
Research Paper

REGIONALIZATION OF BANGLADESH BASED ON THE RELATION BETWEEN INTENSITY OF AGRICULTURAL PRODUCTION AND THE USE OF CHEMICAL FERTILIZER

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Abstract

Agriculture is one of the largest producing sectors of economy since it comprises about 14.2% of the country's GDP. Fertilizer is a chemical or natural substance added to soil or land to enhance its fruitfulness and help in increasing production. The aim of the study is to divide all the 64 districts of Bangladesh on the basis intensity of agricultural production and the chemical fertilizer use. Only the cereal crops have been considered as agricultural production. The study will find out if the highly productive areas are depended on chemical fertilizer or not by comparing the both maps produced from the regionalization according to agricultural production and chemical fertilizer use. Rajshahi, Kurigram, Cox's Bazar, Sylhet, Narshingdi districts have been found as exceptional region where agricultural cereal crops production is not proportional to the amount of chemical fertilizer use which has diversified reasons. In this context, Formal region has been delineated using Composite Index Method for fertilizer use, five factors such as (UREA, TSP, MP, DAP, Others) and for agricultural production such as (Aus, Aman, Boro, Potato, Rape and Mustard) have been considered for regionalization. Data collected from Bangladesh Bureau of Statistics (BBS) has been analysed and presented in maps prepared with ArcGIS (version 10.2.2). This study may help the policy makers for further research on increasing the capacity of agricultural food production and maintenance of chemical fertilizer use in future.

Key words

BBS, Chemical Fertilizer, Cereal crops, Formal Regionalization, Composite Index.

1. Introduction

In South Asia, Bangladesh holds the second position in cereal production, fourth in rice and fish production. It has favourable climate for the production of variety of crops. Per capita cultivable land in the country is about 0.2 acres, which is one of the lowest in the world (SHED, 2012). However, production of rice is solely based on fertilizer subsidies by the government. Farmers use fertilizer depending on availability during the cropping season,

fertilizer price, fertilizer dealer motivation & promotion, assumptions and traditional practices in a locality. The identification of the study to improvement of agricultural production through increasing fertilizer use as well as establishment of agricultural development policy and program. Agricultural regionalization can help to achieve the goal of regional self-sufficiency by proper utilization of agricultural potentials and local resources and infrastructure if proper agricultural development policy & program is undertaken (Singh, J. and Dhilon, S.S. 2004).

BLGG AgroXpertus is an international company located in Wageningen, the Netherlands, it provides soil and plant based fertilizer recommendation by analysing soil test results. Rather recently (< 10 years), BLGG AgroXpertus is doing soil tests in different continents such as Asia, Africa, South America and Australia. However, this company offers recommendation mainly based on information originated from European research. According to the Ministry of Agriculture, Bangladesh has a yearly demand of approximately 5 million tons of fertilizer, where 2.7 million tons are urea and the rest are non-urea fertilizers. Due to the capacity limitation of existing warehouse, every year around 0.25 million tons urea fertilizer is left in the open air, causing huge loss to the state coffer because of wastage and quality deterioration of a large amount of urea fertilizer (The Daily Sun, 2017). Regionalization is the process of delineating regions. (Glasson, 1974). There are two ways for formal region delineation; the composite Index Method is used as there are five factors considered (Glasson, 1974). By using this method 64 districts of Bangladesh have been classified into 5 categories. Those categories are divided based on the relation between intensity of Agricultural Production and the use of Chemical Fertilizer.

To analyses the agriculture production five common cereal crops (Rice: Aus, Aman, Boro, Potato, Rape and mustard) and chemical fertilizer (TSP, UREA, MP, DAP, others) have been selected as these are most common and their data is available in 64 districts. The objective of the study is to delineate regions basis of the relation between intensity of Agricultural Production and the Use of Chemical Fertilizer.

