027*

# Determinants of Farmers' Level Crop Productivity at Dumki Upazila under Patuakhali District

**Shekhar Mondal[1*], Md. Golam Rabbani Akanda[1] and A. T. M. Sanaul Haque[1]**

*[1]Department of Agricultural Extension and Rural Development, Faculty of Agriculture, Patuakhali Science and Technology University, Dumki, Patuakhali-8602, Bangladesh.*

***Authors' contributions***

*This work was carried out in collaboration among all authors. Author SM carried out all research work and performed the statistical analysis. Author MGRA designed the study, wrote the protocol and supervised the work. Authors SM and MGRA managed the analysis of the study of the research. Author ATMSH managed the literature searches and also edited the manuscript. All authors read and finally approved the manuscript.*

***Article Information***

DOI: 10.9734/AJAEES/2020/v38i130300
Editor(s):
(1) Dr. Ian McFarlane (Retired), School of Agriculture Policy and Development, University of Reading, UK.
Reviewers:
(1) Md. Abdul Quddus, Bangladesh Agricultural University, Bangladesh.
(2) Aba-Toumnou Lucie, University of Bangui, Central African Republic.
Complete Peer review History: http://www.sdiarticle4.com/review-history/54574

***Original Research Article***

***Received 07 December 2019***
***Accepted 14 February 2020***
***Published 19 February 2020***

## ABSTRACT

The major aims of this study were mainly to determine and describe the extent of farmers' crop productivity and also explore the relationship between the 12 selected characteristics of the farmers with their crop productivity level. The study was designed with a mixed-method approach where both qualitative and quantitative analyses are blended in a rational way to have a deeper understanding of research problems. The study was conducted in Dumki Upazilla under Patuakhali district, Bangladesh. Simple random sampling technique was used to select 110 farmers except landless engaged in crop production. Data were collected by face to face interview using a pre-tested interview schedule during the period from March 10 to April 15, 2016. Data were analyzed using descriptive statistical measures and computer software like SPSS. Pearson's Product Moment coefficient of correlation results showed that out of 12 independent variables, the correlation coefficients of 7 variables had a positive and significant relationship with their level of crop productivity. The stepwise multiple regression analyses stated that only 4 variables such as communication exposure, innovativeness, risk orientation and training experience had a significant

**Corresponding author: E-mail: smshekhar01@gmail.com;*

contribution to the farmers' crop productivity level and also accounted for 52.8 per cent of the total variation in productivity index. This study also showed some problems which were faced by the farmers during crop production. If these problems can be solved, the farmers' crop productivity level will be increased.

*Keywords: Crop productivity; food security; sustainable agriculture.*

## 1. INTRODUCTION

Agricultural productivity is defined in agricultural geography as well as in economics as "*output per unit of input* or "*output per unit of land area*", and the improvement in agricultural productivity is generally considered to be the results of a more efficient use of the factors of production, viz. physical, socioeconomic, institutional and technological [1]. The measurement of agricultural productivity helps in knowing the areas that are performing rather less or higher efficiency in comparison with the nearby areas [2]. Bhatia defined agricultural efficiency as, "The aggregate performance of various crops regarding their output per acre" [3]. According to Singh agricultural productivity is, "The number of returns from arable land" [4]. Singh and Dhillion suggested that the "*yield per unit*" should be considered to indicate agricultural productivity. This suggestion pointing out that it considered the only land as a factor of production, with no other factors of production [5].

Bangladesh is primarily an agrarian economy. Agriculture is the single largest producing sector of the economy [6]. It is the major source of livelihood in rural areas where most of the people live. The agricultural and rural sector in Bangladesh has particular importance for achieving sustainable food and livelihood security of its large, dense and ever-growing population [7]. The performance of this sector has a great impact on a macro-economic situation like employment generation, poverty alleviation, food security and nutritional attainment etc. Agriculture sector contributes about 17 percent to the country`s Gross Domestic Product (GDP) and employs more than 45 percent of total labour force [8]. The total cultivable land is estimated to be 8.52 million hectares with an average cropping intensity of 191 percent [9]. The performance of this sector is very low and affects overall economic growth. The peace and prosperity of this area depend largely upon the products of the land. So agriculture of the country has become part and parcel of its economy. There is a little scope of bringing more land under cultivation. So, it is necessary to increase the per hectare yield of available land. Per unit yield of the major crops is one of the world lowest in Bangladesh. If a farm wants to be more productive it will be focused on a wider choice in the production of a variety of crops in a given area.

