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Original Research

Rural Infrastructure and Its Impact on Agricultural Production in Bangladesh: A Case Study on Kushtia Sadar Upazila

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Abstract

Agriculture is one of the most important sectors and driving factors of the economy of Bangladesh, which plays a significant role in the prosperity of large rural communities by increasing productivity, income, and creating employment. Presently, this sector has faced a severe challenge in its production, due to the construction of unplanned infrastructure in rural areas. This study investigates the effect of rural infrastructure on agricultural production in Bangladesh. Using the purposive sampling technique, 50 respondents were interviewed through a structured questionnaire to collect primary data from six unions of Sadar Upazila in the Kushtia district. Statistical methods of multiple regression and paired-sample t-test have been utilized to analyze the collected data. The results of the multiple regression model show that the co-efficient of cultivable and infrastructural land size is statistically significant at 1 percent of level, which depicts cultivable land positively affects agricultural production, whereas infrastructural land negatively affects agricultural production in the study area. This means that infrastructure built on cultivable land has reduced agricultural production. Paired-sample t-test result also shows that the mean difference between agricultural production before and after constructing infrastructure is TK.134847.94 per year. The primary reasons for the construction of infrastructure in the study area are unanticipated population expansion, urbanization, unplanned human settlement, and a rise in nuclear families. Lastly, suitable policies have been offered to develop the infrastructure as well as agricultural production in rural areas.

Keywords: Infrastructure, Agriculture, Multiple Regression, Paired Sample, Bangladesh.

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Introduction

Bangladesh is a small country in South Asia where 93.51% of the total landed area is rural, and 81.27% of the country's total population lives in rural areas (BBS, 2020). About 80% of the people of rural Bangladesh are directly and indirectly dependent on agriculture, and 47.1% of employment is being created through this sector (BBS, 2020). Despite significant advances in the services and manufacturing sectors, the role of agriculture in the economy remains unchanged due to continued advances in food production and being one of the major sources of rural employment (dailystar.net). The agriculture sector's contribution to the GDP in the fiscal year 2020-21 is 13.46 percent (BER, 2021). According to the 2016-17 Labor Force Survey, 40.62 percent of the labor force is still engaged in agriculture, which means agriculture is still a significant field of employment.

Bangladesh Bank conducted a report that the figure of agricultural production and trade in Bangladesh has been increasing over time as well as also increases the total market size. This report find out the total agricultural production in the year 2016 was $30,424, and the total market size was $34,927. But in a short time, this figure is gradually increasing, and it is estimated in the year 2020, the total production and total market size are $40,899 and $44,728, respectively. So this sector generates remarkable benefits for Bangladesh's economy. Even the role of this sector in the country's macro-economy, such as job creation, poverty alleviation, human resource development, and food security, is undeniable (Rahman, 2013).

Table 1. Agricultural Production and Trade in Bangladesh (Units: $ millions)

Year	2016	2017	2018	2019	2020 (Estimated)
Total Local Production	$30,424	$33,374	$35,882	$38,095	$40,899
Total Exports	$1,488	$1,625	$1,418	$1,600	$1,342
Total Imports	$5,991	$9,470	$5,952	$8,000	$5,171
Total Market Size	$34,927	$41,219	$40,417	$44,495	$44,728

(Total market size = (total local production + imports) - exports)
Source: USDA, Bangladesh Bank

But the contribution of this potential sector has been steadily declining in GDP growth for more than a decade because of the rapidly declining cropland (Islam & Hassan, 2013). Researcher such as Islam, S. (2014) has said, Land is an important factor in agricultural production which sources of human food, shelter, and clothing. And in recent times, Bangladesh's land use pattern is changing very quickly because of changes in geography, social and economic conditions, climate, adaptation, and population growth. Ahmed & Marjuk, (2013) in their study find out that the country had a huge population and used its land and resources very intensively. Thus, this huge population creates the problem of establishing unplanned infrastructure on this land which has a particularly strong effect on agriculture. In every year, the cropland is declining to human settlement and other human-induced activities. Unplanned land usage is taking place and creating infrastructure here and there (Islam & Hassan, 2013). And this scenario is more acute in rural areas of Bangladesh. Various establishments are being constructed, including

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housing, industrial establishments, roads, hospitals, educational institutions, hat-bazaar, shops, etc (Hasnat et al., 2018). As a result, the agricultural land in rural areas is rapidly going into the non-agricultural sector. And it is estimated that the rising population pressure will devour 50% of the country's arable land by 2025 (Islam, 2014).

