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STUDIES ON THE CROPPING PATTERN AND SOIL BASED COMPUTERIZED FERTILIZER RECOMMENDATIONS IN THE GANGETIC SOILS OF BANGLADESH

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ABSTRACT

Kabir MH, Jabed MA (2013) Studies on the cropping pattern and soil based computerized fertilizer recommendations in the Gangetic soils of Bangladesh. *J. Innov. Dev. Strategy*. 7(2), 39-43.

The results obtained from the studies done on the cropping pattern and soil based fertilizer recommendations show that the fertilizer recommendations given by different agencies for farmers as per soil properties made during the last decade deviated by more than 44-65% for rice-cereal grain based cropping patterns. The study areas included Gangetic Alluvium including AEZ-10 Active Ganges Floodplain, AEZ-11 High Ganges Floodplain (FP), AEZ-12 Lower Ganges FP, AEZ-13 Ganges Tidal FP, AEZ-14 Gopalganj-Khulna Peat Basin, AEZ-15 Arial Beel, AEZ-12 High Ganges FP, and attached AEZ-8 Yong Brahmaputra Jamuna FP and AEZ-9 Old Brahmaputra FP transition soils The work was done after detail analysis of the SRDI-DAE database and data of primary data collection from about 2000 soil samples representing Nowabganj and Gournadi Upazila. The summarized findings of the studies were shared with 50 dealer farmers of which 78% of the dealer-farmers told that they were using fertilizers which quantities are more by about 20% than what is recommended by the DAE agencies. Nawabganj Upazila soil potentials and crop productivity decreased by 37% when compared with the data of last decade. The findings directly indicated the essentiality of doing more researches detailing out the accurate diagnosis of soil fertility problems by field testing of soils and making yield target based computer software based fertilizer recommendations as found workable in this research.

Key words: *cropping pattern, computerized fertilizer recommendation Agro-Ecological Zones*

INTRODUCTION

A fertilizer is a plant nutrient added to a soil to increase its yield. Plants need nutrients to grow and produce fruits and vegetables. Two categories of nutrients have been identified in fertilization: macronutrients and micronutrients. There are only six macronutrients and they are required in large amounts by plants: nitrogen, phosphorus, potassium, sulfur, magnesium, and calcium. However, a larger number of micronutrients are required but in trace amounts: iron, manganese, boron, zinc, copper, molybdenum, chlorine, cobalt, nickel, sodium, and silicon. Eliminate any of these elements, and plants will display abnormal growth and deficiency, or they may not reproduce.

The most popular fertilizers contain the three major nutrients: nitrogen, phosphorus, and potassium, and they are therefore referred to as NPK fertilizers. To illustrate their importance in any economy, in 2000, the world consumption of the total fertilizer nutrient ($N + P_2O_5 + K_2O$) was 140 million tons, representing 52 million tons for developed countries and 88 million tons for developing countries. The correct application of fertilizer is essential for the maximization of farm income, and agricultural production, product quality and environmental improvement. As the rate of fertilizer application have risen over the last two decades, correct fertilizer use has also become increasingly important-together with other best management practices for the minimization of certain undesirable environmental consequences. The correct application of fertilizer is essential for the maximization of farm income. As the rate of fertilizer application have risen over the last two decades, correct fertilizer use has also become increasingly important-together with other best management practices for the minimization of certain undesirable environmental consequences. Micronutrients are not specifically applied to soil since they are naturally found in soils. However, there are some extreme cases where they must be supplied. IN the context the present piece of research was undertaken with the specific objectives namely, to analyze fertilizer recommendation resources for the study AEZ areas; to interpret the soil features and crop requirement soil fertility database and to specify the fertilizer doses for different crops as a digital computerized model for the users.

MATERIALS AND METHODS

The methods and materials use in the study are detailed in the appendices and the salient steps of the methods are mentioned here along with the expected results as per objectives.

The sites and cropping patterns used in the studies are given in the Table 1. The study was formulated with the following methodology such as: i. collection and analysis of soil samples, ii. field observations and documentation of the field level soil fertility and soil productivity problems along with nutrient deficiency symptoms; iii. compilation and processing the data and its interpretation and iv. conducting workshop on fertilizer recommendation findings. The land and soil testing activities were accomplished as per methodical guidelines recommended by Peterson *et al.* (1996) and Raun *et al.* (1998).