Increasing farmers' level crop productivity is one of the coping mechanisms of food security. The major challenges of crop agriculture will be raising productivity and profitability, retaining sustainability. If the crop productivity of farmers' is lower than expected then food security of farmers' will be threatened. Given the importance of farmers' level crop productivity, the present study had been undertaken. Now a large number of people in Patuakhali district are involved in crop production. This study is undertaken to determine the crop productivity level among the farmers' and its major determinants to determine the major problems of crop production in this region. By considering all these reasons this study had been conducted. The objectives of this study were as follows:

i) To know the socio-economic conditions of the farmers and their farming characteristics,
ii) To explore the relationship between selected characteristics and crop productivity, and
iii) To identify the problems faced by the farmers in crop production

Shafi worked on the measurement on agricultural efficiency in Uttar Pradesh by applying the ranking confident method of Kendall (yield per acre) tooling eight food crops grown in each forty-eight tahsils of the state [10]. A study conducted by Adebayo on the factors determining rain-fed rice production in Adamawa state in Nigeria using production function analysis. The results showed that the size of the farm and the amount of seed significantly affect the productivity of rain-fed rice [11].

Kareem et al. determined some drivers of agricultural productivity in Nigeria. Using OLS and Granger causality approaches, they find out that bank loans to agriculture, foreign direct

investment, interest rate and food import value have a positive relationship with agricultural productivity in the country. The result of the Granger causality test also shows that agricultural performance Granger causes commercial loans [12]. On the other hand, some studies conducted by Iganiga, Unemhilin 2011 and Verter, Bečvářová, 2015. They find an inverse relationship between commercial loans and agricultural performance in Nigeria [13,14].

DeSilva and Hemachandra studied on the impacts of credit access on agricultural productivity in case of paddy cultivation in Akmeemana division of the Galle district in Sri Lanka and did not observe any significant relationship [15]. Karimov in his study observed that farmer's education positively affect the efficiency levels of farmers [16]. On the other hand, Kazukauskas and Newman also claimed that subsidies increase the efficiencies of the farm [17].

## 2. MATERIALS AND METHODS

The study was conducted in Dumki Upazila under Patuakhali district. All the farmers involved in crop production except landless constituted the population of the study. For this purpose, and up to- date list of the farmers was prepared with the help of respective union Parishad personnel, sub-assistant agricultural officer, and local leaders. There were a total of 1102 such farmers who are not landless and involved in agricultural activities, which constitute the population of the study. A sample population was obtained by taking 10 percent of the estimated population of two randomly selected villages under one union namely Sreerampur. Thus 110 farmers constituted a sample of the study. Besides, a reserve list of 10 percent of the sample size was also prepared to replace any respondent who could not be made available during data collection despite all attempts.

Socio-economic characteristics: These included variables their age, education, training experience, farming experience, farm size, land ownership, annual income, credit received, organizational participation, communication exposure, knowledge on crop productivity, innovativeness and risk orientation etc. Farmers' level crop productivity was considered as the dependent variable in this study and was measured by the Crop Yield Index. The crop yield index was computed based on the formula used in "Methods of Farm Management Investigation" by the Food and Agricultural Organization (FAO) of the United Nation [18].

**Table 1. Description of variables used in the regression model**

| Variables name | Variables description and unit of measurement |
|---|---|
| i) Dependent variable<br>Farmers' level crop productivity<br>(ii) Independent variables | Crop Yield Index, Obtained a index number from equation. |
| 1. Age | Age of the farmers in years. |
| 2. Education | Year of schooling. |
| 3. Farming Experience | Completed years on farming activities. |
| 4. Training Experience | The number of days training received. |
| 5. Farm Size | Total farm size of the household in a hectare. |
| 6. Land Ownership | Area of land in hectare inherited from the family from total farm size. Expressed in percentage. |
| 7. Annual Income | Farmer's total income in taka in "ooo"taka/year. |
| 8. Credit Received | Amount of credit (''000" tk) received from various sources for farming. |
| 9. Communication Exposure | No. of contact to the selected information source. |
| 10. Knowledge on Crop Production | Scores obtained when asked related questions. |
| 11. Innovativeness | Time of adoption after awareness (whether they had adopted an innovation after knowing about it such as IPM, Green manure, cow dung and whether they practised it within 4 years or more, 3 years,2 years or 1 year etc. and then score was given). |
| 12. Risk Orientation | Measured by a scale of 10 statement were five positive and five negative. The score obtained from those statements and weighed. |

