Future Fertiliser Demand for Sustaining Rice production in Bangladesh: A Quantitative Analysis

উন্নয়ন অন্বেষণ
Unnayan Onneshan
The Innovators
centre for research and action on development

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Author
Jayanta Kumar Basak

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For orders and request please contact:

Unnayan Onneshan-The Innovators
16/2, Indira Road, Farmgate, Dhaka - 1215, Bangladesh
Phone: + 880 2 8158274, Fax: +880 2 8159135
E-mail: info@unnayan.org; Web: www.unnayan.org

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Executive Summary

Fertiliser is considered to be one of the main inputs for increasing crop yields and farm profit for any country but balanced fertilisation is the key to efficient fertiliser use for sustainable high yields. For rice production, 16 elements are essential- carbon, hydrogen, oxygen, nitrogen, phosphorus, potassium, sulfur, calcium, magnesium, zinc, iron, cropper, molybdenum, boron, manganese and chlorine. Among them, Nitrogen, phosphorus, zinc and potassium are nutrient elements most commonly applied by rice fields and sulfur is occasionally applied to some soil.

This research report has been developed, based upon the historical data on the last few years rice production and consumption, demand and supply of fertilisers and cropping intensity in Bangladesh. In this study, the total requirement for commonly used three fertilisers, Urea, Triple Supper phosphate (TSP) and Muriate of potash (MP), has been assessed on the basis of fertiliser recommendation dose and actual dose in farmer level. In this research work, average rice production data for the last 10 years and changing trends of Boro, T.Aman and Aus rice production for the same period has also been considered. For the future prediction of fertilisers, yield of Boro, T.Aman and Aus is assumed to constant and the other factors such as irrigation management, climatic conditions, rice varieties etc. remain unchanged. In this research report, the role of organic fertiliser for rice production in future has also been focused.

According to the fertiliser recommended dose, the requirement of urea fertiliser will be 39.17 lakh tons, TSP 21.77 lakh tons and MP 17.13 lakh tons (calculation based on average rice production data) in 2050. On the basis of trend line analysis of rice production data of Boro, T.Aman and Aus, 38.58 lakh tons of urea will be required, while 20.89 lakh tons of TSP and 17.02 lakh tons of MP will be required (calculation based on recommended dose) in 2050. Therefore, total requirement of fertilisers on the basis of average rice production data is higher than the changing conditions.

Considering the actual dose in field level, in 2050, the total demand of urea, TSP and MP fertiliser will be 30.40 lakh tons, 7.01 lakh tons and 5.45 lakh tons respectively (calculation based on average rice production data). On the basis of trend line analysis of rice production data, the requirement of urea in 2050 will be 29.47 lakh tons, TSP 6.88 lakh tons and MP 5.35 lakh tons (calculation based on actual dose). In this study, it is found that the demand of fertilisers is significantly higher for recommendation dose.

In this study, it is estimated that if it is possible to increase the organic fertilisers production only three times (21 million tons) compared to the present situation, it would contribute more than 15 percent (on average) to the total demand of Urea, TSP and MP and if it is used as bioslurry fertilisers, then it would contribute more than 30 of nutrient supply (N, P and K) for rice production in 2050 (calculation based on recommended dose). Considering the actual dose in field level, organic fertilisers would contribute more than 35 percent to the total demand of Urea, TSP and MP fertilisers in the same period.

This study shows that if 20-30 percent from the total fertiliser subsidy is given to organic fertiliser, it could easily increase the production of organic fertiliser three times from the present situation which could cover a significant portion of future fertiliser demand within 2050 as well as solve the growing fuel crisis in rural households.

The balanced application of fertilisers is very essential for rice production and providing sufficient food to meet their demand. Imbalanced application of chemical fertilisers is one of the main barriers for sustainable development of agriculture production, farm efficiency and land use and also production system, which is more complicated and more expensive. Besides, the demand of fertilisers would become significant in near future. Therefore, it is necessary to increase the production of all types of fertilisers both chemical and organic in domestic level. Government of Bangladesh must take some public awareness media activities and advocacy to influence farmers for using balanced fertiliser dose and organic matter. Above all, public awareness of the impact of imbalanced fertilisation and emphasized using of organic fertilisers on agricultural production deserves priority consideration.

Section 01

1.1 Introduction

Bangladesh has a large agrarian base with 76 percent of total population living in the rural areas and 90 percent of the rural population directly related with agriculture and around 50 percent of the labor force is engaged with agricultural activities (Bangladesh Economics Review, 2009). Increase in food production and attaining food sufficiency in Bangladesh requires sustainable growth of agricultural sector. The main purpose of agriculture in Bangladesh is to provide food for her increasing population.

Fertiliser is considered to be one of the main inputs for increasing crop yields and farm profit for any country but balanced fertilisation is the key to efficient fertiliser use for sustainable high yields. This is also true for the agriculture of Bangladesh because the country has virtually no possibility of increasing its cultivable land area. Therefore, food production of this country can be increased through increasing irrigation facilities together with HYV. Besides, well-timed supply and availability of fertiliser should receive top priority to sustain/increase rice production in Bangladesh.

In the early 1950's, farmers applied organic manures such as cow dung, bone meal etc. to Aus and Aman rice field and farmyard manure (FYM), mustard oil cake and fishmeal to mustard and vegetable crops (EPBS, 1950). Ahmed (2004) pointed out that the use of inorganic fertiliser started in the country in 1951 with the import of 2,698 tons of ammonium sulphate, phosphates in 1957 and muriate of potash in 1960. Quasem (1978) reported that fertiliser was introduced at farm level in 1959. Then, in 1965, the Government launched a 'Grow More Food' campaign and provided fertilisers and low lift pump (LLP) at a highly subsidized rate with pesticide at free of cost to popularize these inputs among the farmers and meet the country's food shortage. Thus, fertiliser consumption began to increase rapidly with the introduction of HYV rice (i.e. IR5 & IR8) and LLP use.

The present research report focuses on the present fertiliser situation (demand and supply) in Bangladesh. The report also quantifies the future fertiliser demand on the basis of “Recommended dose and Actual dose in field level” and shows the role of organic fertiliser for future rice production in Bangladesh. Finally, the study proposes policy recommendations.

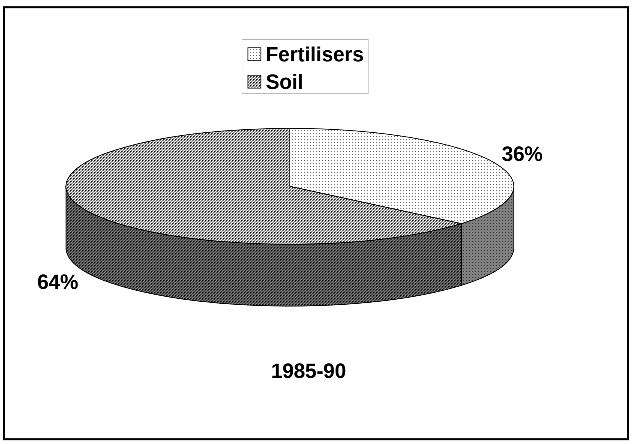
Section 02

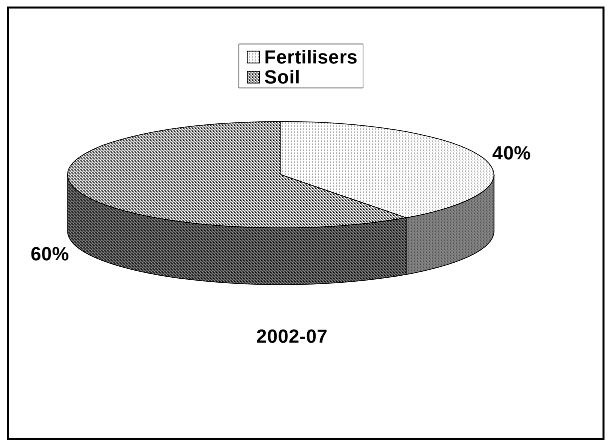
2.1 Contribution of fertilisers to crop production

Nutrition is the supply and absorption of those nutrient chemical elements required by an organism. “*Crop nutrients are the elements, or simple inorganic compounds, indispensable for the growth of crops and not synthesized by the plant during the normal metabolic process (Surajit K. De Datta (1981)*”. For rice production, 16 elements are essential- carbon, hydrogen, oxygen, nitrogen, phosphorus, potassium, sulfur, calcium, magnesium, zinc, iron, cropper, molybdenum, boron, manganese and chlorine. All essential elements must be present in optimum amounts and in forms usable by rice plants. Nitrogen, phosphorus, zinc and potassium are nutrient elements most commonly applied in rice fields and sulfur is occasionally applied in some soil. All the other essential nutrients are provided by air, water, soil and plant residues or as contaminants in commercial fertilisers.