According to a research report funded by the Food and Agriculture Organization of the United Nations, the European Union, and USAID, in 1976, our cultivable land was 96,71,450 hectares. By the year 2000, 3 lakh 21 thousand 909 hectares decreased to 94 lakh 39 thousand 541 hectares. But in the next 10 years alone, by 2010, the total amount of agricultural land has decreased from 6 lakh 8 thousand 604 hectares to 8 lakh 51 thousand 938 hectares. That is, in the last one decade, an average of 6,600 hectares of arable land has been reduced every year. Another report from the World Bank shows that the total land area of Bangladesh is 3 crore 56 lakh 63 thousand acres, of which only 70 lakh 30 thousand hectares are cultivable land. So each person only has access to 0.0526 ha of land, of which one-fourth is now under threat. The report shows that Bangladesh is losing 1 percent of its cultivable land or 82900 hectares of cropland every year and 221 hectares of cultivable land every day. One of the reasons for the decline in agricultural land in the country is unplanned housing, urbanization, and increasing industrialization (Bhuiyan, M. 2003a).

As a district of Bangladesh, its impact on Kushtia is also noticeable. According to the BBS District Statistics-2011, the land survey (a record) from 1966 to 1970, and the final RS Khatian in 1972, the total area of 14 unions and one municipality of Kushtia Sadar Upazila was 316.3. Square kilometers. The total amount of land was 78667 acres. The total amount of permanent agricultural land is 3560 acres, and the amount of temporary agricultural land was 55712 acres. Due to unplanned urbanization, industrialization, and housing in Kushtia Sadar Upazila, about 400 acres of permanent farmland have been reduced at a geometric rate. In that case, the total amount of current agricultural land in Upazila is 3160 acres (BBS, 2020).

Table 2. Land area on the basis of utilization 2008 (*acres)

Upazila	Total area	Permanent Cropped area	Temporary Cropped area	Permanent fallow area	Others
Kushtia Sadar	78667	3560	55712	450	18945

Source: BBS District Statistics-2011

If this continues, not only will the habitable environment be damaged, but in the near future, the entire population will be in a catastrophic state (Kolakar, 1993). At present, the amount of cultivable land per capita is very small. Even then, if agricultural land continues to decline at such a rapid rate, providing food for a large population will not be difficult at all, it will become virtually impossible (Mahbub, A. 2003b).

Under the above circumstance, this investigation was to find out the answers to the following questions:

- Whether the construction of infrastructure affects agricultural production?

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- What are the mean differences between agricultural production in the study area?
- What are the reasons for the construction of infrastructure in rural areas?
- What kind of actions are required to address the infrastructure issue and expand agricultural production?

The study is divided into six parts. The next section provides the objectives of this study. This is followed by a brief outline of the literature review. Section four presents data, model, and methodological framework. Then section five exhibits results and discussion. The final section deals conclusion and recommendations.

Objectives of the Study

The primary objective of this study is to explore the impact of rural infrastructure on agricultural production in Sadar Upazila of Kushtia District. To reach the main objective, this study sets out some specific objectives, which are as follows:

- To determine the mean difference between agricultural production before and after constructing infrastructure by applying paired samples t-test.
- To identify the factors responsible for constructing rural infrastructure in the study area.
- To suggest suitable policy measures and recommendations for developing the rural infrastructure and agricultural production.