According to Yang [18], crop yield index represents the yields of all crops on a farm compared with the average yields of the region. Before calculating the crop yield index for a particular farm, the average yield of each of the crops growing in the region must be determined. Then by dividing the yield per hectare of a crop in the particular farm by the average yield of that crop growing in the region, a percentage figure is obtained which, when multiplied by 100, gives the index number of individual crops. By using the area devoted to each crop as the weight to multiply this percentage index, the products were obtained. By adding the products and dividing the sum of the product by the total crop hectares on the farm (the sum of the total area in hectare), the crop yield index for the particular farm was obtained [18].

> Crop Yield Index= Sum of products (Area × Percentage index)/ The total area covered by those crops

Where Percentage Index for Individual Crop=

> Respondents' Yield of the crop (ton/ha)/ Average Yield of the crop in the Region (ha)×100

Statistical software SPSS 16 was used for data analysis. Descriptive statistical measures such as (frequency, range, mean, percentage distribution, standard deviation, rank order, categories etc.) were used to describe and interpret data.

Effect of selected factors on farmers' level crop productivity was determined by using regression co-efficient. To estimate the respondent's crop productivity level the following multiple regression equation was used.

$$Y_i = \alpha + \beta X_i + \varepsilon_i$$

Where,

Y = Farmers' level crop productivity (obtained from crop yield index score)
X1= Age of the farmers (year)
X2= Education of farmers (year of schooling)
X3= Farming experience (year)
X4= Training experience (no. of days)
X5= Farm size (hectare)
X6= Land ownership (in percentage)
X7= Annual income (Tk.)
X8= Credit received (Tk.)
X9= Communication exposure (frequency of contact)
X10= Knowledge on crop productivity (obtained score)
X11= Innovativeness (obtained score)
X12= Risk orientation (obtained score)

$\varepsilon_i s$ are random components which are independently and normally distributed with mean zero and variance $\sigma^2$. To find out the relationships between farmers' level crop productivity and selected characteristics of the farmers Pearson's Product Moment Correlation (r) was used. Five percent level of significance was used to accept or reject any null hypothesis.

## 3. RESULTS AND DISCUSSION

### 3.1 General Characteristics of Respondents

The majority, 52.72 percent and 34.55 percent of the farmers were old and middle-aged. Thus, most (87.27 percent) of the farmers have belonged to middle age to old age categories. This seems logical because heads of farm households were selected as respondents and the old people hold the position of family heads. It was found that a high proportion of the farmers 44.55 percent had primary level of education. This might be due to a highly educated person in those villages are involved in diversified activities. Among the farmers, 65.45 percent had medium farming experience. This might be due to their medium level of knowledge, skill and practice on crop production. Majority of the farmers, 65.45 percent had short training experience. Training experience is very low due to lower level of opportunities but an important factor, which enhance the demand for knowledge and improve skill on crop production. Among farmers 65.45 percent had small and 32.73 percent had medium farm size. The reason behind this was as they had low land and had to lease land for agricultural cultivation. Most of the farmers 55.45 percent had 76-100% land ownership. Among farmers, 80.91 percent had low annual income. This may be due to as they have a few lands of their own or low training experience, low credit received medium knowledge etc. Majority of the farmers 56.36 percent belonged to low credit received. This may due to their negligence of microcredit organizations. Majority 47.27 percent had low communication exposure. The probable reason behind this might be a lower level of the medium of contact with various extension media. Among farmers, 41.82 percent had moderate knowledge

of crop production. This may be due to their low training and lower communication with various agents for farming practices. 44.55 percent respondents had medium innovativeness and it is an important factor for their crop productivity. This might be due to the most innovative person could understand and apply complex technical knowledge and he/she could cope with a high degree of uncertainty. 41.82 percent farmers belonged to moderate risk orientation. Higher risk-oriented farmers can encounter risk and uncertainty with new ideas.

