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Estimation of Soil Nutrients Transport from Rural to Urban Areas through Food Consumption in Bangladesh

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ABSTRACT

Soil nutrients move from soil to elsewhere through several processes. The present study is based on secondary data sources to estimate how much soil nutrient was transported from rural to urban areas through food consumption of urban people in Bangladesh. Nine soil nutrients such as N, P, K, Ca, Mg, Fe, Cu, Zn and Na and about 15 food items were considered to estimate how much soil nutrient was transported through consumption. Rural areas are the major sources of foods transported from local land to cities to meet growing food demands of urban dwellers. Annually around total 332883 t nutrients were moved from rural to urban areas through food of urban people. The consumption of macronutrients was more than those of micronutrients. The movement of N (224135 t yr-1) was nearly twice to other nutrients, among them crops contributed to remove 141444 t N. Among other macronutrient, the maximum amount of N (79192 t) was moved through rice. Fish removed 45193 t N which was 8000 t more compared to livestock. Around 24712, 50766, 17807, 9118 t P, K, Ca and Mg removed annually by food respectively. The movement of micronutrient was 402, 58, 238 and 5644 t from Fe, Cu, Zn and Na respectively. This continuous nutrient movement process is causing rural soil nutrients loss and needs attention from policy makers and scientists.

Keywords: Food consumption, nutrient movement, rural agriculture, soil nutrients, urban people

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INTRODUCTION

Soil nutrient is an inevitable part of plant growth and food production sources in nature. Nutrient recycling is a dynamic process that goes from one state to another. It can be lost from soil by different natural and manmade processes. Besides different natural processes the losses of soil nutrients through human activities are also prominent. Human induced losses occur through several steps such as during harvesting, food chains, postharvest operations, soil and crop management practices and wastage etc. The

postharvest damage of rice around 937462.34 MT was the highest among other foods and in total it was around USD 400 million [1]. The ultimate nutrient moved through food in a natural food cycling process. Urban dwellers are mostly dependent on rural people for crops, livestock and fisheries which are transported in the city to meet up food demands. Global population has been shifting from rural to urban areas over the past 200 years and increasing urban dwellers day by day [15]. After that, a huge amount of nutrients are moved by urbanization through foods and residues. This urbanization process compels moving huge amounts of nutrients, which aggravated local soil status day by day and promoted nutrient deficiencies for improper soil amendment practices. Food transportation process is constantly creating nutrient depletion in growing soil for increasing crop yield potentiality with application of over doses of nitrogenous fertilizer hampering sustainable crop production [6]. The nutrient deficiency, especially micronutrient depletion, is less in developed countries compared to developing ones, which is a global threat for sustainable food production.

Continuous food supply from rural to urban areas is dumping in soil, small scale, actually organic parts of it. And, the majority of them remain as waste products rather than being incorporated into soil to enrich soil organic matter. It is a fact that thousands of tons of nutrients are left in urban areas as waste disposal rather than being incorporated into soil and other usages. Waste disposal is mainly organic, ranging from 50-80% in the world. In low-income countries 40-85% organic waste is generated which is 20-50% in industrialized countries. In South Asia, it is close to 67% which could be used to produce 0.20-0.25 t of high-quality compost to replenish soil organic matter [4]. Besides these, animal wastage could produce 40-80 cubic meters of biogas. Nearly 3000 urban citizens could be benefitted from usage waste disposal [4]. In Bangladesh, organic waste is recycled, to some extent, for making compost [8] and generating energy yearly around 481.6 MW [2].

Estimation of soil nutrient movement through food intake would become a new walk for addressing these problems. The study is given emphasis on how much soil nutrients are transported to the cities through agricultural foods intake by the urban dwellers, which all come from soils of rural areas.