Table 1. The study sites and its major cropping patterns

AEZ	AEZ name	Major filed crops
7	Active Brahm- Jam FP	Transplant/T Aman, Aus, Jut, Aus + Aman, Wheat
8	Young Brahm Jam FP	T Aman, Boro, Sugarcane, Tobacco, Jute, Mustard
9	Old Brahm FP	T Aman, Boro, Jute, Pulse, Mustard, Sweet potato,
10	Active Ganges FP	T Aman, Blackgram, Wheat, Boro, Jute, Pulse, Mustard
11	High Ganges River FP	Wheat, T Aman, Boro, Chick pea, Aus + sugarcane, Cotton
12	Low Ganges River FP	T Aman, Boro, Lentil + intercrops, Jute, Grass pea, Broadcast Aman
13	Ganges Tidal FP	B Aus, T Aman, Mungbean, Mustard, Boro, cowpea
14	Gopalganj- Khulna Beel	T Aman, Jute, Sesame, Boro, Aus + Aman
15	Arial Beel	Pulse, Aus + Aman, Boro, Mustard

Soil Analysis: The study location is in the Ganges Plain and has alluvial soils ranging from coarse-loamy, mixed, thermic, Hapludults to fine-loamy, mixed, thermic, Ultic Hapludalfs and these were identified and processed as a part of specific site selection and collection as recommended by Brammer (1971); Brammer and Khan (1991); Sawyer (1994) and BARC (2005). Ranges in productivity and fertilizer needs are associated with available water-holding capacity and soil texture. Fertilizer Recommendation Systems on Various Soils and Crops suggested by Csath *et al*. (2009) were followed in interpreting results. Soil samples were taken on a grid throughout the two fields with a total approximate area of 21 ha. The sites and persons selected for interview were determined at random from the Upazila such as: part of Nowabganj, Gournadi, Bauphal, Bakerganj, Kolaroa, Kashiani. The questionnaire was pre-tested in some areas and finalized schedule was used for data collection. The collected data were compiled and analyzed scientifically as to get the output as per objectives. The base line soil fertility data parameters are given in the Table 2.

Table 2. Fertility Status in Percentage of different areas analysis (SRDI Lab MOA)

Upazila/ District		**Fertility status in Percent (%)**					
		Very low	**Low**	**Medium**	**Optimum**	**High**	**Very high**
Nowabganj Dhaka	N*	70.55	11.76	11.76	-	-	-
	P	58.82	29.41	11.76	-	-	5.88
	K	-	-	24.17	41.17	23.52	5.88
	S	76.47	5.88	5.88	5.88		5.88
	Zn*	-	64.70	5.88	5.88	17.64	5.88
	B*	17.64	58.82	17.64	5.88	-	-
	Mg	-	-	-	-	-	100
	pH	6.0-7.8 (slightly acidic to slightly alkaline)					
Gournadi Barisal	N*	87.5	12.50	-	-	-	-
	P	87.5	12.50	-	-	-	-
	K	-	-	37.5	37.5	25	-
	S	-	25	37.5	-	37.5	-
	Zn*	50	50	-	-	-	-
	B*	12.5	37.5	37.5	-	-	12.5
	Mg	-	-	-	-	-	100
	pH	7.0 - 8.0 (neutral- slightly alkaline)					
Bauphal Patuakhali	N*	-	100	-	-	-	-
	P	-	-	50	50	-	-
	K	100	-	-	-	-	-
	S	-	50	50	-	-	-
	Zn*	25	75	-	-	-	-
	B*	-	25	75	-	-	-
	Mg	-	-	-	-	-	100

RESULTS AND DISCUSSION

The results of the study are presented here in both tabular forms and graphs and described sequentially as per crops and Agro-Ecological Zones (AEZ) specially the Gangetic Floodplains. The results are given on the basis of Crops and cropping, Agro-Ecological Zones and Upazila.

Rice

The mean results obtained here with rice Crops and Cropping Pattern based Fertilizer Recommendations (mean of land types, yield 5.00±0.5 t/ha) BARC Guide covering Boro, T. Aman local and HYV of different land types and Agro-Ecological Zones are presented in the Tables 3-6. The results obtained show that the rates currently used by local farmers for different crops were 10-24% higher than the BARC recommendations. It may be due to the gradual degradation soil nutrient content and enhanced target yields of crops as previously apprehended by scientists and extension professionals (Brammer and Khan, 1991).