2. Literature Review

This research is based on several published literatures (journal papers, book), newspapers, and reports from different governmental and non-governmental organizations. This research study underlines the needs to search more literatures about the actual situation of different nutrient status, social, cultural and environmental situation in Bangladesh. The fertilizer recommendation facility at farmer level based on laboratory soil test analytical data is still inadequate. While the farmers of Bangladesh have realized the importance and benefits of fertilizer recommendation during crop cultivation because the natural soil fertility of Bangladesh is reducing rapidly hampering crop productivity and yield apart from environmental degradation. In Bangladesh, most of the demand for fertilizers is fulfilled by imports. Recently Bangladesh Chemical Industries Corporation (BCIC) has signed an agreement with Saudi Arabia Basic Industries Corporation (SABIC) to buy 0.5 million metric tons of urea fertilizer in 2017. This will also open the door for concessions to supply DAP fertilizer to Bangladeshi market (The Financial Express, 2017). In these circumstances, increase of balanced and or recommended fertilizer uses by soil testing for farmers with support of SRDI and Dept. of Extension, Bangladesh, could contribute in resource use efficiency and more economic return from cultivated crops. There are several saline affected districts in Bangladesh such as Satkhira, Khulna, pirojpur, Barguna, Patuakhali, Noakhali and Cox's Bazar; these areas are relatively flat and suffer inundation by saline water to different degrees. Agricultural production constraints due to salinity, i.e., soil and water salinity, high

flooding depth in monsoon season, late draining, heavy soil consistency, poor soil fertility status, high osmic pressure causing reduction in absorption in water and nutrients, poor soil structure and cyclonic storm surges (FRG, 2012). Glasson (1974) introduced composite index method to delineate the region depending on some defined factors. Previously there has been no research work done on the basis of the impact of chemical Fertilizer use on agricultural food production in Bangladesh. That's why we are interested of this research. This research also suggests possible initiatives for agricultural development on the basis of the study.

3. Methodology

The study aims to form a formal region on the basis of fertilizer use to know the condition of agriculture production in Bangladesh. Five factors of chemical fertilizer (UREA, TSP, MP, DAP, Others) and other factor of cereal crops for agricultural production (Rice: Aus, Aman, Boro; Potato, Rape and mustard) are considered for delineate region. All these five variables are positively correlated. Data collected from Bangladesh Bureau of Statistics (BBS) has been input in Excel sheet to calculate the composite score of these factors. Weight of each variables of different district are calculated by the formula,

$$W_n = \frac{\text{Mean of Log}_{10}(X_n)}{\text{Standard Deviation of Log}_{10}(X_n)}$$

[Where n=1, 2, 3, 4, 5]

$$W_i = \sum W_i x_i$$

Then total weight of each districts which is denoted as W, are calculated by the following formula,

$$W_n = \frac{\log_{10}(x_1) \times W_1 + \log_{10}(x_2) \times W_2 + \log_{10}(x_3) \times W_3 + \log_{10}(x_4) \times W_4 + \log_{10}(x_5) \times W_5}{w_1 + w_2 + w_3 + w_4 + w_5}$$

The value of each district indicates the weight of the districts with respect to its influencing factors. Using this formula the composite score for each district has been calculated. Then for determining class interval three methods named Equal Class Interval Method, Mean Standard Deviation Method and Arithmetic Mean method are used.

After calculating and analysing the skewness and Kurtosis of classification we obtained this method, the histogram of Chemical Fertilizer, Equal interval method has been proved to normal distribution that's why we adopted this for further analysis. In Equal Class Interval Method gives the skewness value nearest to zero. The value -0.627 means that there is a very little negative skewness. This value is more acceptable than other two methods (-1.510 from Mean standard Deviation method and -0.968 from Arithmetic Method). So, using Equal Interval Method, We can form the formal regionalization. Again the histogram of agricultural food production, Arithmetic mean method has been proved closer to normal distribution and the Arithmetic Method gives the skewness value nearest to zero. The value -0.049 means that there is a very little negative skewness. This value is more acceptable than other two methods (-0.181 from Mean standard Deviation method and -0.166 from Equal Interval Method). So using Arithmetic Method, the formal regionalization can be formed.