The observed farmers' level crop productivity measured by crop yield index scores ranged from 62.09 to 131.68 with an average of 98.50 and a standard deviation of 16.50. Based on their crop productivity scores, the farmers were classified into three categories: "Low (62.09-85.28)", "Medium (85.29-108.48)", and High (108.49-131.68)".

The majority (47.27 percent) of the farmers in the study area belonged to medium crop productivity category compared to 27.27 percent farmers had high crop productivity and 25.46 percent farmers had low crop productivity and it is not satisfactory. So, the concerned authority should come forward and take effective steps to aware the farmers about increasing farmers' level crop productivity. Alem, et al. [19] confirmed that the farm management practices and socioeconomic factors were shown to significantly affect the economic performance of Norwegian crop farms.

### 3.2 Problems Faced by the Farmers during Crop Production

Through the interview, schedule researcher enlisted and ranked 15 main problems which were faced by the farmers during crop production.

The problems were given in Table 4.

### 3.3 Correlation Analysis among Farmers Level Crop Productivity and Selected Variables

The findings of Table 5 reveal that variables such as training experience, land ownership, annual income, communication exposure, knowledge on crop production, innovativeness, and risk orientation had a positive and significant relationship with farmers' level crop productivity. This indicates that with the increase of training experience, land ownership, annual income, communication exposure, knowledge on crop production, innovativeness, and risk orientation the farmers' crop productivity level was also increased. Dessart, et al. [20] demonstrated that the behavioural factors enrich economic analyses of farmer decision-making, and can lead to more realistic and effective agri-environmental policies. Among them, five variables like age, education, farming experience, farm size and credit received had a positive and non-significant relationship with the farmers' level crop productivity which indicates that these variables are not an important factor towards farmers' level crop productivity.

### 3.4 Stepwise Multiple Regression Analysis Explaining Contribution of Variables to the Farmer's Level Crop Productivity

To determine the contribution of factors influencing farmers' level crop productivity a stepwise multiple regression analysis was carried out. The regression model includes all of the independent variables which had significant correlations with the farmers' level crop productivity. The dependent variable was the respondent's crop productivity level which was defined as their scores obtained from crop productivity index. Parmar, et al. [21] suggested that the Information and Communication Technology sources of marketing and production information play a crucial role in the farmers' access to this information for their business operations. The implication is that proper education and training of farmers (especially the female farmers) about the utilization of Information and Communication Technology sources to accelerate access to information is crucial.

There were 12 independent variables entered in the model, out of which only 4 variables had a significant influence at the 5% level of significance of farmer's level crop productivity. As shown in Table 6, communication exposure, innovativeness, risk orientation and training experience were found to have a positive influence on respondent's crop productivity level.

The R2 value was 0.528 and F value was 29.350, which were significant at 0.000 levels. The R2 value indicated that 52.8 percent of the total variation in the crop productivity level of the farmers could be explained by these 4 variables.