Table 3. Fertilizer element kg/ha for Boro (MV) under irrigated condition, BARC (2005)

Nutrients	AEZ-10	AEZ-11	AEZ-12	AEZ-13	AEZ-8	AEZ-9	AEZ-14
N	65	82	75	69	77	86	56
P	6	8	7	5	8	6	6
K	28	31	22	16	23	27	11
S	11	15	16	12	12	10	4
Zn	2	3	1	2	2	2	1

The results obtained on MV Boro rice under irrigated condition show that the AEZ greatly varied in their fertilizer requirement as per BARC Fertilizer Recommendation Guide for BARC recommendations (Fig. 1 and 2) and existing use rates. The results indicate that the fertilizer recommendations were comparatively in case of High Ganges Floodplain (AEZ 11) and Old Brahmaputra Floodplain (AEZ). While when analyzed and compared for nutrient types, the doses of nitrogen were recommended to be very high creating unbalance with phosphorus and potassium and Sulphur.

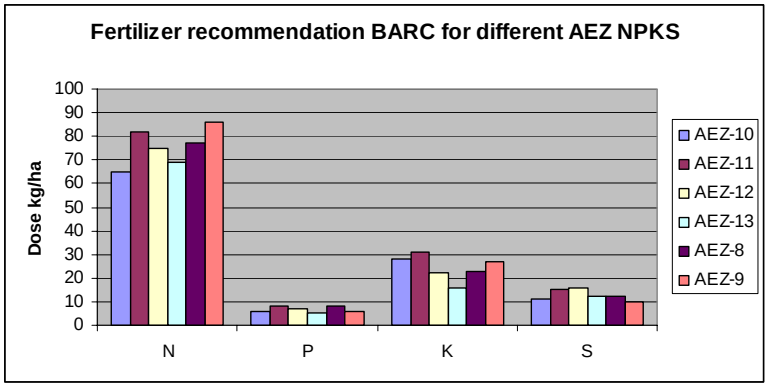

Fig. 1. NPKS recommendation for major AEZ BARC (2005)

Existing doses for winter (boro) rice

The results given in the table 4 show that the mean fertilizer now under use is highest for nitrogen, the mean being 77.86 kg/ha. The mean value as per Agro-Ecological was highest for High Ganges Floodplain being 29 kg/ha including Zinc followed by 28.8 kg/ha foe lower Ganges Floodplain. It reveals rapid degradation of fertility of these 2 Gangetic Floodplains due to intensive cropping system with high yielding modern varieties and hybrids. Similar results were also previously reported by Brammer and Khan (1991). But the intensity of degradation increased at higher rates. The findings illustrated in the Fig. 2. show clearly the inter AEZ and inter nutrient interactions as per cropping pattern studied.

Table 4. Fertilizer element Kg/ha for Boro (MV) under irrigated condition-Existing

Nutrients	AEZ-10	AEZ-11	AEZ-12	AEZ-13	AEZ-8	AEZ-9	AEZ-14	Mean
N	70	87	90	74	82	81	61	77.86
P	6	8	10	5	9	6	7	7.29
K	28	31	22	16	7	31	13	21.14
S	14	16	19	14	17	13	8	14.43
Zn	4	3	3	2	3	2	2	2.71
Mean	24.4	29.0	28.8	22.2	23.6	26.6	18.2	

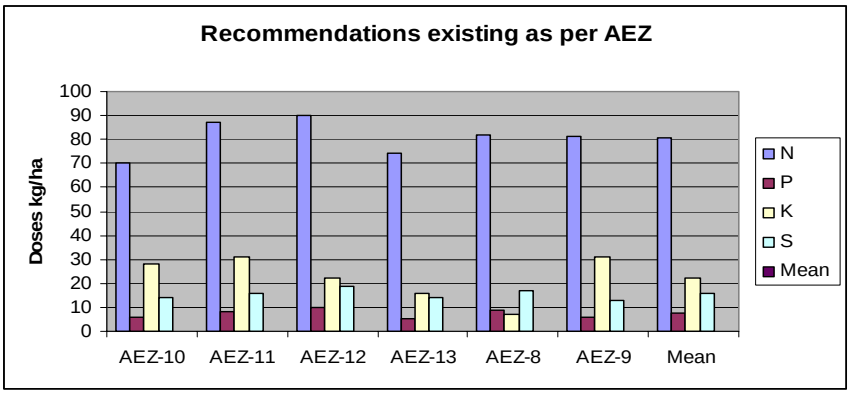

Fig. 2. Fertilizer recommendation pattern as used currently

Fertilizer element Kg/ha for Boro (MV) under rain-fed condition

The results given on the modern composite varieties mentioned here clearly show lower doses compared to irrigated culture of rice. Similar trend of results with respect to fertilizer use were also found in case of rain-fed culture as given in the Table 6 when compared to Tables 3 and 4.