MATERIALS ANDMETHODS

The study was carried out from January to December in 2019. Data used in the study were taken from secondary sources. The amount of food intake from selected 15 items by the urban people was considered as nutrients estimation sources. According to the United Nations [14], the population of Bangladesh was 162951560 in 2016. Urban population (UP) was 35.035% (out of total population) which was approximately 57090079 in 2016 [16]. Selected 15 foods were taken from crops, livestock and fishery subsectors to estimate the amount of nutrients transported through food consumption of urban population. They were rice, wheat, potato, lentil, grass pea, other pulses, pulses, vegetables, leafy vegetables, edible oils, mustard oils, soybean, other oils, onion, chili, other spices, condiments and spices, fruits, sugar/jaggery, beef, mutton, chicken/duck, meat, egg, milk products and different fish products. The nutrient compositional value of nitrogen, phosphorus, potassium, calcium, magnesium, iron, copper, zinc and sodium were taken from the Food Composition Table for Bangladesh as FCTB [12]. The FCTB was performed through the analyses of nationally representative samples of key foods together with the collection of secondary data from all relevant sources and borrowing of values from missing data from reliable and relevant databases from outside of Bangladesh. The sum nutritional values for each nutrient were considered separately for each food item. A short description of 15 food items was described in Tables 1 (crops) and 2 (livestock and fish). The data were analyzed by the Microsoft Excel program.

Table 1: Common food items with available varieties or species from crop sectors

Common food item	Varieties/Species
Rice	BR3, BR11, BR16, BR26, BRRI dhan28, BRRI dhan30 and BRRI dhan40

Wheat	Brown wheat flour and wheat grains
Potato	Raw diamond potato
Pulses	Lentil, grass pea, other pulses (Bengal gram, black gram, green gram and pea)
Vegetables	Amaranth stem, bean scarlet runner, bean seeds and pods, purple brinjal, broad bean, cabbage, carrot, cauliflower, green chili, cucumber, drumstick, ash gourd, bitter gourd, bottle gourd, pointed gourd, ridge gourd, snake gourd, sponge gourd, teasel gourd, okra, papaya, pumpkin, radish, green and red tomato and turnip
Leafy vegetables	Leaves of agathi, alligator, amaranth sps., dock, beet green, bengal day flower, bitter gourd, bottle gourd, bugle, cassava, colocasia sps., cowpea, dima, drumstick, ferns, indian spinach, jute, pumpkin, radish, spinach and sweet potato
Edible oils	Mustard, soybean and palm oil
Other oils	Salted butter, cotton seed, fish oil, clarified butter of cow and vegetables, margarine, salted mayonnaise, pea nut and sesame
Condiments and spices	Onion, chili, other spices (Bayleaf, cardamon, ground cinnamon, cloves, raw coriander leaves, dry coriander seed, cumin seeds, fennel seeds, fenugreek seed, raw ginger, raw indian penny wort, raw lemon grass and peel, ground mace, nutmeg, black pepper, poppy seeds, fresh pearmint leaves and turmeric)
Fruits	Apple, asian pears, banana, bread fruit, bullocks heart, carambola, custard apple, dates, elephant apple, emblic, fig, green grapes, green guava, hogplum, jackfruit, jambolan, jambos, java apple, jujube, lemon, sweet lime, lichi, mango (fazli and langra), melon, monkey jack, musk melon, orange, cotyledon and pulp of palmyra palm, papaya, pomegranate, pineapple, persimmon, pomelo, tamarind, watermelon and wood apple
Sugar/Gur	White sugar, brown sugar, date palm and nolenjiggery

Table 2: Common food items with available varieties or species from livestock and fish

Common food items	**Varieties/Species**
Meats	Beef meats: Beef liver, boneless and fatless beef or with 15-20% fat and beef mince
	Mutton meat: Moderately fat and liver of lamb/mutton
	Chicken/duck meats: Chicken breast-leg (without skin)-liver and duck meat
	Others: Buffalo, goat (lean) and pigeon pea meats
Eggs	Eggs from household and farmed sources
Milk products	Low fat fluid butter milk, cheese at 25% fat, sweetened curd by whole milk, buffalo milk at whole fat, cow milk, goat milk and payasam
Fish	Dried and fresh *Stolephorusindicus*, *Puntius*sps., *Labeobata*, *Wallagoattu*, *Notopterusnotopterus*, *Anchariusfuscus*, *Labeocalbasu*, *Labeocatla*,*Parambassisranga*, *Anabas testudineus*, *Chitalaornata*, *Cyprinuscarpio*, *Protonibeadiacanthus*, *Mystusbleekeri*, fish ball (cooked), dorsal and ventral skin of *Labeorohita*, *Labeocatla* and *Cirrhinuscirrhosus*, *Coricasoborna* fry, *Ailiacoila*, *Mystuscavasius*, *Sperataseenghala*, dried *Anabas testudineus*, *Pomatoschistusmicrops*, *Trichogasterfasciata*, *Tenualosailisha*, *Gudusiachapra*, *Leptomelanosomaindicum*, *Scomberomorusguttatus*, *Labeogonius*, *Sperataaor*, *Rastrelligerkanagurta*, dried and fresh *phoxinus*, *mola*, *Cirrhinuscirrhosus*, *Liza argentea*, *Margaritiferamargaritifera*, *Pangasiuspangasius*, *Percafluviatilis*, raw and fresh *Pampus*sps., prawn sps., *Labeorohita*, *Hypophthalmichthysmolitrix*, *Strongylura marina*, *Channapunctata*, *Heteropneustesfossilis*, *Campostomaanomalum*, *Channastriata*, *Oreochromis* sp., tuna and *Clariasbatrachus*