4. Result and Discussion

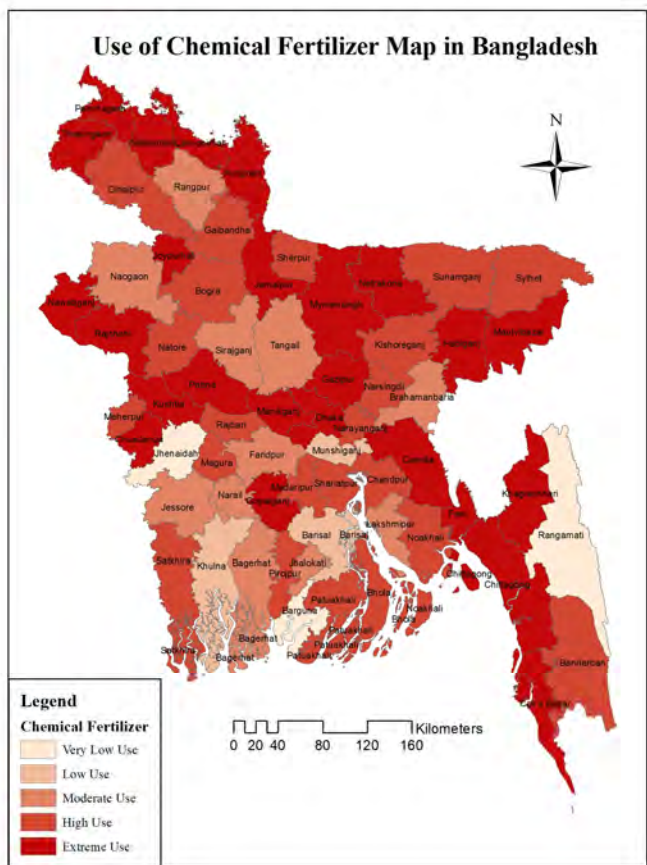
Total 64 districts of Bangladesh were divided into four agricultural region in this study on the basis of combined chemical fertilizer index and composite score. The considered five classes have been grouped as Very low use, Low use, Moderate use, High use and Extreme use regions. Table 1 shows a detailing of the agricultural regions.

Table 1: Districts in different attributes in Chemical Fertilizer

Range of Composite Score	Attribute	Frequency	District Name
2.85-3.22	Very low use	3	Rangamati, Jhenadah, Barguna
3.23-3.60	Low use	3	Khulna, Barisal, Munshiganj
3.61-3.98	Moderate use	22	Dinajpur, Gaibandha, Bogra, Nator, Meherpur, Magura, Rajbari, Shariatpur, Chadpur, Potuakhali, Bogra, Bhola, Nohakhali, Sunamganj, Sylhet, Kishorganj, Narsindi, Pirojpur, Satkhira, Bandarban, Sherpur, Narayanganj,
3.99-4.46	High use	25	Panchagar, Thakurgaon, Nilphamari, Lalmonirhat, Kurigram, Joypurhat, Jamalpur, Mymensing, Netrakona, Gazipur, Pabna, Kustia, Rajshahi, Nawabganj, Chuadanga, Gopalganj, Manikganj, Dhaka, Comilla, Feni, Khagrachari, Chittagong, Cox's Bazar, Habiganj, Maulivbazar
4.37-4.75	Extreme use	11	Rangpur, Naogaon, Sirajganj, Tangail, Brahmanbaria, Lakhimpur, Faridpur, Narail, Jessore, Jhalokathi, Bagherhat,

(Source: Authors' Preparation, 2019)

The map illustrates in Figure 1:



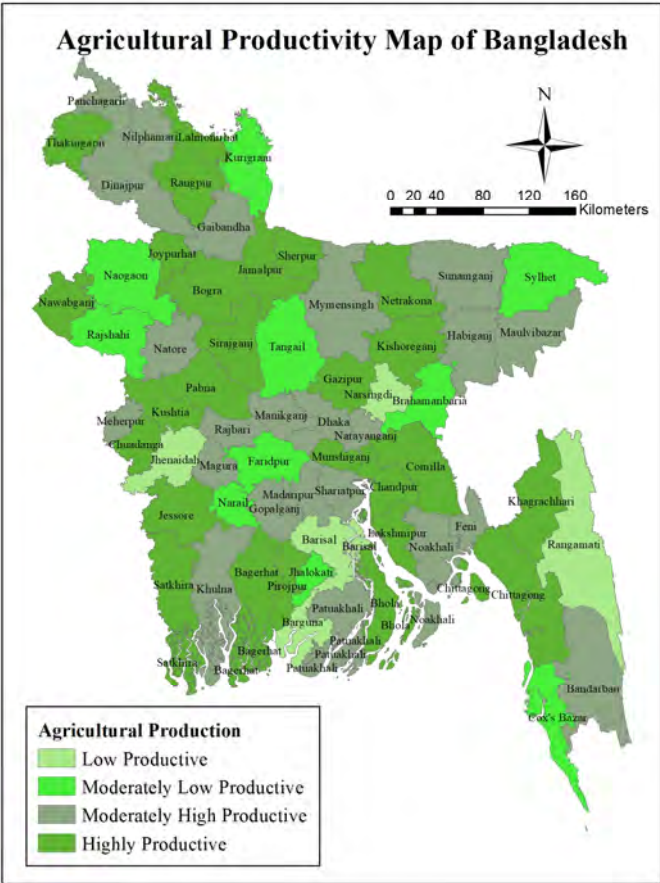
(Source: Authors' Preparation, 2019)

Figure 1: Chemical fertilizer use Map in Bangladesh

Table 2: Agricultural Regionalization Based on Productivity for Bangladesh

Range of Composite Score	Attribute	Frequency	District Name
3.89-4.29	Low productive	5	Barisal, Barguna, Jhenaidah, Narsingdi, Rangamati
4.30-5.11	Moderately low productive	23	Panchagarh, Nilphamari, Dinajpur, Gaibandha, Meherpur, Natore, Mymensingh, Sunamganj, Habiganj, Maulovibazar, Magura, Rajbari, Manikganj, Dhaka, Narayanganj, Gopalganj, Madaripur, Shariatpur, Khulna, Patuakhali, Noakhali, Feni, Bandarban
5.12-6.34	Moderately High productive	26	Thakurgaon, Lalmonirhat, Rangpur, Chapainawabganj, Joypurhat, Bogra, Chuadanga, Kushtia, Pabna, Shirajganj, Jamalpur, Sherpur, Gazipur, Kishoreganj, Netrakona, Jessore, Satkhira, Bagerhat, Pirojpur, Munshiganj, Chandpur, Comilla, Lakshmipur, Bhola, Khagrachari, Chittagong
6.35-7.98	Highly productive	10	Kurigram, Sylhet, Naogaon, Rajshahi, Tangail, Brahmanbaria, Faridpur, Narail, Jhalokati, Cox's Bazar

