Development of fertilizer recommendation for cabbage production in Low Ganges River Floodplain of Bangladesh

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Abstract
The study was conducted during rabi season of 2013-14 and 2014-15 at the farmer’s field of Farming System Research and Development (FSRD) site, Hatgobindapur, Faridpur under On-Farm Research Division (OFRD), Bangladesh Agricultural Research Institute (BARI) to evaluate the performance of chemical fertilizers for maximum yield of cabbage and higher economic return. The experiment was laid out in Randomized Complete Block Design (RCBD) with five dispersed replications. The experiment consisted of eight treatments viz. N242P120K33S19Zn1.4B0.6 kg ha\(^{-1}\) (100% NPKSZnB from Soil Test Based (STB) dose, T1), T1+25% N (T2), T1+25% NP (T3), T1+25% NK (T4), T1+25% PK (T5), T1+25% NPK (T6), 75% of T1 (T7), and native nutrient (control, T8). The treatment 100% NPKSZnB (soil test based) and additional 25% NPK (T6) treatment produced maximum head yield of cabbage (78.89 t ha\(^{-1}\)) which was statistically identical with 100% soil test based NPKSZnB (T1), 100% NPKSZnB with additional 25% N (T2), 100% NPKSZnB with additional 25% NP (T3) and 100% NPKSZnB with additional 25% NK (T4) treatments. The lowest head yield (33.92 t ha\(^{-1}\)) was obtained from native nutrient (control). The highest gross margin (Tk 756,093 ha\(^{-1}\)) was obtained from T6 (100% NPKSZnB from STB with additional 25% NPK) followed by T2 (T1 with additional 25% N) and T1 treatments. The results indicated that, the marginal rate of return (MRR) of changing from T7 to T1 was 1818% (for every Tk 100 of additional investment Tk 1,818 was obtained) and a changing from T1 to T2 gave MRR of 319%. From the experimental results, it was concluded that application of 100% chemical fertilizers of N242P120K33S19Zn1.4B0.6 kg ha\(^{-1}\) from soil test based (T1) would be suitable for higher yield and economic return of cabbage production in calcareous soil under Low Ganges River Floodplain (Agroecological Zone 12).

Keywords: Soil test based fertilizer, partial budget and dominance analysis, marginal rate of return, cabbage

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1 Introduction

Cabbage (Brassica oleracea L. var. capitata) is an important and nutritious leafy vegetable for winter season in Bangladesh. It is identified as one of the top twenty vegetables as well as an important source of food globally (FAO, 1988). Nutritionally, it contains vitamin A, B, C, E, and mineral such as iron, potassium, zinc, etc. Edible fibre content is significantly high in cabbage. In addition, the various other nutrients present in cabbage such as protein, manganese, folate, thiamin (vitamin B1), riboflavin (vitamin B2), omega-3 fatty acids, calcium, magnesium, potassium, etc., are very useful and blended 250 mL of raw cabbage contains 21 kilocalories whereas cooked contains 58 kilocalories (Haque, 2006).

Cabbage is grown throughout the world where China alone is growing about 45% and India 12% of the total world production (FAO, 2015). Bangladesh is also growing cabbage with an average production of 0.26 million tonnes per year (BBS, 2015). Among the winter vegetables grown in Bangladesh, cabbage ranks 7th and 5th in respect of area and production, respectively. The total area, production and yield of winter vegetable in Faridpur was 4125 ha, 87412 t and 21 t ha$^{-1}$, respectively (Anonymous, 2015). Different types of vegetables are cultivated mainly in high land to medium high land either in Vegetables-Vegetables-Vegetables cropping pattern (4680 ha of land covering 3% area by this pattern) or other minor pattern (12% area covered by this pattern) with different field crops. In the year of 2014-15, total area and production of cabbage in Faridpur was 254 ha and 7920 t, respectively. Faridpur Sadar upazilla covered 23% area for cabbage production followed by Modhukhali upazilla (22%) and Nagarkanda upazilla (17%) (BBS, 2013). However, the productivity of cabbage per unit area is quite low as compared to the developed countries of the world (Anonymous, 2006).