The daily food intake by per head urban people was converted into annual food intake by total UP (Table 4).

Equation 1:

$$\text{Annual total each food intake by UP (t/yr)} = \frac{\text{Daily food intake by per capita UP (g/day)} \times 365 \times 57090079}{1000000}$$

Here,

Total urban population = 57090079, 1 year = 365 days, 1000000 = Daily food intake by urban peoples (g/day) to ton/yr

After that, Equation 1 was multiplied with 'Table 3'to find protein and other nutrients' movement, except N. The nutrient conversion factor (Table 3) was used to estimate the amount of soil nutrients (macro and micro) transported through food of UP presented in Tables 5 and 6.

Equation 2:

$$\text{Nutrient intake by total UP (t/yr)} = \frac{\text{Annual total each food intake by UP (t/yr)} \times \text{Nutrient conversion factors}}{100}$$

Here, 100 = Protein (g) per 100 g

Equation 3:

$$\text{N intake through food of total UP (t/yr)} = \frac{\text{Protein intake by TUP (ton /yr)}}{\text{N conversion factor}}$$

Here, 'The protein: N conversion factor' for rice, wheat, milk products and rest other food items was 5.95:1, 5.83:1, 6.38:1 and6.25:1[7].

Table 3: Nutrient conversion factors of different food items from crops

Food Items	Conversion factors								
	Protein	**Phosphorus (P)**	**Potassium (K)**	**Calcium (Ca)**	**Magnesium (Mg)**	**Iron (Fe)**	**Copper (Cu)**	**Zinc (Zn)**	**Sodium (Na)**
	(g/100g)	**mg/100 g of each food items**							
Rice	7.14	127	146.86	2.86	43.29	0.7	0.2	1.35	2
Wheat	11.25	311	288.5	46.5	146.5	4.9	0.615	2.905	17
Potato	1.2	40	286	11	21	0.5	0.43	0.79	16
Pulses	24.15	335.34	907.17	92	122.67	5.87	1.11	3.1	31.5
Vegetables	1.72	35.73	181	34.2	20.89	0.9	0.24	0.44	25.70
Leafy vegetables	3.65	48.43	347.50	222.58	72.81	4.15	0.17	0.53	47.5
Edible oils						0.03		0.0034	
Other oils	0.3	8.56	11.45	5.11	0.89	0.1	0.0078	0.057	189.89
Condiments and Spices	8.47	205.72	831.39	431.24	163.96	12.77	0.65	2.47	54.43

Fruits	**1.009**	**28.03**	**253.08**	**28.53**	**21.72**	**0.69**	**0.157**	**0.27**	**7.97**
Sugar/Gur	0.575	37.5	73.75	138.5	30.5	0.45	0.218	0.05	21
Meat	20.136	236.63	288.543	10.688	23.168	3.075	1.465	3.299	61.312
Egg	15	229	149	55	15.5	2	0.232	2.008	134.67
Milk products	9.585	249.461	342.385	336	28.616	0.262	0.0516	1.467	145.692
Fish	19.96	293.57	313.43	346.56	32.09	1.68	0.16	1.06	80.88

RESULTS

According to BBS [3], daily food intake by urban people with annual food intake by them is given in Table 4. Rice is the staple food in Bangladesh so it is the highest consumed over other food items. The average intake of rice is 316.70 g per urban person per day. Annual rice consumption of total urban people was around 6599356 t. Urban people consumed 174.06 g vegetables per person per day and annual vegetables consumption was around 3627041 t by total urban people. The daily consumption of meat, milk and milk products were the same (30.04 g/day) and their annual consumption was around 625970 t/yr by UP. Urban people intake 67.91 g fish per day and annually it was 1415100 t.