Literature Review

In this section, a few works of literature were reviewed related to rural infrastructure and agricultural production in Bangladesh. This section also provides a summary of the findings from the previous research work. Notable analyses of Islam and Hassan (2013), Hasnat et al., (2018), Islam (2013), Shafiqul (2014), Rana et al., (2019), and Khan (2020) have been reviewed here.

(Islam & Hassn, 2013) investigated the factors that influence the loss of Agricultural Land, and they showed that due to Infrastructural Development, the agricultural land in Bangladesh is decreasing day by day. To analyze their study, they chose the Rajshahi district as the study area because it has seen a lot of growth in infrastructure development through different regional development programs. They used remotely sensed data (Landsat MSS-1977, TM-1990, and TM- 2010) and GIS techniques as their study methods to analyze the land use pattern and its changes. The secondary data of this study were collected from SPARRSO and various government sources. The data (spatial and characteristics) were evaluated using GIS, statistical tools, and several types of tables. They found that the land use pattern in the Rajshahi district is changing. Among the different causes of agricultural land loss, infrastructure development is one of the most significant. The agricultural land of the study area is losing 0.46% per year, whereas the area devoted to infrastructure is expanding by 5.86 percent annually. (Hasnat et al., 2018)

made a study about land use changing patterns and challenges for agricultural activities in Dumki Upazila, Patuakhali. The study was based on both primary and secondary data sources. In the selected Unions, a total of 70 households were purposely chosen to perform the questionnaire survey. After finding the sample households, a semi-structured qualitative questionnaire was used to collect primary data from the family representatives. The survey found that the pattern of land use of the studied households is slowly changing. In this study, they revealed that in the last 20 years, residential areas and water bodies have grown by about 3.56 acres and 1.37 acres, respectively. In contrast, approximately 4.13 acres of agricultural land have been declining from 1998 to 2018 due to new house construction, selling or mortgaging of land to meet financial needs, distributing land among successors, reducing soil fertility, wearing away land parts due to riverbank erosion, and government acquisition of land. As a result, these factors can be considered the main challenge for agricultural development in the study area. (Islam, 2013) carried out a survey of the causes and consequences of Agricultural land losses of Rajshahi District, Bangladesh. In this study, he predicted that just 0.0526 hectares of land are available per person in the Rajshahi district. He has also investigated two significant reasons for losing land: a) The rapid growth rate of the population consuming valuable land for settlement and b) the paucity of land to meet the growing demand for food. PRA techniques were used for the analyses to gather primary data, and both published and unpublished data about crops, populations, and other environmental factors, mostly from government sources, were used as secondary data. The findings of this study reveal that the causes of agricultural land losses are diverse, and their consequences are also multi-dimensional. (Islam, M. S. 2014) remains that land fragmentation is the most crucial factor in losing Bangladesh's land. For analysis, he conducted a clear picture of the status of land fragmentation in the Rajshahi district. Thus, he interviewed a total of 30 people to learn about the state of land fragmentation in Rajshahi, as well as the effects of land fragmentation on agriculture, the environment, the economy, and sustainable development. He found that Bangladesh's land use pattern is rapidly changing due to unplanned human settlement and industrialization. Consequently, agricultural land is rapidly diminishing. This study's findings revealed that the Rajshahi area's land fragmentation is changing, with agricultural land declining at an alarming pace and becoming more susceptible. Every year, the study area's agricultural land disappears. Agricultural productivity is also declining owing to a shortage of agricultural land, industrialization, a decrease in soil fertility, and the use of pesticides to make soils poisonous. If current trends continue, agricultural land will be depleted over the next several years. (Beckersa, V. et al., 2020) identified in their study urbanization is one of the major factor to a continuous loss of agricultural land, both directly under land acquisition and indirectly through the use of agricultural land for non-productive rural activities such as recreation, horse rearing or hobby farming. To implement their study, they are used agricultural agent-based model to explicit the urbanization scenerio of different city in Belgium. The study result find that farmers are under pressure from urbanization processes, which make farming more difficult due to decreased agricultural land, negative externalities, and competition for land. The findings also revealed that these decreases are predicted to be greater in the rural-urban periphery. (Fazal, S. 2000) conduct a survey in Saharanpur City to measure the urban expansion and loss of agricultural land. He applied in his study a remote sensing methodologies to enable extensive mapping of land use changes, including the location of agricultural land loss, changes in land use type, and the quality of lost agricultural land. The findings also