Among the various factors involved, nutrient supply is an important input for realizing higher cabbage yield and its nutrient content. Results from the previous experiment showed that the response of cabbage is high to nitrogen and moderate to phosphorus application. The importance of nitrogen, phosphorus, potassium and sulphur on the growth and yield of vegetable crops is well established (Hossain et al., 2011). Among the nutrients, nitrogen plays the most important role for vegetative growth of the crop. Phosphorus is also essential nutrient element which helps in the good growth of the roots of vegetable crops. Potassium exerts balancing role on the effects of both nitrogen and phosphorus. Boron nutrient is important in cell division, nitrogen and carbohydrate metabolism and water relation in plant growth (Brady, 1990). The cultivation of cabbage is required proper supply of plant nutrients. The requirement of these plant nutrients can be provided by applying inorganic fertilizer or organic manure or both. But, excessive fertilizer application caused a higher production cost and worse soil structure such as physical, chemical and biological degradation (Khosla et al., 2002; Li et al., 2007). As such, the nutrient deficient soils of cabbage production should be enriched with nitrogen, phosphorus, potassium, sulphur, etc through balanced use of fertilizer. The agronomic and economic data upon which the recommendations are based must be relevant to the farmers’ own agro-ecological conditions, and the evaluation of those data should be consistent with the farmers’ goals and socio-economic circumstances. The present study was, therefore, undertaken to find out the suitable combination of chemical fertilizers for maximum yield of cabbage as well as economically viable for farmers.

2 Materials and Methods

2.1 Physical environment of the study area

The study was conducted by On-Farm Research Division (OFRD), Bangladesh Agricultural Research Institute (BARI) in the farmer’s field of Farming System Research and Development (FSRD) site, Hatgobindapur, Faridpur during the two consecutive seasons of 2013-2014 and 2014-2015. The experimental field is situated in the eastern part of Krishnanagar union and south western part of Faridpur Sadar upazilla (23.6204° N to 89.8130° E). The topography of the study area was mainly high land having irrigated facilities with moderately well drained and falls under calcareous soil of Low Ganges River Floodplain (Agroecological Zone 12). The soil belongs to the Gopalpur series having loamy textural class.

2.2 Collection of soil sample and chemical soil analysis

The initial soil sample of the experimental site was collected from 0-15 cm depth. Chemical properties like exchangeable K and available P, S, Zn and B of collected soil samples were analyzed in the Soil Resource Development Institute (SRDI) laboratory in Faridpur and Dhaka following standard laboratory procedures (Hunter, 1984). Results of soil physical and chemical properties of initial soil samples are presented in Table 1. Characteristically, the soil was loam having pH 7.4 to 8.0, low in organic matter (1.31% ~ 2.43%). The fertility status of N, P and B was below the critical level and above the critical level for S, Zn and K nutrients (FRG, 2012).
were applied to ensure luxuriant growth of the crop. Insecticide i.e. Darsban (Chloropyriphos), Regent (Fipronil) and Nitro (Chloropyriphos and cypermethrin) 2 to 3 times and STB fertilizer dose for high yield goal. The tested cabbage variety was Atlas 70. The experiment was laid out in a Randomized Complete Block Design (RCBD) with eight treatments containing five dispersed replications. The unit plot size was 5 m \( \times \) 4 m. The treatment T1 comprises with soil test based (STB) fertilizer dose for high yield goal. The treatment combination is given in Table 2.

### 2.3 Experimental design

The tested cabbage variety was Atlas 70. The experiment was continued for 15 to 18 days from starting of first harvesting in the experimental plot.

Ten plants from each plot were tagged at random to keep records on number of unfolded leaves plant\(^{-1}\), head height plant\(^{-1}\) (cm), circumference of head plant\(^{-1}\), whole head weight (kg plant\(^{-1}\)), marketable head weight (kg plant\(^{-1}\)) and head yield (t ha\(^{-1}\)). During harvest, total number of plant population per unit plot was counted. After the harvest, whole head weight was measured with unfolded leaves. After that, number of unfolded leaves was counted. Then, marketable head without unfolded leaves was determined by weighing. At harvest, the head circumference of cabbage was measured by measuring tape at the widest part of the head. Finally, heads were cut on longer side and head height was measured. Different agronomic parameters and yield contributing attributes were analyzed statistically using MSTATC software and the mean separations were tested at 5% by Least Significant Difference (LSD) test.