Chemical fertiliser provides the essential nutrient elements (nitrogen, phosphorus, zinc and potassium) to soils and plays the most vital role in crop production. It supports half of the world's grain production (Bockman et al. 1990). Tandon (1992) reported that the contribution of fertilisers to rice production was 40 percent. Results of long term experiments conducted in Bangladesh Rice Research Institute (BRRI) also showed 36-40 percent contribution of fertilisers for rice to the total annual production (averaged over Boro and T.Aman crops during the period 1985-86 to 2006-07). In 1985-86, fertilisers contribute 36 percent to the total soil fertility whereas in 2002-07 it was 40 percent. Thus, the increasing response of fertilisers with time indicates the degradation of soil fertility.

Fig.1: Percent contribution of soil and fertiliser on rice yield in 1985-90 and 2002-07



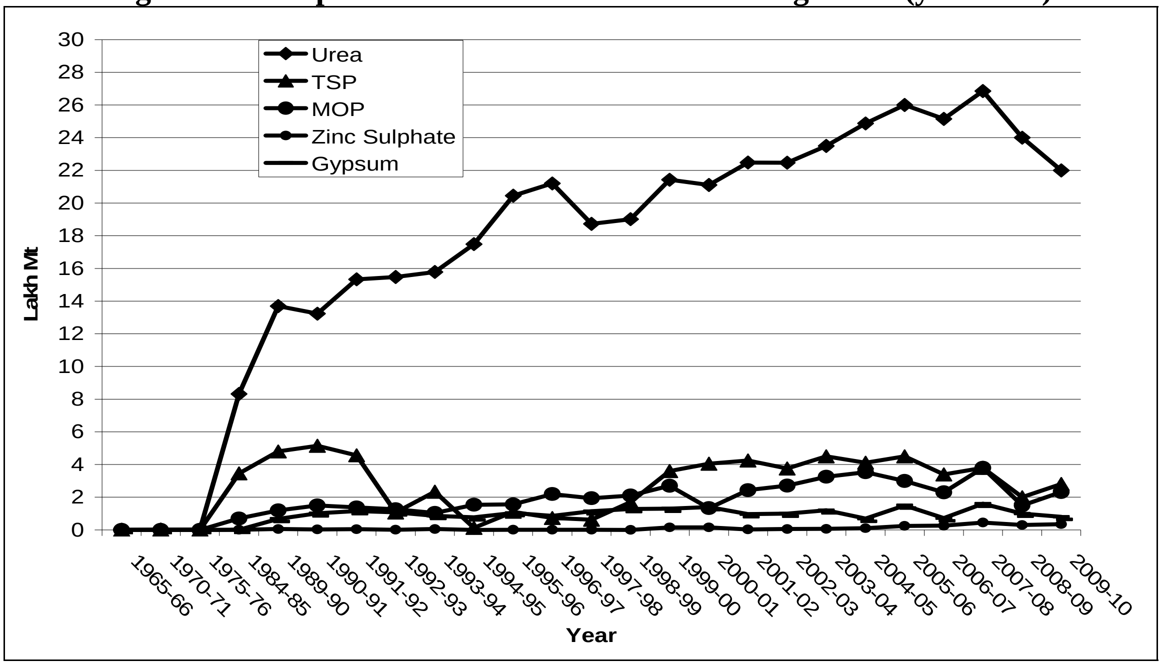


(Source: shah et al. 2008)

2.2 Fertilisers demand in Bangladesh

Fertiliser application mainly depends on the soil types, growing season, irrigation applications and the cultivars used. The demand for fertiliser is also affected by agro climatic conditions. High yielding varieties of rice are highly responsive and need adequate supply of fertiliser to achieve targeted production. Urea (Nitrogen), triple supper phosphate (TSP), muriate of potash (MP), gypsum and dasta ($ZnSO_4$) are the major fertilisers which are applied in agricultural land in various proportions for rice production in Bangladesh. Urea is applied in three steps after rice transplanting and the other types of fertilisers are applied during the field preparation.

Fig. 2: Consumption of different Fertilisers in Bangladesh (year wise)



(Source: Authors' calculation based on Bangladesh Fertiliser Association (BFA) data, 2009 and Bangladesh Economic Review, 2010; * up to March month 2009-2010)

The use of chemical fertilisers in Bangladesh started sharply after the year of 1975. Significant amount of chemical fertiliser consumption was noted during 1975-76. Since then, increasing trends of fertilisers were being observed which reached peak value of 36.50 lakh tons during 2007-08 (Fig. 2). Along with urea, TSP and MP, the use of gypsum, zinc sulphate and other micronutrients were also increased after 1975-76.

Fertiliser application sharply increased with the introduction of high yielding varieties (HYV). In this study, it is found that urea application rate is significantly higher compared to the application of other fertilisers for crop production especially cultivating high yielding crop varieties. Before 1975-86, maximum farmers cultivated traditional varieties and used organic manures such as cow dung, bone meal etc. After the period of 1975-76, the irrigated area of rice and other crops were increasing year after year. In irrigated condition, most of the farmers use HYV rice, which requires high fertiliser dose than local low yielding rice varieties. Hossain (1987) reported that the HYV acreage and irrigation have a significant positive influence on fertiliser consumption.

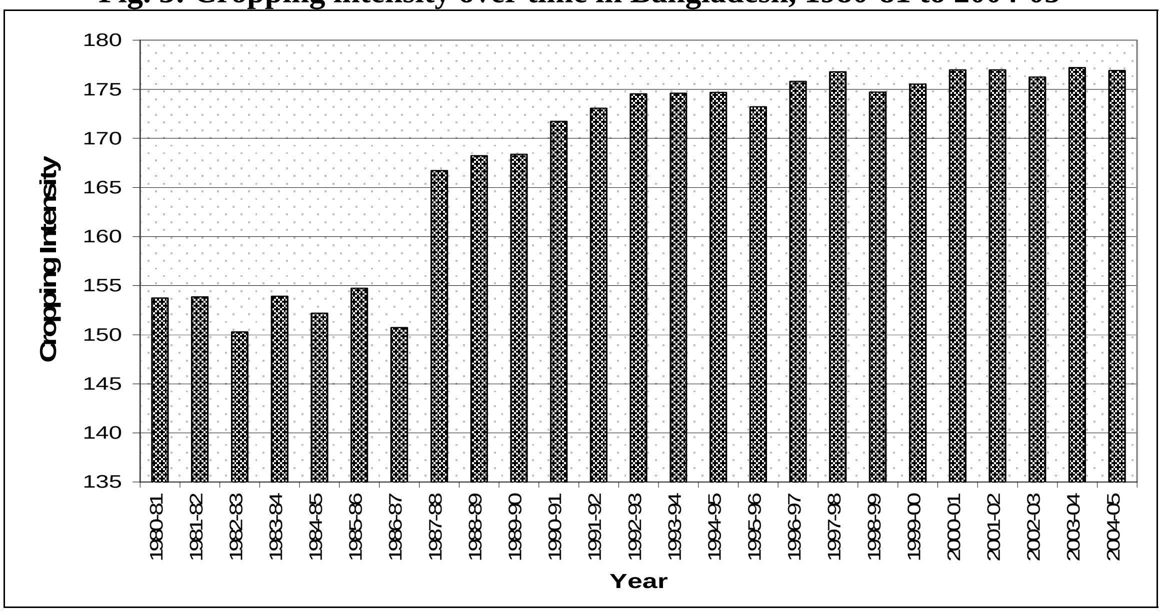
In 2008-09, high yielding varieties covered more than 72 percent to the total cultivable land area in Bangladesh (Table 1). Therefore, a large amount of fertiliser is being used to cultivate high yielding varieties and consequently the demand of chemical fertilisers follows an increasing trend. Similarly HYV, cropping intensity also influences fertiliser application over the years. Cropping intensity has increased dramatically in the last decades. In 1980, the cropping intensity was 153.74 percent, whereas in 2004-05, it was 176.91. The Department of Agriculture Extension (DAE) claims that the current cropping intensity is 195 percent. Therefore, cropping intensity increased more than 23 percent in the last 15 years (1980-81 to 2004-05) (Fig. 3). Farmers try to produce more crops in their limited agricultural land and use a large quantity of chemical fertilisers to increase production. So, chemical fertilisers demand increases with the increase of cropping intensity in Bangladesh.