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identifies the non-agricultural land uses that accounted for the majority of the lost agricultural land and explores the implications of these results for India and other countries where urbanization is limiting the availability of high-quality agricultural land. (Halim, M. A. et al., 2013) concluded a field survey how crop land converted every year into non- agricultural sector in the sub-urban area of Bangladesh. In this regard, they are purposively selected two villages (Narikel Baria and Baze Silinda) from ten surrounding sub-urban villages in the Pabna Upazila of the Rajshahi district. Both primary and secondary data are used to attain the objectives and various statistical tools like SPSS, EXCEL and GIS are used to process the data. The study result noted that more land has been converted from agriculture to non-agriculture associated uses in recent years than in the past due to steadily rising land demand for housing and related services, which has a negative impact on agricultural land and the people who depend on it. Finally they are provide better alternatives for meeting the land demand for the agricultural and housing sectors, integrated land-use planning is required. On a different angle (Rana et al., 2019) have used trend analysis to show the land utilization scenario in Bangladesh. To analyze the changes in land use patterns in Bangladesh they collected the data from secondary sources during the period of 1990 to 2015. The trend analysis and exponential growth rate indicated that the forest area considerably rose by 35.93 percent and 0.3 percent per year, whereas land not available for cultivation greatly declined by 4.49 percent and 0.04 percent per annum correspondingly. (Khan, 2020) published an article entitled "Worries over farmland depletion." In this article, he revealed that due to rapid industrialization, unplanned urbanization, and more rural settlements, over 69,000 hectares of farmland are being lost every year. He also showed that Bangladesh lost around 13,412 hectares of agricultural land between 1976 and 2000 and 30,000 hectares of land lost from 2000 to 2010. He said that rapid urbanization, including the building of new roads and highways and the increase in population, is consuming a significant area of farmland. If this situation continues, the country's food security will be at risk in the future.

Most of the research has only addressed infrastructural and agricultural development (Edeme, Nkalu, Idenyi, & Arazu., 2020, Andersen P. P., 2006, Patel. D. A., 1994). Furthermore, a few studies have revealed the causes of arable land losses and its consequence on agricultural production (Isalm R., 2013, Hasnat, Siddik, & Zaman 2018**,** Islam S., 2014). But there are no studies about infrastructure and its impact on agricultural production in rural areas in Bangladesh. Even no district-level study like Kushtia discussed the construction of unplanned infrastructure, which directly affects agricultural production. For that reason, a field research is required to determine the agricultural production difficulties and bring opportunities to Kushtia district as well as Bangladesh.

Data, Model and Methodological Framework

Study Area

The study is basically conducted on field-level data. Kushtia Districts in the Khulna Division of Bangladesh are purposively selected as the study area. Generally, rural areas under Kushtia Sadar Upazila are chosen for this study because of the rapidly growing rural infrastructure. A total of 6 unions namely Abdulpur, Ailchara, Alampur, Battail, Harinarayanpur, and Ujangram under Sadar Upazila of Kushtia District have been

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purposively selected to get the real picture of the study areas. The following Table 3 represents the sampling area of the study.

Table 3. Sample Size and its Distribution (N=50)

Name of District	Name of Upazila	Name of Union	Number of Samples
Kushtia	Kushtia Sadar	Abdulpur	7
		Ailchara	5
		Alampur	10
		Boattail	16
		Harinarayanpur	6
		Ujangram	6
Total	1	6	50

Data Collection and Process

A total of 50 respondents have been randomly selected from the six unions under Sadar Upazila of kushtia District for interviews regarding rural infrastructure and its impact on agricultural production. A face-to-face interview method was used to give a structured questionnaire to acquire the primary data. The questions were both open-ended and closed. The data collection period was from January 2022 to March 2022. Secondary data sources (journals, govt. websites &reviews of literature) were also used to enhance the reliability of the outcome of this study. After data collection, it was processed with MS Excel and presented in tabular and graphical style for easy perception.