Table 4: Estimation of food intake by the urban people of Bangladesh from crops, livestock and fish sectors

Items	**Daily food intake by each urban people (g/day)**	**Annual food intake of each items by UP (t/year)**
Rice	316.70	6599356
Wheat	26.22	546369
Potato	62.01	1292157
Pulse	16.88	351743
Vegetables	174.06	3627041
Leafy vegetables	36.3	756415
Edible oils	29.57	616176
Other oils	0.1	2084
Condiments & spices	69.3	1444065
Fruits	45.23	942497
Sugar/Gur	7.57	157743
Meat	30.04	625970
Egg	15.85	330280
Milk and milk products	30.04	625970
Fishes	67.91	1415100

The annual total N was 224135 t transported from rural to urban areas by food consumption of urban people (Table 5). These were estimated from crops (141444 t/yr), livestock (37498t/yr) and fish (45193 t/yr). The nitrogen 79192 t/yr was the highest consumed element in comparison to others through rice intake. Wheat grain removed around 10543 and 1699 t/yr of N and P respectively after consumption of rice.

Yearly around 24712.18 t total P was transported from rural to urban areas through foods. The crops, livestock and fish were contributed 16750.18, 3802 and 4160 t/yr P respectively. Consumption of rice transported the highest phosphorus was of 8381 t/yr than that of other foods.

The total estimated K was 50766.239 t/yr transported from rural to urban areas through foods. The yearly transported K through crops, livestock and fish were 41879.239, 4444 and 4443 t, respectively. The

highest annual consumed potassium was 12015 transported through condiments and spices.

Table 5: Estimation of macronutrients intake by urban population of Bangladesh from crops, livestock and fish

Food items	Macronutrient intake by urban population (t/yr)				
	Nitrogen (N)	Phosphorus (P)	Potassium (K)	Calcium (Ca)	Magnesium (Mg)
Rice	79192	8381	9701	191	2851
Wheat	10543	1699	1579	254	800
Potato	2481	517	3696	142	271
Pulse	13591	1178	3190	324	431
Vegetables	9982	1306	6565	1233	762
Leafy vegetables	4417	371	2632	1687	552
Other oils	1.00	0.18	0.239	0.107	0.019
Condiments & spices	19570	2975	12015	6224	2368
Fruits	1522	264	2385	270	207
Sugar/Gur	145	59	116	218	48
Subtotal crops	141444	16750.18	41879.239	10543.107	8290.019
Meat	20167	1484	1809	69	145
Egg	7927	756	492	182	51
Milk and milk products	9404	1562	2143	2103	179
Subtotal livestock	37498	3802	4444	2354	375
Fish	45193	4160	4443	4910	453
Total	224135	24712.18	50766.239	17807.107	9118.019

The annual total transported Ca was 17807.107 t. Among them the crops, livestock and fish contributed10543.107, 2354 and 4910 t/yr, respectively. Condiments and spices transported the highest Ca were 6224 t/yr. Annually around 9118.019 t Mg was transported through foods from rural to urban areas. And, among them annually around8290.019, 375 and 453 t were transported through crops, livestock and fish, respectively. The highest transported Mg of 2851 t/yr was estimated from rice. Among 402.159 t annual total estimated Fe; crops, livestock and fish were transported at356.857, 21.302 and 24 t, respectively (Table 6). The highest consumed Fe of 185 t was transported annually through condiments and spices. The annual total estimated Cu was 58.278 t transported through crops, livestock and fish at 45.535, 10.479 and 2.264 t, respectively. Rice contributed the highest volume annually of 13.20 t Cu. Annually total Zn was 238.82 t transported through crops, livestock and fishwere186.82, 36 and 16 t, respectively. And, yearly 92.39 t Zn was transported through rice intake. The estimated Na 5644.93 t was yearly transported from rural to urban areas through food intake. It was transported through crops, livestock and fishat2753.93, 1745 and 1146 t/yr, respectively. The highest consumed Na of 1146 t/yr was transported through fish.