**Table 2. Socio-economic characteristics of farmers**

| Characteristics of the farmers | Range | Categories | Respondents | | Mean | Standard deviation |
|---|---|---|---|---|---|---|
| | Observed | | Number | Percent | | |
| Age | 25-75 | Young aged (up to 35years) | 14 | 12.73 | | |
| | | Middle-aged (36-50 years) | 38 | 34.55 | 52.22 | 11.68 |
| | | Old aged (above 50 years) | 58 | 52.72 | | |
| Education | 0-12 | Illiterate (0) | 5 | 4.54 | | |
| | | Can sign only (.5) | 12 | 10.91 | | |
| | | Primary education (1-5) | 49 | 44.55 | | |
| | | Secondary education (6-10) | 42 | 38.18 | 5.06 | 2.87 |
| | | Above secondary education (above 10) | 2 | 1.82 | | |
| Farming experience | 10 to 65 | Low experience (10-28) | 30 | 27.27 | | |
| | | Medium experience (29-47) | 72 | 65.45 | 34.20 | 11.24 |
| | | High experience (above 48) | 8 | 7.28 | | |
| Training experience | 0 to 22 | No experience (0) | 9 | 8.18 | | |
| | | Short experience (1-7) | 72 | 65.45 | | |
| | | Medium experience (8-15) | 23 | 20.91 | 5.69 | 4.87 |
| | | High experience(above 16) | 6 | 5.46 | | |
| Farm size | 0.28 to 3.02 | Landless (below 0.02ha) | 00 | 00 | | |
| | | Marginal (.02-0.20 ha) | 00 | 00 | 0.99 | 0.59 |
| | | Small (.21-1.00 ha) | 72 | 65.45 | | |
| | | Medium (1.01-3.00 ha) | 36 | 32.73 | | |
| | | Large (above 3.00 ha) | 2 | 1.82 | | |
| Land ownership | 21.56-100 | Below 25% land ownership | 2 | 1.82 | | |
| | | 26-50% land ownership | 17 | 15.46 | 76.73 | 24.08 |
| | | 51-75% land ownership | 30 | 27.27 | | |
| | | 76-100% land ownership | 61 | 55.45 | | |
| Annual income | 52.0 to 363.85 | Low income (52-156) | 89 | 80.91 | | |
| | | Medium income (156.01-261) | 19 | 17.27 | 114.33 | 54.22 |
| | | High income (above 261) | 2 | 1.82 | | |
| Credit received | 0 to 45 | No credit received) | 4 | 3.64 | | |
| | | Low credit received (0-15) | 62 | 56.36 | 15.56 | 8.73 |
| | | Medium credit received (16-30) | 39 | 35.45 | | |
| | | High credit received (above 30) | 5 | 4.55 | | |
| Communication exposure | 17 to 52 | Low exposure (17-28) | 52 | 47.27 | | |
| | | Medium exposure (29-40) | 47 | 42.73 | 29.81 | 7.73 |
| | | High exposure (above 40) | 11 | 10.00 | | |
| Knowledge on crop Production | 14 to 37 | Low knowledge (14-21) | 28 | 25.45 | | |
| | | Medium Knowledge (22-29) | 46 | 41.82 | 25.90 | 5.43 |
| | | High (above 29) | 36 | 32.73 | | |
| Innovativeness | 10 to 38 | Less innovativeness (below 19) | 28 | 25.45 | | |
| | | Moderate innovativeness (20-29) | 49 | 44.55 | 24.50 | 6.10 |
| | | High innovativeness (above 30) | 33 | 30.00 | | |
| Risk orientation | 23 to 45 | Low-risk orientation (23-30) | 27 | 24.54 | | |
| | | Moderate risk orientation (31-38) | 46 | 41.82 | 34.80 | 5.60 |
| | | High-risk orientation (39-450 | 37 | 33.64 | | |

**Table 3. Classification of farmers according to their level of crop productivity**

| Categories | Farmers | | Mean | Standard deviation |
|---|---|---|---|---|
| | Number | Percent | | |
| Low crop productivity | 28 | 25.46 | 98.50 | 16.50 |
| Medium crop productivity | 52 | 47.27 | | |
| High crop productivity | 30 | 27.27 | | |

**Table 4. Distribution of problems faced by the farmers in a rank order**

| Problems | Citation | Rank |
|---|---|---|
| Lack of improved varieties of seed | 72 | 1 |
| The high price of farm inputs | 69 | 2 |
| Lack of skilled labour in proper time | 65 | 3 |
| An infestation of insect and pest | 61 | 4 |
| Unavailability of input dealer | 56 | 5 |
| Lack of agricultural machinery | 50 | 6 |
| Scarcity of irrigation water | 48 | 7 |
| Lack of organizational support | 44 | 8 |
| Lack of information from agriculture officers | 39 | 9 |
| Lack of training facilities | 37 | 10 |
| Lack of credit facilities | 32 | 11 |
| Lack of adequate transport facilities | 30 | 12 |
| Lack of proper market facilities | 27 | 13 |
| Stealing of crops | 8 | 15 |