Descriptive Analysis

Descriptive statistics gives a comprehensive understanding of the study's variables with the use of Central tendency (Kaushik et al.,2016). In this study, the statistical terminology used to characterize them includes mean, standard deviation, maximum value, and minimum value. Descriptive analysis is used to delineate the information about age (Year), education (Year of Schooling), family size (members), and land size (Bigha). In addition, the causes of constructing infrastructure have been illustrated here. Furthermore, it has become used for categorizing, summarizing, and indicating the link between two or more variables. Besides Frequency, percentage, rank, and other metrics are also examined by using it.

Functional Analysis

Multiple Regression Model

The following model illustrates how the Multiple Regression Model was constructed and used to assess the impact of factors on the annual agricultural production. The following specification of the model has been applied:

$$\boldsymbol{Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \cup_i} \quad (1)$$

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A multiple regression model has been utilized to estimate the effects of variables on agricultural production. In this instance, the influence of several factors on agricultural production is examined using the multiple regression model. As a consequence, there are two linear types of models have been used in this study. The first linear type multiple regression model is considered in this study, i.e.,

$$\boldsymbol{Ln\, Y_i = ln\, \beta_0 + \beta_1\, ln\, X_1 + \beta_2\, ln\, X_2 + \beta_3\, ln\, X_3 + \cup_i} \quad (2)$$

Where, Y_i = Agricultural Production, β_0= Intercept, $\beta_i = \beta_1$ to β_3 are coefficients, X_1= Cultivable Land Size, X_2= Infrastructure-building year, X_3= Family Size

The second linear type multiple regression model is considered in this study, i.e.,

$$\boldsymbol{Ln\, Y_i = ln\, \beta_0 + \beta_1\, ln\, X_1 + \beta_2\, ln\, X_2 + \beta_3\, ln\, X_3 + \beta_4\, ln\, X_4 + \cup_i} \quad (3)$$

Where, Y_i = Agricultural Production, β_0= Intercept, $\beta_i = \beta_1$ to β_4 are coefficients, X_1= Cultivable Land Size, X_2= Infrastructure Land Size, X_3= Infrastructure-building year, X_4= Family Size

Paired Sample t-test

In this study, paired sample t-test is used to show the mean difference between agricultural production before and after constructing infrastructure in the study area. This model is basically based on the differences between the values of a single pair, that is one deducted from the other. The test statistic for the Paired Sample t-Test, denoted t, follows by the following formula as the one-sample t-test:

$$\boldsymbol{t = \frac{\bar{x}_d - 0}{s_{\bar{x}}}}$$

Where,

$$\boldsymbol{s_{\bar{x}} = \frac{s_d}{\sqrt{n}}}$$

Where, $\bar{x}_d =$ sample mean of the differences, $n =$ sample size, $s_d =$ sample standard deviation of the differences, $s_{\bar{x}} =$ estimated standard error of the mean.

Results and Discussion

Results from Descriptive Statistics of the Variables

Descriptive statistics displays the estimation variables and associated sample data, including the respondents' maximum and minimum values, mean, and standard deviation about their Socio-Demographic variables (Age, Education, Family Size) along with economic variables (Establishing Year, Land Size, Agricultural Production). The results of the descriptive variables that are found in this study are shown in Table 4:

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Table 4. Descriptive Statistics of the Variables

Variables	Minimum	Maximum	Mean	Standard Deviation
Age of respondents (Years)	23	77	45.82	12.53841
Education of respondents (Years)	0	17	8.86	4.598181
Family Members of respondents	2	12	4.92	1.957090719
Year Of Establishing (Ago)	1	20	8.92	5.913803
Infrastructure Land Size (Bigha)	1	50	6.54	7.990326
Before yearly agricultural production (Per Bigha)	9000	69600	40490	11731.73
Current yearly agricultural production (Per Bigha)	8570	80000	39791.77	15226.17

From table 4, it is found that the average age of the respondent is 45.82 years, with a minimum age of 23 years and a maximum age of 77 years. The average level of education of the respondent is 8.86, which means most of the respondents are educated. The respondent's average member is 4.92, with a minimum member of 2 and a maximum of 12.