Table 1: Comparative land use scenario under rice production of different varieties

Seasons	% area coverage		
	Local varieties	HYV	Hybrid
Aus	28.67	71.33	0.00
Aman	32.11	67.89	0.00
Boro	2.29	78.56	19.16
Total	19.79	72.55	7.66

(Source: DAE, 2008-09)

Fig. 3: Cropping intensity over time in Bangladesh, 1980-81 to 2004-05

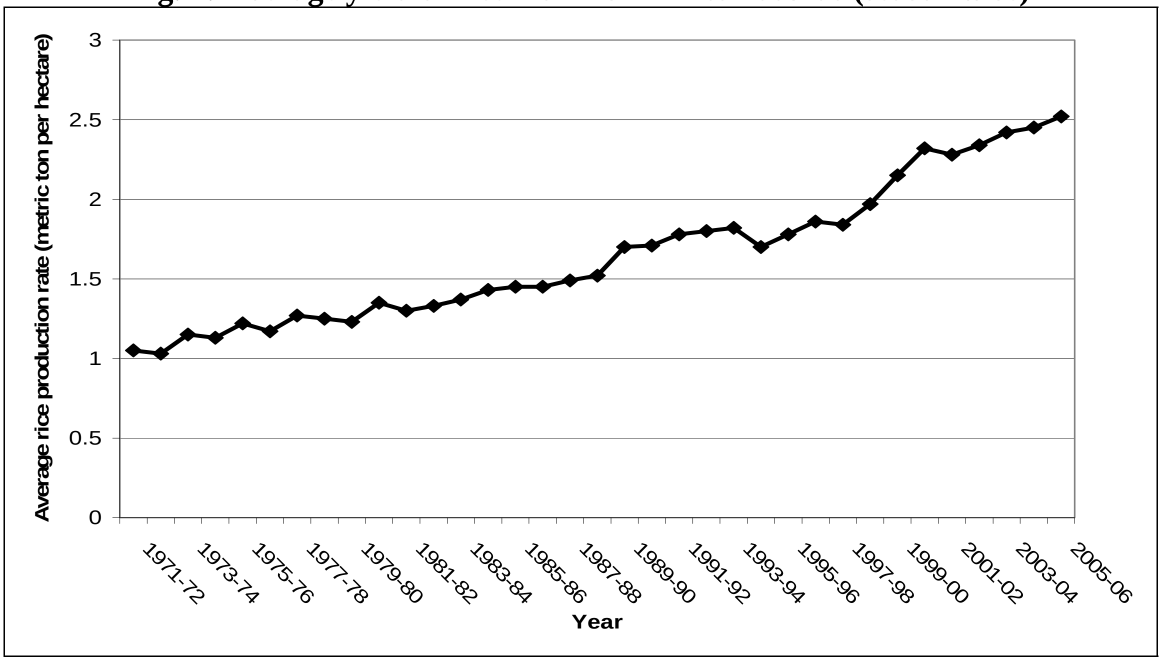


(Source: Authors' calculation based on Handbook of Agricultural Statistics, Ministry of Agriculture, December 2007)

Most of agricultural production is carried out in small pieces of lands. Moreover, the cropping intensity along with the cropping pattern played a vital role in the whole production system (Fig. 3). Besides, high yielding crop varieties, modern technology, new management practices such as irrigation, fertiliser, crop management etc, are used to improve the production rate (Fig. 4).

By analyzing rice yield data of the last 35 (1971-72 to 2005-06) years, it is found that rice production rate is continuously increasing over the year. In 1971-72, the average rice yield was 1.05 metric ton per hectare, while in 2005-06, it was 2.52 metric ton per hectare. Therefore, average rice yield increased 2.4 times in the last few decades. In that situation, increasing fertiliser application rate influenced the rice yield significantly. For an example in Bangladesh, application of fertilisers increased several times in same piece of land. In 1975-76, fertiliser application was 0.36 kg per hectare of agricultural land, whereas in 2007, it was above 298 kg (Titumir and Basak, 2010). So, it is clear that fertilisers create a force to increase rice yield. On the other hand, soil fertility is decreasing due to the use of huge amount of chemical fertilisers, which is not at per with sustainable conception of agriculture.

Fig. 4: Average yield of rice from 1971-72 to 2005-06 (season wise)

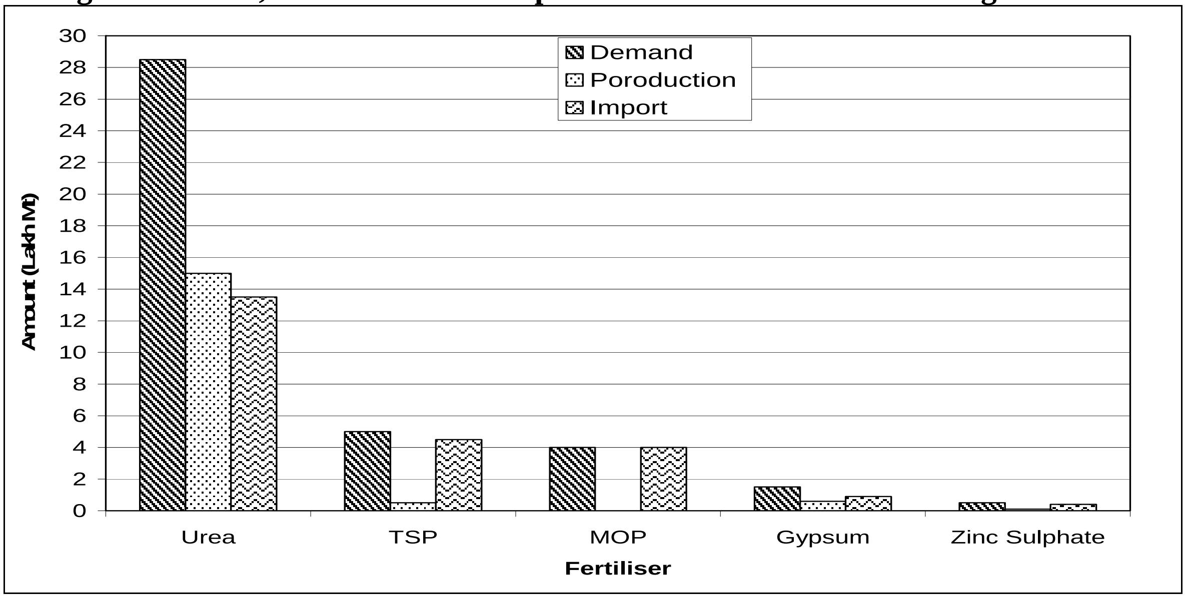


(Source: Authors' calculation based on Handbook of Agricultural Statistics, Ministry of Agriculture, December 2007)

2.3 Fertilisers consumption outlook

The total urea fertiliser production in 2008-09 was 15 lakh tons in six urea factories and total demand was 28.50 lakh tons. Domestic production covered more than 50% to the total demand of urea. Similarly, domestic production of TSP was 0.50 lakh tons, which covered 10% and domestic production of 0.60 lakh tons of Gypsum covered 40% to the total demand (Fig. 5). Moreover, the demand of 4 lakh tons of MP was completely imported from foreign countries (Kafiluddin et al., 2008). It is quite evident that demands of fertiliser are heavily dependent on imported fertiliser. Therefore, any disruption in the supply chain is quite possible to affect the total production system.