**Table 5. Correlation analysis among farmers level crop productivity and selected variables**

| Dependent variable | Independent variable (Farmers characteristics) | Coefficient of correlation (r) |
|---|---|---|
| | 1. Age | .011$^{NS}$ |
| | 2. Education | .159$^{NS}$ |
| | 3. Farming experience | .048$^{NS}$ |
| | 4. Training experience | .452$^{**}$ |
| Farmers' Level Crop | 5. Farm size | .148$^{NS}$ |
| Productivity | 6. Land ownership | .227$^{*}$ |
| | 7. Annual income | .509$^{**}$ |
| | 8. Credit received | .112$^{NS}$ |
| | 9. Communication exposure | .602** |
| | 10. Knowledge of crop production | .587** |
| | 11. Innovativeness | .578** |
| | 12. Risk orientation | .580** |

***=Significant at .01 level, NS=Not significant, *=Significant at .05 level; Source: Author's calculation using SPSS from field survey data, 2016*

**Table 6. Results of multiple regression analysis**

| Predictor variables | B | Standard error | β | T | p |
|---|---|---|---|---|---|
| Constant | 35.454 | 7.114 | | 4.984 | .000 |
| Communication exposure | 0.469 | 0.197 | 0.220 | 2.388 | .019 |
| Innovativeness | 0.662 | 0.229 | 0.245 | 2.890 | .005 |
| Risk orientation | 0.833 | 0.249 | 0.283 | 3.344 | .001 |
| Training experience | 0.675 | 0.254 | 0.199 | 2.654 | .009 |

*$R^2$=0.528, F=29.35 and P=0.000*

The variable that had the greatest influence on farmers' level crop productivity was communication exposure with the β1=.469, implies that when communication exposure of the farmer increases by a unit then level of crop productivity increases by .469 units. Similarly,

**Table 7. Change in multiple R2 for entry of the said variable into the stepwise multiple regression models**

| Model | Variables | $R^2$ | Adjusted R square | Std. The error of the estimate | R square change | Variance explained (%) | Sig. F change |
|---|---|---|---|---|---|---|---|
| 1 | Communication Exposure | .363 | .357 | 12.237 | .363 | 36.3 | .000 |
| 2 | Innovativeness | .448 | .438 | 12.374 | .086 | 8.6 | .000 |
| 3 | Risk Orientation | .496 | .482 | 11.881 | .048 | 4.8 | .002 |
| 4 | Training Experience | .528 | .510 | 11.556 | .032 | 3.2 | .009 |

innovativeness, β2=.662, implies that when innovativeness of the farmer increases by a unit than their crop productivity level increases by .662 units. Similarly, risk orientation β3=.833, implies that when risk orientation of the farmer increases by a unit than their level of crop productivity increases by 0.833 units. However, training experience β4=.675, implies that when training experience of the farmer increases by a unit then their level of crop productivity increases by 0.675 units.

The unique contribution of the variables was also determined by taking the changes in $R^2$ value occurred for the entry of a particular variable in the stepwise regression model. The results of Table 7 shows that communication exposure along could explain 36.3 percent of the total variation in the farmer's level crop productivity and other three variables namely innovativeness, risk orientation and training experience could explain 8.6, 4.8 and 3.2 percent variation respectively in case of Level of crop productivity.

## 4. CONCLUSIONS AND RECOMMENDATIONS

Crop productivity is an important consideration that ensures food security and it also has an impact on income and livelihood status of the farmers. But findings of the study revealed that the majority (72.73 percent) of the farmers belonged to low to medium crop productivity level. So it can be said that the tendency or trend of crop productivity level is not satisfactory in the study area. The result showed that training experience, land ownership, annual income, communication exposure, knowledge on crop production, innovativeness, and risk orientation had a positive and significant relationship with farmers' level crop productivity. Also, multiple regression analysis showed that communication exposure, innovativeness, risk orientation and training experience were found to have a positive influence on respondent's crop productivity level. Therefore, the implementing agencies need to keep this in view for its dissemination. Therefore, it may also be concluded that unless proper steps are taken to increase the production of various crops, the national goal of increasing crop productivity will continue to suffer seriously.

## CONSENT

As per international standard or university standard, farmers' written consent has been collected and preserved by the author(s).