According to table 4, The average value of the year of establishing infrastructure is 8.92, with minimum and maximum years of 1 and 20, respectively. The average size of infrastructure land (Bigha) in the study area is 6.54, with a range of 1 to 50. Table 3 also shows, the average yearly agricultural production (Per Bigha) is TK. 40490 before constructing infrastructure, with the minimum and maximum production of TK. 9000 and TK. 69600 respectively. Finally, it is found that the average value of current yearly agricultural production (Per-Bigha) after constructing infrastructure is TK. 39791.77, with the minimum production value of TK. 8570 and the maximum value of TK. 80000. This result means that both the average yearly agricultural production are almost the same in the study area. The standard deviation of both yearly agricultural production (per bigha) before and after establishing infrastructure is TK. 11731.73 and TK. 15226.17 respectively. The standard deviation of age, education, family members, year of establishing, and infrastructure land size are 12.54, 4.60, 1.96, 5.91, and 7.99, respectively.

Results from Estimation of Multiple Regression Model

Using the Multiple Regression Model, the output of agricultural production and input are estimated here. Agricultural production is examined using different explanatory variables in this study. The results of the multiple regression model are divided into two sections. Table 4 shows the first section, and table 5 shows the second section. Both tables depict an interpretation of the variables' effects on agricultural production.

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Factors Affecting Agricultural Production before Constructing the Infrastructure

In this part, we show the effect of various factors on agricultural production before constructing the infrastructure in the study area. The three explanatory variables influencing agricultural production are listed in the table below:

Table 5. Estimation of Coefficient of Multiple Regression Model of Factors Affecting the Agricultural Production

Explanatory Variables	Coefficients	Std. Error	t-Statistic	P-value
Constant	1547.291	154015.5	0.010046	0.9920
Total Cultivable land size (X1)	28910.70	2199.028	13.14703	0.0000*
Infrastructure-building year (X2)	1034.198	9339.498	0.110734	0.9123
Number of family members (X3)	12547.02	28466.66	0.440762	0.6615
F-Value	59.38			
R-Squared	0.79			
Dependent Variable: Yearly Gross Agricultural Production (TK), Number of Observation (N)=50 *1% level of significant				

The estimated result shows that cultivable land size is significant at 1%, and the coefficient is 28910.70. This result indicates that as the cultivable land size increases by 1 unit, then the gross agricultural production increases by TK.28910.70. The coefficient of multiple determination R-squared is 0.79. That means the explanatory variable included in the model explains about 79% of the variation in the yearly agricultural production in the study area. It implies that the interpretation of the yearly agricultural production primarily depends on the explanatory variable considered in this model. Although the number of family members has a favorable effect on agricultural productivity, this effect is not statistically significant here. In addition, both the constant and year of building infrastructure are not statistically significant in this model.

Factors Affecting Agricultural Production after Constructing the Infrastructure

In this part, we show the effect of various factors on agricultural production after constructing the infrastructure. The four explanatory variables are used to examine agricultural production that is listed in the table below:

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Table 6. Estimation of Coefficient of Multiple Regression Model of Factors Affecting the Agricultural Production

Explanatory Variables	Coefficients	Std. Error	t-Statistic	P-value
Constant	-36397.65	63696.60	-0.571422	0.5706
Present cultivable land size (X1)	41680.10	1937.771	21.50930	0.0000*
Infrastructure land size (X2)	-24698.59	4041.603	-6.111087	0.0000*
Infrastructure-building year (X3)	-103.2390	3865.742	-0.026706	0.9788
Number of family members (X4)	16774.75	11809.71	1.420421	0.1624
F-Value	178.19			
R-Squared	0.94			
Dependent Variable: Yearly Gross Agricultural Production (TK), Number of Observation (N)=50 *1% level of significant				