Table 6: Estimation of micronutrients intake by urban people of Bangladesh from crops, Livestock and fish (t/yr)

Food items	Micronutrients intake by urban people (t/yr)			
	Iron (Fe)	**Copper (Cu)**	**Zinc (Zn)**	**Sodium (Na)**
Rice	46	13.20	92.39	132
Wheat	27	3.28	16	93
Potato	6.46	5.17	10	207
Pulse	20	3.87	11	111
Vegetables	33	7.26	15	943
Leafy vegetables	32	1.513	3.78	363
Edible oils	0.185		0.021	
Other oils	0.002	0.00016	0.00119	3.93
Condiments & spices	185	9.39	36	794
Fruits	6.5	1.508	2.55	74
Sugar/Gur	0.71	0.344	0.079	33
Subtotal crops	356.857	45.535	186.82	2753.93
Meat	19	9.39	20	388
Egg	0.661	0.766	7	445
Milk and milk products	1.641	0.323	9	912
Subtotal livestock	21.302	10.479	36	1745
Fishes	24	2.264	16	1146
Total	402.159	58.278	238.82	5644.93

In total annually around 332882.732 t nutrients were moved from rural to urban areas through foods (Table 7). The movement of nitrogen was higher than others, which was chronologically followed by potassium, phosphorus, calcium, magnesium, sodium, iron, zinc and copper.

DISCUSSION

An urban person intakes 19332966 g foods per year from crops, livestock and fish, which come from the rural areas to fulfill food requirement of urban population. Moreover, organic food waste is crucial to adorn soil health whereas annually around 3 lakhs t soil nutrients were transported through foods from 57090079 urban people. Moreover, continuous food supply from rural areas for consumption of urban people creates a negative impact on soil fertility in Bangladesh where a few soil amendments are taken to nourish local soil status. The results are true for Africa with all developing countries increasing soil degradation that threatens long-term food production stated by Sanchez and Sheldrick et al. [11, 13]. In the globe around 13×108 t food waste is produced annually. And, 30% is lost or wasted along the food supply chain, whereas in Bangladesh it is 24×106 t from only urban areas stated by Ananno et al. [2].

The estimated transported nitrogen was two thirds of total nutrient elements and movement of macronutrients was higher than micronutrients. The following finding is contradicted, to some extent, with the statement of Robert et al. [9] who found that nutrient harvest index of N and P was more than 75% of total nutrient removed by harvested crops, whereas it was less than 50% in case K and micronutrients. But the result strongly supports the finding of Hossain [5] who explained that harvested crops removed more macronutrients than micronutrients. Nitrogen (10543 t/yr) removed through wheat grain's intake by UP was around 6 times higher than phosphorus (1699 t/yr), which is strongly agreed with the result of Sahota [10] explained that wheat grain removed around 28 kg/MT of N, whereas P was only 4.6 kg/MT. On the other hand, the transportation rate of two major nutrients P and K varied from food to food. The total transported K of 50766.239 t was double than P, but it was four times less than N transportation. In case of micronutrients, the removal rate of Fe was higher through foods than Zn and Cu. The results contradict with Sahota [10] who revealed that wheat grain removed more Zn 49 g/MT than other micronutrients. On the contrary, the present findings agree with Hossain [5]. He proved that the highest value was 0.33 kg/ha Fe removed by corn and it was followed by Zn, Mn and Cu.

Table 7: Grand total nutrient elements transport through crops, livestock and fish by urban population in Bangladesh (t/yr)

Name of the nutrient elements	Total nutrient element (t/yr) transport
Nitrogen (N)	224135
Phosphorus (P)	24712.18
Potassium (K)	50766.239
Calcium (Ca)	17807.107
Magnesium (Mg)	9118.019
Iron (Fe)	402.159
Copper (Cu)	58.278
Zinc (Zn)	238.82
Sodium (Na)	5644.93
Grand total nutrients	332882.732

CONCLUSION

Soil nutrient moved through foods is a major concern for sustainable crop production. It is an emphasizing fact that yearly over 300 thousand t of nutrient shifted from rural to urban areas to fulfill food requirements, whereas nitrogen is nearly two-thirds of it. Food comes from local areas to cities to meet food requirements of urban people. These transported nutrients through foods are not returned to the producer. Therefore, increasing food production by farmers is depleting the soil nutrient status of rural soil. Even in the long run continuous nutrient depletion without proper soil nutrient enrichment technology would affect sustainable agriculture and crops production. The definite soil amelioration measure ought to be taken for ensuring local soil is more productive in future to keep food sustainability.