Fig. 5: Demand, Production and Import scenario of Fertilisers during 2008-09



(Source: Authors' calculation based on Bangladesh Fertiliser Association (BFA) data, 2009)

2.4 Fertiliser Dose for rice production in Bangladesh

Information on nutrient balance for a particular crop production system is essential for developing nutrient management strategies for sustainable production. The continuous and unbalanced use of the chemical fertilizers under intensive cropping systems has been considered to be the main cause for declining crop yield and environmental degradation. All essential elements must be present in optimum amounts and in forms usable by plants.

Rice is the staple food for the people of Bangladesh and will continue to remain so in future. The country needs substantial increase in rice production to provide her teeming millions with food and other basic needs of life. There are not many options but for improving the living standard of her common people, raising the level of rice production from the limited land resources and diverse climatic conditions is essential. Variations in management practices (irrigation and fertilizer application, crop management practices etc), use of new high yielding varieties (HYV) and modern technologies play vital role for increasing rice production of this country.

Considering total cereal production (32.896 million ton), rice occupies about 95.20 percent (31.32 million tons) and other cereal crops only 4.80 percent (Bangladesh Economic Review, 2010). Zaman (1987) reported that 75 percent of total fertilisers are consumed for rice production and the rest of 25 percent for other crops. Therefore, it is necessary to asses the future fertiliser demand for rice production in the country.

Urea, TSP and MP are chemical fertilisers most commonly applied by rice farmers. The amounts of recommended and actual dose of fertilisers for rice production in Bangladesh are given in Table 2. Urea (nitrogen) is a major component of proteins, hormones, chlorophyll, vitamins and enzymes, essential for rice. Rice plants require a large amount of nitrogen at the early and mid-tillering stage to maximize the number of panicles (Datta, 1981). The recommended doses of other nutrients are also necessary for potential rice yield. Eliminate any one of these elements, and plants will display abnormalities of growth, deficiency symptoms, or may not reproduce normally.

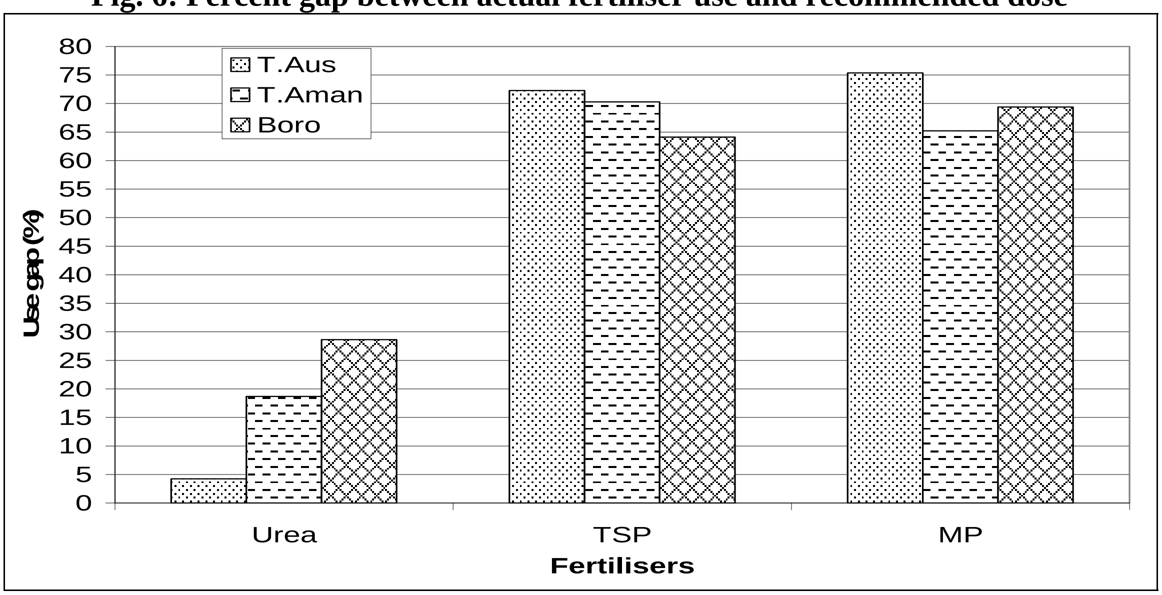
Table 2: Use of fertilisers in Bangladesh

Name of Crop (HYV)	Recommended dose (kg/ha)			Actual dose (kg/ha)			Use gap (%)		
	Urea	TSP	MP	Urea	TSP	MP	Urea	TSP	MP
T.Aus	141	101	69	135	28	17	4.26	72.28	75.36
T.Aman	166	101	69	135	30	24	18.67	70.30	65.22
Boro	269	131	121	192	47	37	28.62	64.12	69.42

(Source: Agriculture Sector Review, MOA, May, 2004)

It is evident from the Table 2 that actual use of all the different fertilisers for rice production are below the recommended dose (Fig. 6). The gap between the actual and recommended dose would be also true for other crops. The gap is also significant for both TSP and MP fertilisers in Bangladesh. Non availability of fertilisers (availability of both fertilisers are fully depended on import process) and costs have lead to lower use of fertilisers against the recommended dose. But continuing rice production in a sustainable way, one of the important inputs required is the supply of balanced fertilisers consisting of N-P-K. Besides, it is also necessary for keeping soil fertility for a long period. Moreover, balanced fertilisers application is also essential for achieving higher level yield. Thus, there appears to be a large potential for raising fertiliser consumption through adoption of the recommend fertiliser practices by farmers.

Fig. 6: Percent gap between actual fertiliser use and recommended dose



(Source: Authors' calculation based on Agriculture Sector Review, MOA, May, 2004)

2.5 Future fertilisers requirement for rice production

If the annual population growth continues at a business as usual rate (1.4 percent annually), it is estimated that the total population would be 191.65 million by 2020, 220.24 million by 2030, 253.09 million by 2040 and 290.83 million by 2050. Therefore, huge amount of food will be necessary for the future generation to meet their food demand and major part of the demand will be provided by rice. From the analysis of the last 40 year's data, it is found that the per capita rice consumption rate in Bangladesh is 153.02 Kg per person per year. If the current rice consumption rate is continued to 2050, the total demand of rice would reach to 68.09 million tons which is more than 1.8 times compared to 2007.