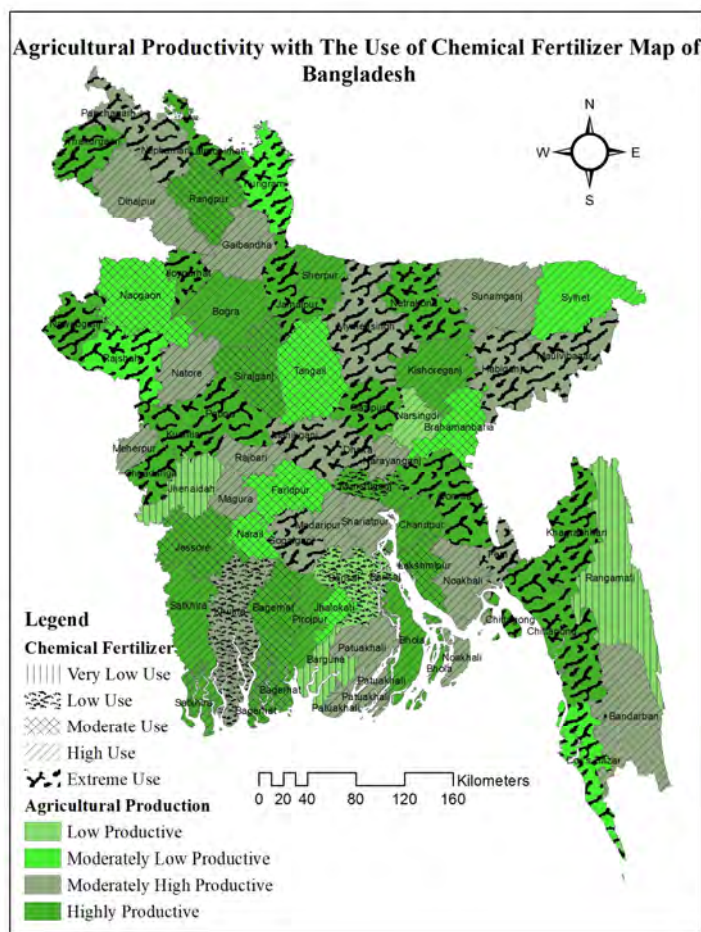
The map illustrates in figure 2.



(Source: Authors' Preparation, 2019)

Figure 2: Agricultural Productivity Map for Bangladesh based on cereal crops production

Regionalization map of Bangladesh under categories of two sector; Chemical fertilizer and agricultural cereal crops production are merged and is presented as following with different colours and Symbol.



(Source: Authors' Preparation, 2019)

Figure 3 Map of Relation between intensity of Agricultural cereal crops Production and the Use of Chemical Fertilizer.

The subcategories from both sector is presented on table.

Table 3: Districts in Different attributes in Agricultural cereal crops Production on the basis of chemical fertilizer use

Attribute	Frequency	District Name
High Fertilizer Use and Highly Productive	42	Panchagarh, Nilphamari, Mymensingh, Habiganj, Maulovibazar, Dhaka, Manikganj, Gopalganj, Feni, Thakurgaon, Lalmonirhat, Joypurhat, Nawabganj, Jamalpur, Netra kona, Chuadanga, Kushtia, Pabna, Gazipur, Comilla, Khagrachari, Chittagong, Bogra, Sherpur, Kishoreganj, Chandpur, Satkhira, Pirojpur, Bhola Dinajpur, Gaibandha, Natore, Meherpur, Sunamganj, Narayanganj, Rajbari, Magura, Madaripur, Noakhali, Shariatpur, Patuakhali, Bandarban

High Fertilizer Use but low Production	5	Rajshahi, Kurigram, Cox's Bazar, Sylhet, Narshingdi
Moderate Fertilizer Use and Highly Productive	5	Jessore, Bagerhat, Lakshmipur, Sirajganj, Rangpur
Moderate Fertilizer Use and low Productive	6	Jhalikathi, Narail, Faridpur, Brahmanbaria, Tangail, Naogaon
Low Fertilizer use but High Production	2	Khulna, Munshiganj
Very Low Fertilizer Use and low Production	4	Rangamati, Borguna, Jhenaidah, Barisal

We are particularly focusing the highlighted districts in the above table.