LIMITATION

The nutrient value of food items was collected from secondary data sources. Only limited species of individual food were considered for food source. Raw and boiled both types of food were included for consumption. The food coming from rural areas were considered only for urban people consumption, hence urban food producing sources were not included. Other soil nutrient losses sources, namely runoff, volatilization, harvesting, transport, processing, food wastage etc. were not considered in the study.

REFERENCES

1. AGRS (2019). Agriculture and Rural Statistics Survey (ARSS) Project-2017. Retrieved June 2,2020fromhttp://bbs.portal.gov.bd/sites/default/files/files/bbs.portal.gov.bd/page/b343a8b4_956b_45ca_872f_4cf9b2f1a6e0/2020-02-02-10-36-84ecf771aa4c2e480f245fb79538ce14.pdf.
2. Ananno AA, Masud MH, Chowdhury SA, Dabnichki P, Ahmed N and Arefin AME (2021). Sustainable food waste management model for Bangladesh. *Sustainable production and Consumption*, 27: 35-51.
3. BBS (2020). Statistical Yearbook Bangladesh 2019: per capita per day intake of major food items (Grams) HIES 2010 to 2016. 39th ed. P. 532-533. Bangladesh Bureau of Statistics, statistics & informatics division, Bangladesh, Dhaka, www.bbs.gov.bd.
4. ESCAP (2017). Sustainable Development Benefits of Integrated Waste Management. Retrieved from June 4, 2020 fromhttp://www.unescap.org.file:///D:/Soil%20Nutrient%20Transport%20by%20food/Agriculture,%20Ecosystem%20and%20Environment/New%20folder/Sustainable-Development-Benefits-of-Waste-Management.pdf.
5. Hossain MF (2006). Nutrients removed in harvested portion of crop by continuous Corn receiving organic and inorganic fertilizers. *Journal* of *Plant Sciences*, 1(3): 264-272.
6. Jones DL, Cross P, Withers PJA, DeLuca TH, Robinson DA, Quilliam RS, Harris LM, Chadwick DR and Jones GE (2013). Nutrient

stripping: the global disparity between food security and soil nutrient stocks. *Journal of Applied Ecology*, 50: 851–862.

7. Jones DB (1941). Factors for converting percentages of nitrogen in foods and feeds into percentages of protein. Retrieved December 10, 2016 from http://foodfacts.foodcomp.info/References/Protein/Jones_1941%20nitrogen-protein%20conversion%20cir183.pdf.
8. Moqsud MA, Bushra QS and Rahman MH (2017). Composting barrel for sustainable organic waste management in Bangladesh. *Waste Management & Research*. 29(12): 1286-1293.
9. Roberts T, Kirkpatrick W, Slaton N and Norman R (2015). Estimating nutrient removal for Row crops grown in Arkansas. Retrieved from April 15, 2021 from https://www.uaex.edu/publications/pdf/FSA-2176.pdf.
10. Sahota TS (2015). Nutrients removal by field crops at Thunder Bay. Retrieved from June 6, 2020 from https://www.lakeheadu.ca/sites/default/files/uploads/3470/Documents/Extension_Articles/Nutrients_removal_by_field_crops.pdf.
11. Sanchez PA (2002). Soil fertility and hunger in Africa. *Science*, **295**: 2019-2020.
12. Shaheen N, Rahim ATMA, Mohiduzzaman M, Banu CP, Bari ML, Tukun AB, Mannan MA, Bhattacharjee L and Stadlmayr B (2016). Food composition table for Bangladesh. Retrieved January 5, 2019 from http://www.fao.org/fileadmin/templates/food_composition/documents/FCT_10_2_14final_version.pdf.
13. Sheldrick WF, Syers JK and Lingard J (2002). A conceptual model for conducting nutrient auditsat national, regional, and global scales. *Nutrient Cycling inAgroecosystems*,62(1):61-72.
14. United Nations (2018). World population 2018: demographics, maps and graphs. Retrieved March 1, 2019 from http://worldpopulationreview.com/countries/bangladesh-population/.
15. United Nations (2008). World urbanization prospects, the 2007 Revision: Highlights. Retrieved April 3, 2018 from https://www.un.org/esa/population/publication/wup2007/200WUP_Highlights_web.pdf.
16. World Bank (2016). Rural populationfrom1960-2016 (% of total Population). Retrieved December 12, 2018 fromhttp://databank.worldbank.org/data/reports.aspx?source=2&series=SP.RUR.TOTL.ZS&country=BGD.