Last 10 year's data (1999-2000 to 2008-09) reveals that Boro rice contributes 52 percent to the total rice production in Bangladesh, while T.Aman 41 percent and Aus only 7 percent. If the production rates of Boro, T.Aman and Aus go at business as usual rate, the total Boro rice demand would be 35.41 million tons in 2050, T.Aman and Aus would be 27.92 and 4.77 million tons, respectively (Table 3). From the trend line analysis in the same period data, it is also found that Boro rice would contribute 59 percent in 2020, 60.5 percent, 61.5 percent and 63 percent in 2030, 2040 and 2050, respectively. Contribution of T.Aman would be 34 percent, 33 percent, 32 percent, 31 percent respectively and Aus would be 7 percent, 6.5 percent, 6.5 percent, 6 percent, respectively for the corresponding years. If the production rates of Boro, T.Aman and Aus follow trends, then the total Boro rice demand would be 42.90 million tons in 2050, T.Aman and Aus would be 21.11 and 4.09 million tons in that order (Table 4).

Table 3: Paddy rice demand in Bangladesh in year wise (average)

Year	Population (million)	Paddy rice req. (million tons)	Boro rice (million tons)	T.Aman rice (million tons)	Aus rice (million tons)
2007	157.75	36.93	19.20	15.14	2.59
2020	191.65	44.87	23.33	18.40	3.14
2030	220.24	51.56	26.81	21.14	3.61
2040	253.09	59.25	30.81	24.29	4.15
2050	290.83	68.09	35.41	27.92	4.77

(Source: Data calculation based on World Bank and FAOSTAT, 2009).
Population data are calculated from World Bank data, 2009.
Rice consumption rate is calculated from the last 40 years data (1964 -2003).
Data source: Food and Agriculture Organization, FAOSTAT Update as of July, 2009.

Table 4: Paddy rice demand in Bangladesh in year wise (changing condition)

Year	Population (million)	Paddy rice req. (million tons)	Boro rice (million tons)	T.Aman rice (million tons)	Aus rice (million tons)
2007	157.75	36.93	19.20	15.14	2.59
2020	191.65	44.87	26.47	15.26	3.14
2030	220.24	51.56	31.19	17.01	3.35
2040	253.09	59.25	36.44	18.96	3.85
2050	290.83	68.09	42.90	21.11	4.09

(Source: Data calculation based on last 10 years data of BBS, 2009).

Gomosta (2004) reported the following options to meet the demand for obtaining increasing yield (Shah et al., 2008):

- Replacement of local T.Aman varieties by modern T.Aman varieties in some areas

- Limited increase in the area of modern Boro varities

- Supplement irrigation needs to be ensured in some drought prone areas during T.Aman season

The three pointed implications require more assistance in use of fertiliser development to get a higher yield from a piece of land. Therefore, it is necessary to asses the future fertilisers requirement for sustaining rice production.

In this study, the total requirement for commonly used three fertilisers has been assed on the basis of fertiliser recommended dose and actual dose in farmer level. In this research work, average rice production data for the last 10 years and trends of changing of Boro, T.Aman and Aus rice production for the same period has also been considered. For calculation, yield of Boro, T.Aman and Aus is kept constant and other factors such as irrigation management, climatic conditions, varieties etc. are also remain unchanged.

According to the fertiliser recommended dose, requirement of urea fertiliser would be 39.17 lakh tons, TSP 21.77 lakh tons and MP 17.13 lakh tons (calculation based on average rice production data) in 2050 (Table 5). On the basis of trend line analysis of rice production data, requirement of urea would be 38.58 lakh tons in 2050, while 20.89 lakh tons of TSP and 17.02 lakh tons of MP would also required by the same year (calculation based on recommended dose) (Table 6). Therefore, total fertilisers requirement on the basis of average rice production data is higher than the changing conditions (Fig. 7).

Table 5: Future fertiliser demand on the basis of recommended dose (average rice production data)

Year	Urea fertiliser requirement (lakh tons)			**Total (lakh tons)**	TSP fertiliser requirement (lakh tons)			**Total (lakh tons)**	MP fertiliser requirement (lakh tons)			**Total (lakh tons)**
	Boro	Aus	Aman		Boro	Aus	Aman		Boro	Aus	Aman	
2007	10.33	1.58	9.31	21.22	5.03	1.14	5.66	11.83	4.65	0.78	3.87	9.3
2020	12.55	1.93	11.3	25.78	6.11	1.38	6.88	14.37	5.65	0.94	4.7	11.29
2030	14.42	2.21	13	29.63	7.02	1.58	7.91	16.51	6.49	1.08	5.4	12.97
2040	16.58	2.54	14.9	34.02	8.07	1.82	9.09	18.98	7.46	1.24	6.21	14.91
2050	19.05	2.92	17.2	39.17	9.28	2.09	10.4	21.77	8.57	1.43	7.13	17.13

(Source: Data calculation based on Agriculture Sector Review, MOA, May, 2004 and BBS, 2009)

Table 6: Future fertiliser demand on the basis of recommended dose (changing conditions)

Year	Urea fertiliser requirement (lakh tons)			**Total (lakh tons)**	TSP fertiliser requirement (lakh tons)			**Total (lakh tons)**	MP fertiliser requirement (lakh tons)			**Total (lakh tons)**
	Boro	Aus	Aman		Boro	Aus	Aman		Boro	Aus	Aman	
2007	10.33	1.58	9.31	21.22	5.03	1.14	5.66	11.83	4.65	0.78	3.87	9.30
2020	14.24	1.93	9.38	25.55	6.94	1.38	5.71	14.03	6.41	0.94	3.90	11.25
2030	16.78	2.05	10.50	29.33	8.17	1.47	6.36	16.00	7.55	1.01	4.35	12.91
2040	19.60	2.36	11.70	33.66	9.55	1.69	7.09	18.33	8.82	1.16	4.85	14.83
2050	23.08	2.50	13.00	38.58	11.20	1.79	7.90	20.89	10.40	1.23	5.39	17.02

(Source: Data calculation based on Agriculture Sector Review, MOA, May, 2004 and BBS, 2009)

Considering the actual dose in field level, the total demand of urea, TSP and MP in 2050 might be 30.40, 7.01 and 5.45 lakh tons, respectively (calculation based on average rice production data) (Table 7). On the basis of trend line analysis of rice production data, requirement of urea, TSP and MP might be 29.47, 6.88 and 5.35 lakh tons in 2050 correspondingly (calculation based on actual dose) (Table 8). Therefore, total fertilisers requirement on the basis of average rice production data is higher than the changing conditions (Fig. 8). In this study, it is also found that the demands of fertilisers are significantly higher for recommended dose.

Table 7: Future fertiliser demand on the basis of actual dose (average rice production data)

Year	Urea fertiliser requirement (lakh tons)			**Total (lakh tons)**	TSP fertiliser requirement (lakh tons)			**Total (lakh tons)**	MP fertiliser requirement (lakh tons)			**Total (lakh tons)**
	Boro	Aus	Aman		Boro	Aus	Aman		Boro	Aus	Aman	
2007	7.37	1.52	7.57	16.46	1.81	0.31	1.68	3.80	1.42	0.19	1.35	2.96
2020	8.96	1.84	9.20	20.00	2.19	0.38	2.04	4.61	1.73	0.23	1.64	3.60
2030	10.30	2.12	10.60	23.02	2.52	0.44	2.35	5.31	1.98	0.27	1.88	4.13
2040	11.83	2.43	12.10	26.36	2.9	0.50	2.70	6.10	2.28	0.31	2.16	4.75
2050	13.60	2.80	14.00	30.40	3.33	0.58	3.10	7.01	2.62	0.35	2.48	5.45