## ACKNOWLEDGEMENT

The authors expresses their great indebtedness to the Ministry of Science and Technology of Bangladesh for the financial support by giving National Science and Technology (N.S.T.) Fellowship, Funded by Ministry of Science and Technology, Government of the People's Republic of Bangladesh and to the Department of Agricultural Extension and Rural Development, Faculty of Agriculture, Patuakhali Science and Technology University (PSTU), Patuakhali, Bangladesh, for providing logistic support to accomplish the research.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES

1. Dharmasiri LM. Measuring agricultural productivity using the Average Productivity Index (API). Sri Lanka Journal of Advanced Social Studies. 2009;1(2).
2. Dharmasiri LM. Land use, land tenure and agricultural productivity in Sri Lanka*:* A

Spatio-temporal analysis (Unpublished PhD Thesis). Department of Geography, University of Kelaniya, Kelaniya, Sri Lanka; 2009.
3. Bhatia SS. A new approach to measure agricultural efficiency in Uttar Pradesh. Economic Geography. 1967;43:224–260.
4. Singh J. A new technique for measuring agricultural productivity in Haryana (India). The Geographer. 1972;19:15 - 33.
5. Singh J, Dhillion SS. Agricultural geography (2nd Ed.) New Delhi: Tata McGraw Hill; 2000.
6. Ghose B, Razib B, Sharmistha G. Reviewing the status of agricultural production in Bangladesh from a food security perspective. Russian Journal of Agricultural and Socio-economic Sciences. 2014;25(1).
7. FAO F. The future of food and agriculture–Trends and challenges. Annual Report; 2017.
8. BBS. Statistical Yearbook of Bangladesh. Bangladesh Bureau of Statistics, Statistics Division. Ministry of Planning, Government of People's Republic of Bangladesh, Dhaka; 2014.
9. Ministry of Agriculture. Bangladesh Agriculture at a Glance. Dhaka, Bangladesh: Agricultural Division. MOA; 2014.
Available:http://www.moa.gov.bd/site/page/93798708-0076-42da-a9f5-318ddf098a2a
10. Shafi M. Measurement of agricultural efficiency in U.P. Economic Geography. 1960;36(4):296-305.
11. Adebayo EF, Moses J. Efficiency of factors determining rainfed rice production in Ganye Local Government Area, Adamawa State. Journal of Sustainable Development in Agriculture & Environment. 2007;3:20-30.
12. Kareem, et al. Analysis of factors influencing agricultural output in Nigeria: Macroeconomics perspectives. American Journal of Business, Economics and Management. 2013;1(1):9-15.
13. Iganiga BO, Unemhilin DO. The impact of federal government agricultural expenditure on agricultural output in Nigeria', Journal of Economics. 2011;2(2): 81-88. ISSN 0976-5239.
14. Verter N, Bečvářová V. An analysis of yam production in Nigeria. Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis. 2015;63(2):659-665.
ISSN 1211-8516
15. Desilva SKGN, Hemachandra DWK. Micro credits and agricultural productivity: With special reference to paddy cultivation in akmeemana divisional secretariat division. 2015;IV:435.
16. Karimov AA. Factors affecting efficiency of cotton producers in rural Khorezm, Uzbekistan: Re-examining the role of knowledge indicators in technical efficiency improvement. Agricultural and Food Economics. 2014;2(1):1.
17. Kazukauskas A, Newman C, Sauer J. The impact of decoupled subsidies on productivity in agriculture: A cross-country analysis using microdata. Agricultural Economics. 2014;45(3):327-336.
18. Yang WY. Methods of farm management investigations for improving farm productivity, F.A.O. Agricultural Development. Paper No. 80 FAO Rome; 1980.
19. Alem H, Lien G, Hardaker JB. Economic performance and efficiency determinants of crop-producing farms in Norway. International Journal of Productivity and Performance Management; 2018.
20. Dessart FJ, Barreiro-Hurlé J, Van Bavel R. Behavioural factors affecting the adoption of sustainable farming practices: A policy-oriented review. European Review of Agricultural Economics. 2019;46(3):417-471.
21. Parmar IS, Soni P, Kuwornu JK, Salin KR. Evaluating farmers' access to agricultural information: Evidence from Semi-arid region of Rajasthan State, India. Agriculture. 2019;9(3):60.



*Peer-review history:*
*The peer review history for this paper can be accessed here:*
*http://www.sdiarticle4.com/review-history/54574*