Highly Productive Region

Panchagarh, Nilphamari, Mymensingh, Habiganj, Maulovibazar, Dhaka, Manikganj, Gopalganj, Feni, Thakurgaon, Lalmonirhat, Joypurhat, Nawabganj, Jamalpur, Netrakona, Chuadanga, Kushtia, Pabna, Gazipur, Comilla, Khagrachari, Chittagong, Bogra, Sherpur, Kishoreganj, Chandpur, Satkhira, Pirojpur, Bhola, Dinajpur, Gaibandha, Natore, Meherpur, Sunamganj, Narayanganj, Rajbari, Magura, Madaripur, Noakhali, Shariatpur, Patuakhali, Bandarban Districts are highly productive regions for agricultural production as being high fertilizer use. Due to high agricultural productivity of the districts of the country has always received a priority for expenditure on agricultural sector of the government. Districts like Dhaka, Comilla, and Dinajpur which are divisional headquarters. They have better infrastructure and communication system for agricultural improvement (LGED, 2013). For this, they have higher level of production. High productivity of Naogaon, Dinajpur, can also be attributed by presence of rice mill encouraging farmer's rice production (The Daily Star, 2011). Kushtia and Thakurgaon has also potentiality for Rice production.

Low Productive Region

Around 4% districts are in low productive region. Rangamati, Borguna, Jhenaidah, and Barisal these districts are low productive region as fertilizer use is low. Rangamati is hilly area which is unsuitable for agricultural production (LGED, 2013)

High Fertilizer Use but low Productive Region

From the analysis we can see that Rajshahi, Kurigram, Cox's Bazar, Sylhet, and Narshingdi are low productive region for agricultural production in spite of using high chemical fertilizer. In Cox's Bazar Rice: Aus, Aman, Boro; Potato, Rape and mustard are equally low production proportionally comparatively other districts though the amount of fertilizer use is high. There may be other reason behind this, as this districts is near to sea level and soil fertility is not as good for good production as saline soil is present there. In this region excess amount of saline soil is present. Due to closeness to Bay of Bengal, this district is the worst victim of

the hurricane, typhoon, cyclone etc. For these kind of natural disasters local agriculture have a negative impact. Another reason for low productivity in this region is low expenditure in the agriculture sector of Government (World Bank, 2013). In Rajshahi region the organic matter status of soil is very low <1.0%, Nur Muhammad Mondal, Joint Director (Fertilizer) of BADC, said soil fertility in the region has gradually been decreasing with intensified crop production, high-yielding crop varieties and an over dependency on chemical inputs. During the last couple of decades, food grain production has considerably increased due to substantial intensification of cropping, introduction of high yielding varieties and expansion of irrigated area and use of chemical fertilizers. Nur Muhammad added that integrated nutrient management has become an urgent need for sustaining crop productivity and improvement of soil fertility through overcoming the constraints in the region (Green Watch news). As Sylhet has dominance of hilly topography, crop production is relatively low than other districts. Among the seven haor districts under consideration, in the haor areas of Sunamgonj, Kishoregonj, Sylhet and Hobigonj, rice is not grown in Aus season. (DAE, 2007). Area coverage under different crops by season in the haor areas rice (Aus, Aman, Boro) production rate is average low than other haor areas. That's why though being high fertilizer use, production rate is low in this region (DAE, 2007). Kurigram is flood prone area, farmer can't not harvest properly because of flood. Maximum agricultural land become flooded during heavy rain. That's why the average agriculture food production is low though being use of high chemical fertilizer.

Low Fertilizer use but highly productive region

Khulna, Munshiganj are the best for production though being use low fertilizer. Munshiganj alone produce about 34 percent of the country's potato, according to the Agriculture Extension Department (AED) of the district. Potato production is the factor behind highest production of this region. Another districts highly productive but low fertilizer use is Khulna. Khulna consists of both saline and non-saline ecosystem. Agriculture of this region is mainly dominated by rice and fish. In Khulna most of the area about 63% is covered by exclusive rice-based cropping pattern. (BBS, 2014-15). In spite of being prone to salinity intrusion and natural disaster, they have high level of production. It is because the characteristics of this district Ganges Tidal Flood Plain Agro ecological zone which provide higher level of fertility due to alluvial characteristics of land which is suitable for agricultural production (Quddus, M.A. 2009).