Gross margin of the different fertilizer treatments was continued for 15 to 18 days from starting of first harvesting in the experimental plot. Partial budget and marginal analyses were used to determine the most economically acceptable fertilizer dose (Elias and Karim, 1984). Marginal rate of return was calculated by the following equation:

\[
MRR = \frac{AdB}{AdC} \times 100 \tag{1}
\]

where, MRR=marginal rate of return, AdB=Additional benefits between each pair of non-dominated treatments, AdC=Additional costs between each pair of non-dominated treatments.
3 Results and Discussion

Similar trend of yield and yield attributes of cabbage was observed in both the years of 2013-14 and 2014-15. Hence, pooled analysis was done, results are discussed below accordingly.

3.1 Head height of cabbage

In both the years, significant variation of head height of cabbage was found due to the application of different chemical fertilizers (Table 3). The maximum head height was 13.75 cm and 12.20 cm obtained from the 100% STB inorganic fertilizers dose and 25% additional NPK (T6) during 2013-14 and 2014-15, respectively. In pooled analysis, the maximum head height (12.93 cm) was obtained from T6 which was statistically similar to 100% STB inorganic fertilizers dose (T1), 25% additional N with T1 (T2), 25% additional NP with T1 (T3) and 25% additional PK with T1 (T5). The lowest head height (8.83 cm) was observed from control (T0) as well as weight of whole head weight (1257 g plant−1). The lowest head height was found from 100% STB inorganic fertilizers dose (T1) to 100% STB inorganic fertilizers dose and 25% additional NPK (T6). The maximum was found from the T6 where the highest fertilizer doses was used followed by T1. The minimum was recorded from control (T0) (Table 3). This result was in agreement with the report of Din et al. (2007).

3.4 Plant population at harvest

There was no significant effect of chemical fertilizers on the final plant population in cabbage in the year of 2013-14 and 2014-15. However, in pooled analysis, the final plant population varied from 77 to 78 (Table 4).

3.5 Whole head weight and marketable weight

Table 4 represents the whole head weight and marketable weight of cabbage was influenced by different nutrient packages during both the years. In both years, the treatment comprises of T1 to T6 showed statistically identical head weight but showed significant difference from T7 treatment. In 2013-14 and 2014-15, whole head weight ranged from 1.43 to 3.15 and 1.22 to 2.36 kg plant−1, respectively. From the pooled analysis, it was observed that, the highest whole head weight (2.73 kg plant−1) was obtained from T6 (100% STB with 25% NPK) followed by T1 (100% STB). The lowest head weight (1.32 kg plant−1) was obtained from T8 treatment. Same result was showed from marketable head weight. In 2013-14 and 2014-15, marketable head weight ranged from 0.94 to 2.36 and 0.79 to 1.73 kg plant−1, respectively. From the pooled analysis, it was observed that, the highest marketable head weight (2.05 kg plant−1) was obtained from T6 (100% STB with 25% NPK) due to might be maximum circumference of head followed by T2 (100% STB with 25% N). The lowest marketable head weight (0.98 kg plant−1) was obtained from T8 treatment due to might be found the maximum number of unfolded leaves. Kamal et al. (2007) found that nitrogen at the rate of 20 kg N ha−1 gave the highest total weight (1257 g plant−1) as well as weight of head (1032 g) in Chinese cabbage.

3.3 Circumference of cabbage head

Different fertilizer levels markedly influenced the circumference of head of cabbage. From both the year, the maximum and minimum circumference was observed from T6 treatment (100% STB inorganic fertilizers dose and 25% additional NPK) and T8 (Native nutrient), respectively. From the pooled analysis, it was observed that, significant variation in circumference of head among the treatment, varying from 44.71 to 65.63 cm. There was no significant difference on circumference of cabbage head among 100% STB inorganic fertilizers dose (T1) to 100% STB inorganic fertilizers dose and 25% additional NPK (T6). The maximum was found from the T6 where the highest fertilizer doses was used followed by T1. The minimum was recorded from control (T0) (Table 3). This result was in agreement with the report of Din et al. (2007).