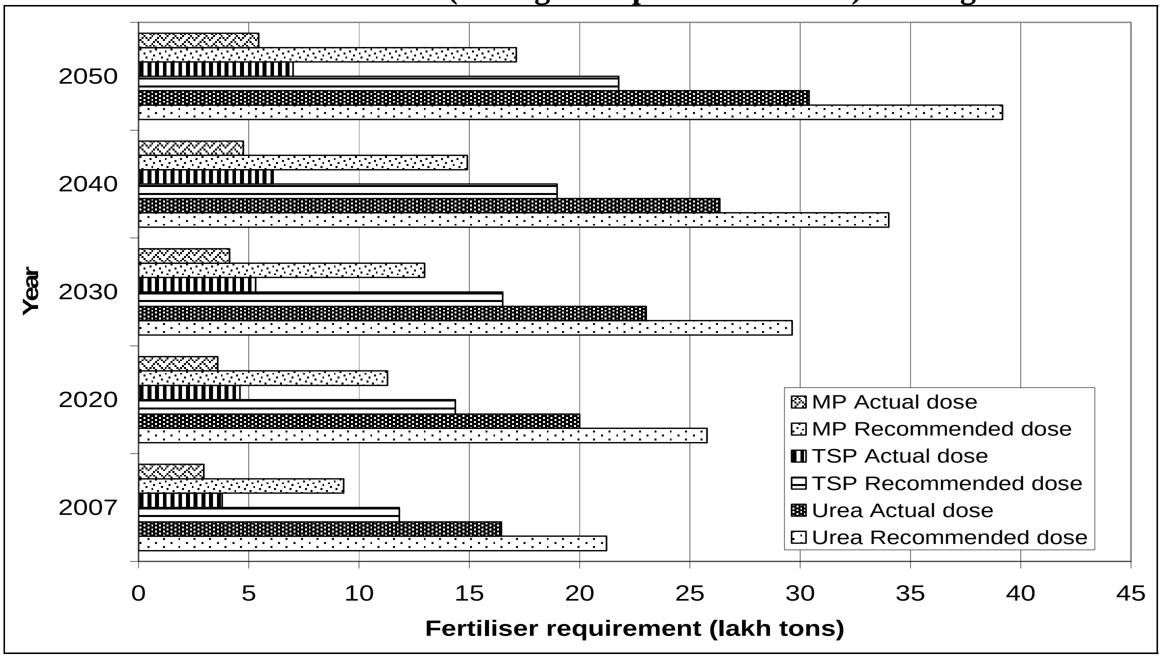
(Source: Data calculation based on Agriculture Sector Review, MOA, May, 2004 and BBS, 2009)

Table 8: Future fertiliser demand on the basis of actual dose (changing conditions)

Year	Urea fertiliser requirement (lakh tons)			**Total (lakh tons)**	TSP fertiliser requirement (lakh tons)			**Total (lakh tons)**	MP fertiliser requirement (lakh tons)			**Total (lakh tons)**
	Boro	Aus	Aman		Boro	Aus	Aman		Boro	Aus	Aman	
2007	7.37	1.52	7.57	16.46	1.81	0.31	1.68	3.8	1.42	0.19	1.35	2.96
2020	10.17	1.84	7.63	19.64	2.49	0.38	1.7	4.57	1.96	0.23	1.36	3.55
2030	11.98	1.97	8.51	22.46	2.93	0.41	1.89	5.23	2.31	0.25	1.51	4.07
2040	13.99	2.26	9.48	25.73	3.43	0.47	2.11	6.01	2.7	0.28	1.69	4.67
2050	16.47	2.4	10.6	29.47	4.03	0.5	2.35	6.88	3.17	0.3	1.88	5.35

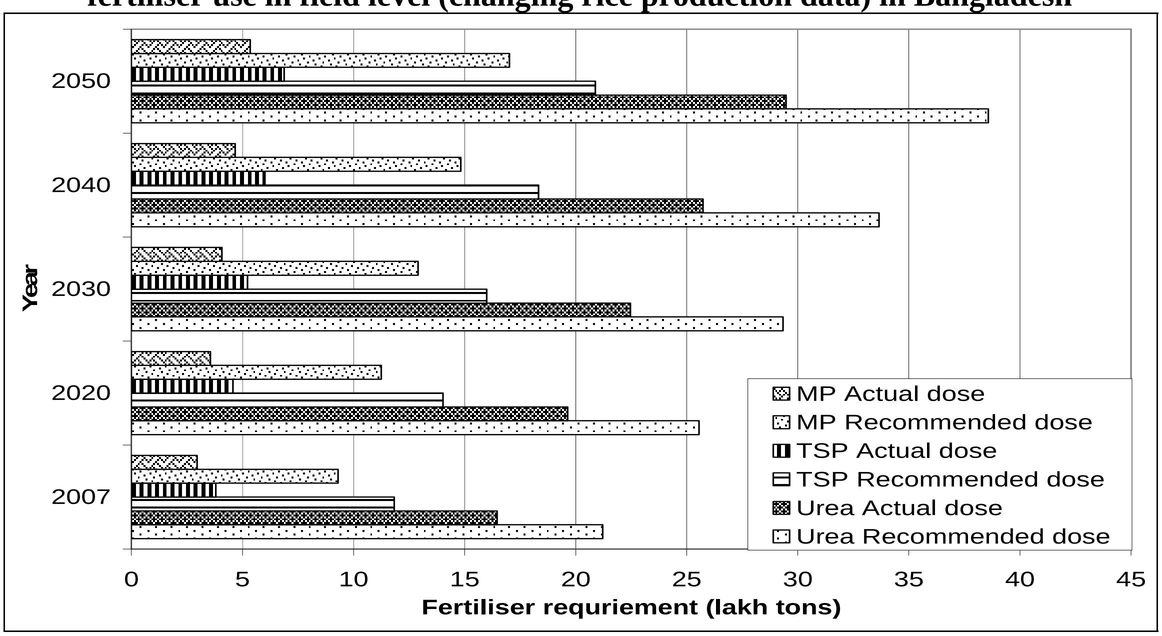
(Source: Data calculation based on Agriculture Sector Review, MOA, May, 2004 and BBS, 2009)

Fig. 7: Fertilisers requirement on the basis of recommended dose and actual fertiliser use in field level (average rice production data) in Bangladesh



(Source: Data calculation based on Agriculture Sector Review, MOA, May, 2004 and BBS, 2009)

Fig. 8: Fertilisers requirement on the basis of recommended dose and actual fertiliser use in field level (changing rice production data) in Bangladesh



(Source: Data calculation based on Agriculture Sector Review, MOA, May, 2004 and BBS, 2009)

2.6 Importance of Organic Fertiliser

Due to huge demand of chemical fertiliser, consequently changing scenario of soil fertility management, the organic fertilizers can play a vital role in restoring fertility as well as organic matter status of the cultivating soils. Organic matter content in Bangladesh soil is very low around 1 percent in most and 2 percent in few soils, whereas it should be maintained at least 3 percent that is conducive to high crop productivity (Islam, 2006).

The fertility status of Bangladesh soil is extremely variable because, it has different thirty agro-ecological zones and those have a specific soil and hydrological characteristics. Most of the soils are depleted and decline in crop yields, if proper fertility management is not made. In this study, it is found that most of the farmers of our country use chemical fertilisers indiscriminately without adequate information on actual soil/plant requirement and do not follow the recommended dose. Therefore, in over application of some nutrients, under application of others play a significant negative impact on agriculture soil over the years. Due to continuous absorbing of nutrients, soils are losing productive capacity. To make the soil productive, the organic matter content in them should be maintained at least at 3 percent level (*ibid*.).

Under such situations, there is no alternative but to add organic fertiliser in the soils to sustain crop productivity and increase fertility. Due to high oil prices in the internal market and shrinking natural resources for fertiliser production, the price of imported fertilisers would continue to increase in the coming years. Therefore, mobilisation of all organic resources and recycling them into soil fertilisation program must be considered.

Bioslurry[1] is one of the best organic fertilisers to rejuvenate soils since it is a rich source of both plant nutrients and organic matter. It increases the physical, chemical and biological properties of the soils besides supplying essential nutrients to the crop plants. It also increases the organic matter content of the soils and maintains soil health. The use of bioslurry can reduce the application of chemical fertilisers up to 50% (*ibid*.). As a result, using reduced doses of chemical fertilizers will benefit the farmers in their cultivation costs and the soil environment will be in a high fertility and productive state. The nutrient content of the commonly used organic fertilisers including bioslurry is shown in Table 9. From Table 9, it is seen that bioslurry contains more nutrients than the ordinary organic fertilisers.