Table 5. Fertilizer element Kg/ha for T. Aman (MCV) under rain-fed condition, BARC (2005)

Nutrients	AEZ-10	AEZ-11	AEZ-12	AEZ-13
N	55	68	65	64
P	5	5	5	8
K	18	17	12	6
S	7	6	6	2
Zn	1	1	1	1

Table 6. Fertilizer element Kg/ha for T. Aman (MCV) under rain-fed condition (yield 4.00t/ha) –Existing

Nutrients	AEZ-8	AEZ-9	AEZ-14
N	72	74	59
P	8	7	7
K	22	24	12
S	8	6	1
Zn	2	1	1

High yield target irrigated cultures

The results found in the studies with higher yield Medium High Land (MHL) and Low Land (LL) irrigated culture show that (Table 7) the fertilizer doses did not very significantly other than for AEZ 14 for nitrogenous fertilizer. But the fertilizer requirement for Ganges Floodplain and other river floodplains including Brahmaputra Jamuna Floodplains for all other nutrients like phosphorus, potassium, sulphur and zinc. These results indicate that the current fertilizer doses need to be increased even yearly basis as per climate change driven soil fertility change dynamics to get the expected higher yield from the similar lands, soils and irrigation status for the modern varieties. The results were found to agree with the BARC (2005) comments and as they suggested for regular update of the BARC Recommendation Guide adapting future situations (Fig. 3).

Table 7. Boro (MV) cultivation under irrigated condition in MHL with yield goal t/ha 6.0

Fertilizer element	AEZ-8	AEZ-9	AEZ-11	AEZ-12	AEZ-13	AEZ-14
N	120	120	120	120	120	20
P	18	14	14	14	22	18
K	36	58	36	24	11	-
S	10	8	8	8	2	-
Zn	1.0	1.0	1.0	1.0	1.0	1.5

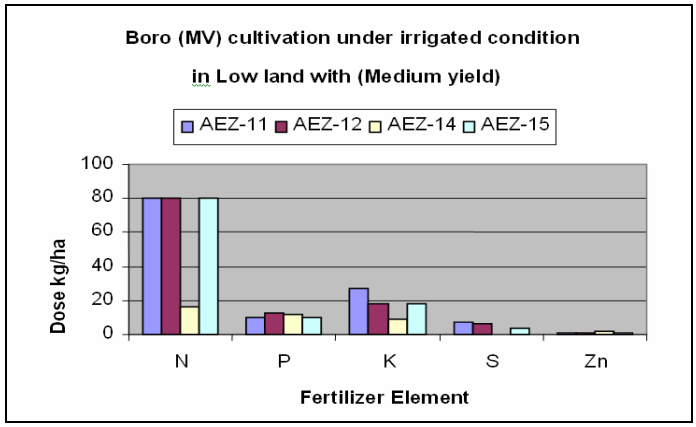

Fig. 3. Mean fertilizer use trends under irrigation culture in LL for medium yield

The results analyzed and reported here were tested with a IT fertilizers recommendations software supported by practical IPNS based nutrient deficiency symptoms covering 65 different major crops of Bangladesh, sampling from 30 AEZs.

CONCLUSION

From the study and analytical results it is needed to a single source fertilizer recommendation for farmers for high phase of medium high lands. The field tests made using Soil Testing Kit used by DAE and field tester made in Japan should be expanded covering both irrigated and rain-fed cultures. The nutrient deficiency symptoms found in the fields of the selected sites were documented and found to coincide with nutrient degradation of the soils. It should be taken in to technical account that the increased use of fertilizers by the farmers themselves up to 20% than what is recommended by the DAE agencies immediately. According to the findings the fertilizer recommendations as per soil properties made during the last decade deviated by more than 45% for cereal and fiber crops need on farm research in the context of climate and soil fertility changes. A detailed analysis of the Upazila based soil potentials and crop productivity should be done. The findings are in favour of doing more researches detailing out the accurate diagnosis of soil problems by field testing of soils and making yield target based specific fertilizer recommendations including micronutrients (zinc and boron). It is recommended that in the greater Ganges Floodplains under intensive crop culture, Upazila based variability of fertilizer recommendations made by different agencies should not vary more than 10% for NPK individually for similar cropping patterns which was at present found to be more than 20%.

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