The finding shows that both the current cultivable land and infrastructure land size are statistically significant at 1%, and the coefficient is 41680.10 and -103.2390 respectively. The coefficient of multiple determination R-squared is 0.94. That means the explanatory variable included in the model explains about 94% of the variation in the yearly agricultural production. This result indicates that the cultivable land size has positively impacted the gross agricultural production in the study area. On the other hand, infrastructure land size has negatively impacted the gross agricultural production and it depicts that if the other factors remained constant, a 1% increase in infrastructure land size would decrease the gross agricultural production by 103.2390 %. Although the other variables have a favorable effect on agricultural productivity, this effect is not statistically significant in this model. In addition, both the constant and year of establishing infrastructure have negatively impacted the gross agricultural production in the study area.

Results from Estimation of Paired sample t-test

The results of this test are classified into three parts: paired samples statistics, paired-samples correlation, and paired samples test. All these parts are the following:

Table 7: Paired Samples Statistics of Gross Production

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Gross Production TK (Per Year)	399050.00	50	803354.055	113611.420
	Present Gross Production TK (Per Year)	264202.06	50	613663.644	86785.145

Table 6 represents the paired sample statistics that give univariate descriptive statistics for a single variable, such as the mean, sample size, standard deviation, and standard error.

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Notice that the sample size here is 50; this is because the paired t-test can only use cases that have non-missing values for both variables. According to table 6, the average value of gross production before constructing infrastructure is TK. 399050.00, and the average value of current gross production is TK. 264202.06. That means when the infrastructure is built on the cultivable land then the average gross production is declined in the study area. The standard deviation of the two variables is TK. 803354.055 and TK. 613663.644 respectively. In addition, the standard error of the two variables is TK. 113611.420 and TK. 86785.145.

Table 8. Paired Samples Correlations of Gross production

Paired Samples Correlations				
		N	Correlation	Sig.
Pair 1	Gross Production TK (Per Year) & Present Gross Production TK (Per Year)	50	.974	.000

The paired sample correlation shows the bivariate Pearson correlation coefficient (including the significance of the two-tail test) for each pair of entered variables. The Paired Samples Correlation table 7 adds the information that gross production before constructing infrastructure and the current production scores are significantly positively correlated (r = .974). The correlation result depicts that the gross productions before constructing infrastructure are slightly varied when the infrastructure is built on the cultivable land in the study area.

Table 9. Paired Samples Test of Gross Production

Paired Samples Test									
		Paired Differences					t	df	Sig.(2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair1	Gross Production TK (Per Year) - Present Gross Production TK (Per Year)	134847.940	248033.436	35077.225	64357.617	205338.263	3.844	49	.000

In table 8, the first column shows the pair of variables being tested, and the sequence has been subtracted. The second column shows the mean difference between the two variables is TK.134847.94 which means the gross agricultural production declined every year because of construction infrastructure. The third and fourth columns in this table depict the standard deviation of different scores and the standard error in which both the scores are 248033.436 and 35077.225, respectively.

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Causes of Constructing Infrastructure

In recent times, the construction of unplanned infrastructure is considered the main issue of agricultural land losses as well as decreasing agricultural production. In this study, the respondents of the study region give the various reasons that are responsible for constructing the unplanned infrastructure in rural areas of the kushtia district. In this section, we included all the factors in the table below and then analyzed all of these factors.