An experiment conducted by Grameen Shakti revealed that more than 25,000 biogas plants generate[2] more than 200,000 tons of bioslurry on dry weight basis. This bioslurry is equivalent to about 9,000 tons of urea; 25,000 and 3,200 tons of TSP and MP, respectively plus other secondary and micronutrients. According to Razzak (2006) and

[1] Bioslurry obtained from biogas plant is considered as quality organic fertiliser. This organic fertiliser is environmental friendly, has no toxic or harmful effects. Cow dung, poultry litter, compost, crop residues and green manure are commonly used in biogas plant.
[2] 25,000 biogas plants of varying gas producing capacities (2 6 m) run with cow dung and or poultry litter for domestic purposes and some large sized ones in poultry farms are now in operation in the country.

Alam (2006), about 7 million tons of organic fertilizers are produced every year from animal wastes, household wastes, city wastes and crop wastes. If this huge amount of organic fertilisers can be converted into bioslurry, we can fulfill a great portion of our huge fertiliser demand; consequently, it can be possible to cover a number of populations under electricity supply. From analysis, it is found that if 7 million tons of organic fertiliser is used for crop production completely, then it could cover 5.3 percent of Urea, 19 percent of TSP and 34.13 percent of MP to the total demand of fertiliser in the fiscal year 2008-09. If the total organic fertiliser is used as a bioslurry, then it could cover 11 percent demand of Urea, 89 percent of TSP and 22.8 percent of MP in the same period (Table 10).

Table 9. Nutrient concentrations in commonly used organic fertilizers and bioslurry of Bangladesh

Organic fertilizers	Nutrient content (%)		
	N	P	K
Cow dung	0.51-1.5	0.40.8	0.51.9
Poultry manure	1.6	1.5	0.85
Compost (common)	0.40.8	0.30.6	0.71.0
Farmyard manure	0.51.5	0.40.8	0.511.9
Water hyacinth compost	3.0	2.0	3.0
Bioslurry (cow dung)	1.29	2.80	0.75
Bioslurry (Poultry litter)	2.73	3.30	0.80
Rice straw	0.52	0.25	1.20
Wheat straw	0.63	0.28	0.80
Maize stove	0.45	0.30	0.70
Sugarcane trash	0.35	0.25	0.80
Tobacco stems	0.42	0.25	1.10

(Source: Islam, 2006)

Table 10: Contribution of organic fertilisers to total fertiliser demand in the fiscal year 2008-09

Fertilisers	Demand (Lakh tons)	Contribution of organic fertiliser (Lakh tons)	Contribution of bioslurry fertiliser (Lakh tons)	% of total demand (organic fertiliser)	% of total demand (bioslurry fertiliser)
Urea	28.5	1.50	3.13	5.30	11
TSP	5.0	0.95	4.45	19.00	89
MP	4.0	1.37	0.91	34.13	22.8

(Source: Authors' calculation based on the nutrient concentrations in commonly used organic fertilizers and bioslurry of Bangladesh)

From Table 10, it is found that the organic fertilisers have a considerable role to the crop production in Bangladesh. But the contribution can be significant and production can be increased, if the fertilisers are used as a bioslurry fertiliser. It is calculated that if it is possible to increase the production of organic fertilisers only three times (21 million tons) to the present situation, it would contribute a large amount of nutrient supply to soil for rice production in 2050 (Table 11 and 12).

From this analysis, it is found that on average, organic fertilisers would contribute more than 15 percent to the total demand of Urea, TSP and MP fertilisers and if they are used as bioslurry fertilisers, then they would contribute more than 30 of nutrient supply (N, P and K) for rice production in 2050 (calculation based on recommended dose).

Considering the actual dose in field level, organic fertilisers would contribute more than 35 percent to the total demand of Urea, TSP and MP fertilisers and if they are used as bioslurry fertilisers, however, they would contribute more than 85 of nutrient supply in the same period.

From this analysis, it is clear that organic fertilisers and bioslurry fertilisers can play a vital role in future to attain and sustain self-sufficiency in food within shortest possible times, intensification of agricultural production by multiple cropping, increasing cropping intensity and the use of high yielding varieties.

Table 11: Contribution of organic and bioslurry fertilisers for rice production in 2050 (Calculation based on recommended dose)

Fertilisers	Based upon Average condition					Based upon Changing condition				
	Demand (Lakh tons)	Contribution of organic fertiliser (Lakh tons)	Contribution of bioslurry fertiliser (Lakh tons)	% of total demand (organic fertiliser)	% of total demand (bioslurry fertiliser)	Demand (Lakh tons)	Contribution of organic fertiliser (Lakh tons)	Contribution of bioslurry fertiliser (Lakh tons)	% of total demand (organic fertiliser)	% of total demand (bioslurry fertiliser)
Urea	39.17	4.50	9.40	11.50	23.97	38.58	4.50	9.40	11.66	24.36
TSP	21.77	2.85	13.35	13.10	51.32	20.89	2.85	13.35	13.64	63.91
MP	17.13	4.10	2.73	24.00	17.02	17.02	4.10	2.73	24.10	16.04

(Source: Authors' calculation based on the nutrient concentrations in commonly used organic fertilizers and bioslurry of Bangladesh, Agriculture Sector Review, MOA, May, 2004 and BBS, 2009)

Table 12: Contribution of organic and bioslurry fertilisers for rice production in 2050 (Calculation based on recommended dose)

Fertilisers	Based upon Average condition					Based upon Changing condition				
	Demand (Lakh tons)	Contribution of organic fertiliser (Lakh tons)	Contribution of bioslurry fertiliser (Lakh tons)	% of total demand (organic fertiliser)	% of total demand (bioslurry fertiliser)	Demand (Lakh tons)	Contribution of organic fertiliser (Lakh tons)	Contribution of bioslurry fertiliser (Lakh tons)	% of total demand (organic fertiliser)	% of total demand (bioslurry fertiliser)
Urea	30.40	4.50	9.40	14.80	30.92	29.47	4.50	9.40	15.27	31.90
TSP	7.01	2.85	13.35	40.00	190.44	6.88	2.85	13.35	4.42	194.04
MP	5.45	4.10	2.73	75.23	50.10	5.35	4.10	2.73	76.64	51.03

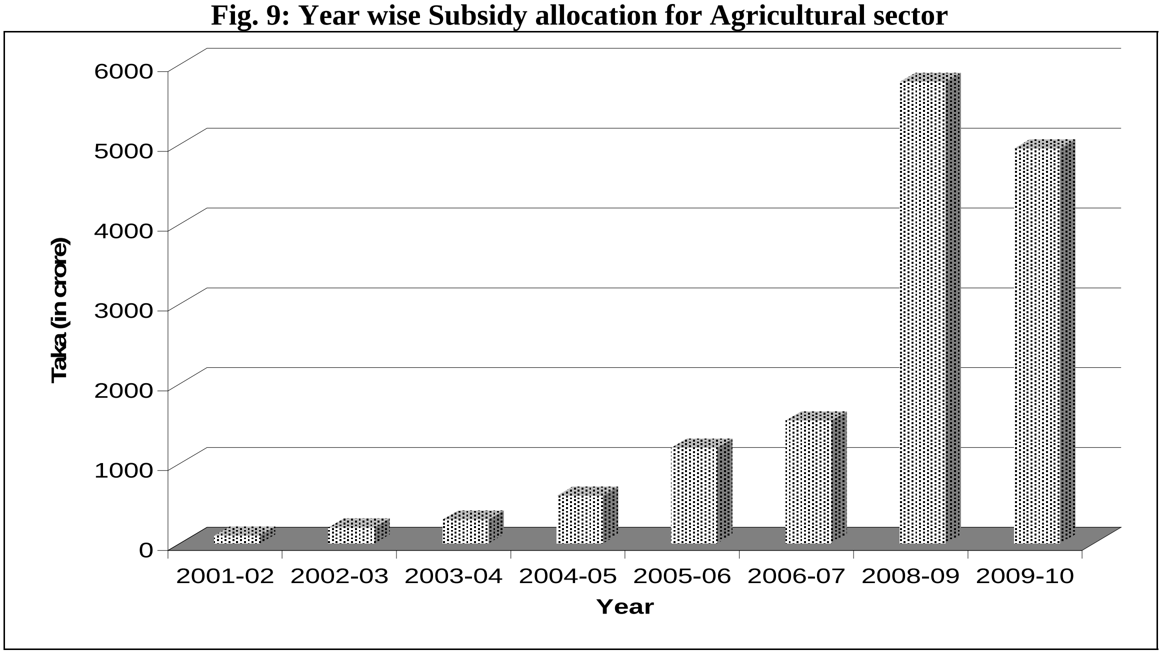
(Source: Authors' calculation based on the nutrient concentrations in commonly used organic fertilizers and bioslurry of Bangladesh, Agriculture Sector Review, MOA, May, 2004 and BBS, 2009)