5. Conclusion

From the research it is clear that all districts are not equally well off. The main reasons behind inequality are the lack of fertility of land, topographic variation, inadequate infrastructure facility like fertilizer warehouse etc. Due to uneven distribution of crop production, crucial result is dependency of the low productive districts on the higher productive districts. Agriculture plays a key role in the overall economic performance of Bangladesh not only in terms of its contribution to GDP but also as a major source of foreign exchange earnings and in providing employment to a large segment of the population, particularly the poor. From analysis we can see that 40% area is good for agriculture production under high fertilizer use and 4% districts are low for agriculture production with 8% high fertilizer use. Exceptional districts are also seen in different condition. In our research we can see that some districts are low for agriculture production though high fertilizer use and some districts are best for production with low fertilizer use. There may be reason for soil, weather and other factor. But we didn't go so far in our research. So there remains a great scope for further research. Fertilizers play an essential role in increasing crop yields, although, fertilizer marketing and distribution system are weakly organized. The crisis is more emphasized due to the time impressibility of fertilizer application. Fertilizer factory

at every Upazila level can meet up the total demands of fertilizer throughout the country. In these circumstances, increase of balanced and or recommended fertilizer uses could contribute in resource use efficiency and more economic return from cultivated crops. Information in this research would be helpful to serve as an intermediate between intensity of fertilizer use and agriculture production.

6. Reference

- Annonomous. (2012), Fertilizer recommendation guide, Bangladesh Agricultural Research Council
- AgroXpertus. B, (2014), BLGG AGROXPRTUS, from- <http://blgg.agroxpertus.nl/>
- Basak. J. K, (2010), Future fertilizer demand for sustaining rice production in Bangladesh Department of Agricultural Extension, (2007), Field Crops Wing, Khamarbari, Farmgate, Dhaka, Department of Agricultural Extension
- FRG, (2012), Fertilizer Recommendation Guide, Bangladesh Agriculture Research Council, pp 275, Farmgate, Dhaka
- Glasson. J, (1975), An Introduction to Regional Planning, London, Hutchinson and Co Ltd
- LGED, (2013), <http://www.lged.gov.bd/Default.aspx> accessed on 29-10-2013
- (2011), Population and Housing Census, Dhaka: Bangladesh Bureau of Statistics
- Quddus. M. A, (2009), Crop Production Growth in Different Agro-Ecological Zones of Banglad1esh, Vol: 7(2), pp: 351-360, Journal of Agricultural University
- Singh. J, Dhilon. S.S, (2004), Agricultural Geography, India: Tata McGraw-Hill Education
- Society for Environment and human Development, (2012), Bangladesh: Land, Forest and Forest People, from- <http://www.sehd.org/publications/adivasis-andforests/29-bangladesh-land-forestand-forest-people>.
- The Financial Express Bangladesh, (2017), from- www.thefinancialexpress-bd.com/2017/03/08/63786/Bangladesh,-SaudiArabia-sign-agreement-to-buy-urea-fertilizer.
- The Daily Sun, (2017), retrieved from- www.dailysun.com/printversion/details/215525/Govt-to-set-up-13-buffer-fertiliser-warehouses-
- The Daily Star, (2011), from <http://archive.thedailystar.net/newDesign/news-details.php?nid=206220> accessed on 30-10-2013.
- World Bank, (2018), Poverty Assessment in Bangladesh: Creating Opportunities and Bridging East-West Divide, from <http://siteresources.worldbank.org/BANGLADESHEXTN/Resources/2957591240185591585/BanglaPD.pdf> accessed on 28-10-2013.