Table 10. Causes of Constructing Infrastructure in the Study Area

No.	Factors Responsible	Frequency	Percentage	Rank
1	Population Growth	45	90	1
2	Urbanization	39	78	2
3	Family Separation	27	54	3
4	Family Conflict	22	44	4
5	Advantages of Employment	12	24	5
6	River Erosion	9	18	6
7	To promote the educational expansion	4	8	7
8	Industrialization	2	4	8

From table 9, around 90% of respondents agree that population growth is the main reason for establishing infrastructure in the study area. With this high population growth, people are looking for new places to live. As a result, they are constructing new buildings on agricultural land in rural areas. Secondly, 78% of respondents consider urbanization as another factor in construction infrastructure in rural areas. At present, the trend of urbanization in Bangladesh is increasing day by day. Mainly people in rural areas are choosing the non-agricultural sector as their profession more than the agricultural sector. As a result, they are building new infrastructure on their agricultural land that results in rural areas rapidly turning into urban areas and the amount of arable land gradually decreasing. About 54% of respondents answered in favor of family separation. They believe that family separation creates a high rate of nuclear families in rural areas and every family constructs new houses on their arable land which brings extra pressure on agricultural production. In addition, about 44% of respondents further think that family conflict is another reason for building infrastructure in the study area. At present, most joint families are being divided into nuclear families due to family conflicts. Besides, because of the employment opportunities, many people have built new houses, shops, markets, and industrial institutions in rural areas and 24% of the people in the study area have expressed their opinion in favor of it. They remain that these infrastructures are more profitable institutions than agricultural production and they can get more money from these institutions.

Due to river erosion, rural infrastructure has grown dramatically in recent years. According to 18% of respondents, agricultural land in the study region is declining every year because of river erosion. Consequently, the residents of the region have built new infrastructure and put further strain on agricultural land. Educational development and

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industrialization are also cited as the reasons for building infrastructure in rural areas, supported by 8% and 4% of the people in the study area.

Conclusion and Recommendations

The study was carried out to investigate the influence of rural infrastructure on agricultural production in Sadar Upazila of Kushtia district in Bangladesh. Primary data were collected from 50 respondents randomly in the rural areas of Kushtia Sadar Upazila. Both descriptive and econometric tools were used to analyze the data. The findings of the study depict that the average age of the respondent was 45.82 years and the average year of schooling was 8.86, which shows that most of the respondents are educated and experienced. Most of the respondents' families in the study area were laid in the medium size whose members were 4.92 on average. In this study, the coefficient of agricultural land size is positively significant at 1 percent on agricultural production. That means if the infrastructure is not built on cultivable land, each unit of cultivable land increases the agricultural production in the study area. On the other hand, the coefficient of infrastructural land size is negatively significant at 1 percent on agricultural production and it reduces agricultural production. Family members and the year of establishing infrastructure are not statistically significant in this study. Besides, the result of the paired-sample t-test shows that the mean difference between agricultural production before constructing infrastructure and current agricultural production is TK.134847.94 per year. In this study, we see that several factors are affecting the demand for infrastructure and its uses in the rural areas under Kushtia districts. Increasing numbers of nuclear families and unplanned urbanization are among them, which are also restricting agricultural production day by day. Besides, the studied area's land use pattern is fast changing due to uncontrolled population expansion and economic development. As a result, it is observed that the study areas' agricultural land is losing every year, which is putting extra pressure on agricultural production. And this tendency will face a big challenge if a proper plan of agricultural land in the study area is not adopted and implemented.

In this situation, the following recommendations have been proposed for future planning: Vertical infrastructural development is necessary; accumulation of zonal growth planning; taxes can be imposed for new infrastructures; rate of population growth must be controlled; and most importantly, awareness should be raised among people. In addition, the following recommendations for further measures were made:

District and Upazila-based satellite towns should be developed to protect agricultural land from unplanned housing.

Villages must be turned into small towns without building houses in isolation. In that case, multi-storied buildings can be built.

'Land banks' can be created based on the nature of the land and the use of the land and can be used appropriately in development issues.

Creation of a 'Combined Data Bank' to clearly capture data on land use and agricultural production from the Union level to the State level in chronological order.

To encourage living in the extended family so that the rate of creating a nuclear family will decline.

Necessary legal actions should be taken to ensure proper utilization of agricultural land.

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