2.7 Importance of organic fertiliser in Economical point of view

Due to changing pattern of soil fertility management of cultivable land with emphasis on organic matter replenishment, the organic fertilisers could play a vital role in restoring fertility as well as organic matter status of the soils (Islam, 2008). However, the subsidy on chemical fertilisers follows an increase trend day by day. From this study, it is found that the rate of subsidy in agriculture sector increased significantly after the fiscal year 2001-02 and it reached the highest point in 2008-09 (Fig. 9). But, it is also found that the maximum portion of this subsidy has gone to import, production and distribution purposes of chemical fertilisers (Fig. 10). In 1999-00, a small portion of the subsidy (15 percent) was given to chemical fertiliser purposes, whereas in 2007-08, it reached to 66 percent. Subsidy of chemical fertilisers increased 51 percent in the last 8 years due to the special attention on increased food production in this country.

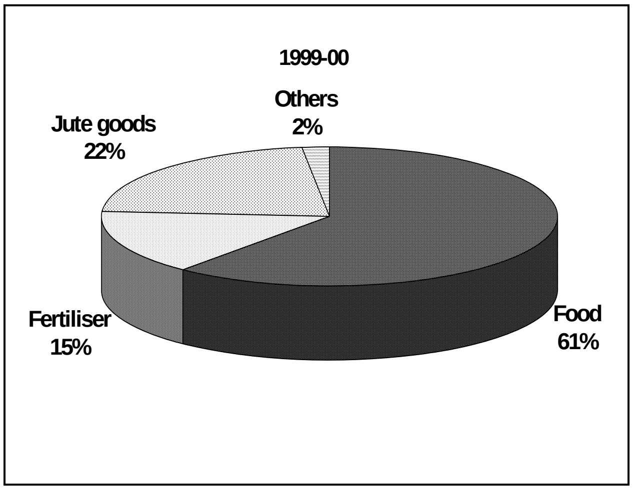
But high oil prices in the internal market and shrinking natural resources for fertiliser production, the prices of the imported fertilisers will continue to increase in the coming years. Therefore, the subsidy of chemical fertilisers will continue to increase which may occur the negative impacts on the others portions and consequently soil health. So, mobilization of all native organic resources and recycling them into soil fertilisation program is essential for sustainable rice production in future. From this study, it is found that if 20-30 percent of the total fertiliser subsidy is given to organic fertiliser, it could easily increase the production of organic fertiliser three times from the present production which could cover a significant portion of future fertiliser demand within 2050 *(see section: 2.7 Importance of Organic Fertiliser)* as well as solve the growing fuel crisis in rural households.

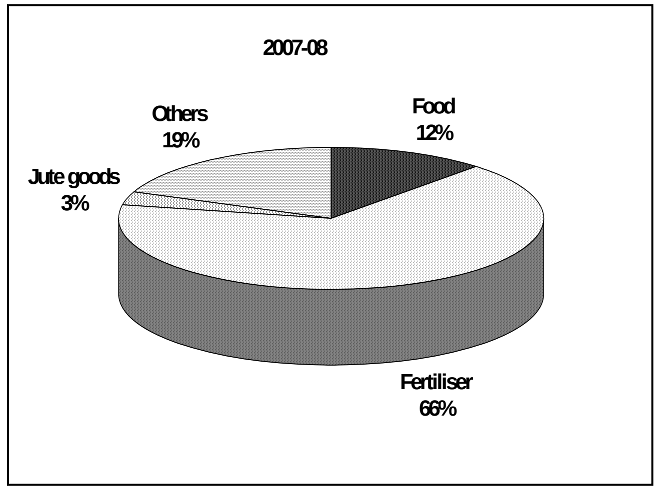
Fig. 9: Year wise Subsidy allocation for Agricultural sector



(Source: Authors' calculation based on Bangladesh Economic Review, 2010)

Fig. 10: Growth of Subsidies in some Major Areas





(Source: Adapted from http://www.mof.gov.bd/en/budget/rw/fiscal_sector)

Section 03

3.0 Conclusion and Discussion

The sustainable increase of rice production for food sufficiency requires efforts to enhance the capacity of rice production system. All agricultural inputs which are involved directly or indirectly in rice production must be adequate and accessible at farmers' field during the total growing season. Timely supply and availability of fertilisers at reasonable prices at the doorsteps of the hard working farmers in the country is necessary for optimum supply of nutrients to the depleted soils for successful achievement of the targeted rice production. Therefore, well-timed supply and availability of fertilizer should receive top priority to sustain/increase rice production, while food availability is crucial factor for poverty stricken people and the country is being challenged with feeding increasing population.

The study shows that the use of chemical fertilisers in agriculture of Bangladesh started sharply after the year of 1975 and significant amount of fertiliser consumption was noted during 1975-76. In this study, it is also found that there is a linear correlation among the fertiliser application, the cropping intensity and high yielding varieties. In 2008-09, high yielding varieties covered more than 72 percent to the total cultivable land area in Bangladesh. Similarly, cropping intensity has increased dramatically in the last decades and increased more than 23 percent in the last 15 years.

Nutrient balance for rice production system is very useful in developing nutrient management strategies for sustainable production. But most of our farmers do not know the recommended dose for rice production. The continuous and unbalanced use of the chemical fertilizers under intensive cropping systems is one of the main causes for declining crop yield. This study reveals that actual use of all the different fertilisers for rice production are below the recommended dose and the gap is also significant for both TSP and MP fertilisers. However, one of the important inputs required for continuing rice production in a sustainable way is the supply of balanced fertilisers consisting of N-P-K.

Furthermore, applying organic manure along with NPK fertilizer has been found to be beneficial because it supplements P and K, adds some secondary and micronutrients, and improves the physical and biological characteristics of the soil. Moreover, the organic fertilizers can play a vital role in restoring fertility as well as organic matter status of the cultivating soils.

The study shows that the demand of fertilisers would become significant in near future. Therefore, it is necessary to increase the production of all types of fertilisers both chemical and organic in domestic level. Under such situations, there is no alternative but to add organic fertiliser in the soils to sustain crop productivity and to increase fertility. The prices of the imported fertilisers will continue to increase in the coming years due to high price of oil in internal market and raw materials for fertiliser production in external market, and shrinking natural resources for fertiliser production. Therefore, mobilisation of all organic resources and recycling them into soil fertilisation program must be considered. Besides, Government can take some public awareness media activities and advocacy to influence farmers for using balanced fertiliser dose and can emphasize the use of organic fertiliser for rice production in Bangladesh.

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