3.6 Head yield

The head yield of cabbage was significantly affected by different combinations of nutrient treatments (Table 4). From both the year’s result, it was found that the treatment T6 which comprises of 100% NPKSZnB with 25% NPK treatment produced maximum head yield. In 2013-14 and 2014-15, the maximum head yield of cabbage was 86.62 t ha−1 and 69.48 t ha−1, respectively. In pooled analysis, the maximum head yield was 78.89 t ha−1. Increase in maximum head
Table 3. Effect of fertilizer dose on head height plant\(^{-1}\), number of unfolded leaves plant\(^{-1}\) and circumference head plant\(^{-1}\) of cabbage (individual year wise and pooled of 2013-14 and 2014-15)

| Treatment† | Head height plant\(^{-1}\) (cm) | Unfolded leaves plant\(^{-1}\) | Circumference of head plant\(^{-1}\) |
|------------|---------------------------------|---------------------------------|-----------------------------------|
|            | 2013-14 | 2014-15 | Pooled | 2013-14 | 2014-15 | Pooled | 2013-14 | 2014-15 | Pooled |
| T\(_1\)    | 13.45ab | 12.08a  | 12.71ab | 14.05   | 11.24ab | 12.85   | 72.60a  | 57.34ab | 64.82a |
| T\(_2\)    | 13.26bc | 11.92a  | 12.54ab | 14.04   | 10.68b  | 12.34   | 72.69a  | 56.88ab | 64.66a |
| T\(_3\)    | 13.73a  | 12.00a  | 12.77ab | 13.86   | 10.92ab | 12.23   | 72.53a  | 56.58ab | 64.12a |
| T\(_4\)    | 12.98c  | 11.80a  | 12.40b  | 14.71   | 11.56ab | 13.25   | 72.00a  | 55.26ab | 63.51a |
| T\(_5\)    | 13.17bc | 11.86a  | 12.54ab | 15.57   | 11.04ab | 13.32   | 71.81a  | 55.86ab | 63.61a |
| T\(_6\)    | 13.75a  | 12.20a  | 12.93a  | 17.56   | 11.20ab | 13.17   | 73.48a  | 58.06a  | 65.63a |
| T\(_7\)    | 12.88c  | 11.14b  | 11.94c  | 14.9    | 11.44ab | 13.42   | 69.69b  | 52.96c  | 60.84b |
| T\(_8\)    | 8.38d   | 8.06c   | 8.83d   | 15.52   | 11.92a  | 13.96   | 50.60c  | 38.76d  | 44.71c |

CV (%) 2.75 2.75 2.83 9.67 6.63 9.7 2.78 2.89 3.08
LSD (0.05) 0.38 0.41 0.44 NS 0.96 NS 2.08 2.02 2.4

† T\(_1\)=100% NPKSZn from STB dose, T\(_2\)=T\(_1\)+ 25% N, T\(_3\)=T\(_1\)+ 25% NP, T\(_4\)=T\(_1\)+ 25% NK, T\(_5\)=T\(_1\)+ 25% PK, T\(_6\)=T\(_1\)+ 25% NPK, T\(_7\)=75% of T\(_1\), T\(_8\)=native fertility without addition of fertilizers

‡ In a column, means followed by same letter(s) are statistically similar at 5% level by DMRT, and NS=Not significant

Table 4. Effect of fertilizer dose on yield and yield contributing characters of cabbage (individual year wise and pooled of 2013-14 and 2014-15)

| Treatment† | Plant population (30m\(^{2}\)) at harvest | Whole head wt. (kg plant\(^{-1}\)) | Marketable head wt. (kg plant\(^{-1}\)) | Head yield (t ha\(^{-1}\)) |
|------------|------------------------------------------|---------------------------------|-----------------------------------|------------------------|
|            | 2013-14 | 2014-15 | Pooled | 2013-14 | 2014-15 | Pooled | 2013-14 | 2014-15 | Pooled | 2013-14 | 2014-15 | Pooled |
| T\(_1\)    | 74.23   | 79.6    | 77    | 3.01a  | 2.36a  | 2.69a | 2.27ab | 1.71a  | 1.99ab | 82.38ab | 68.08a | 76.21ab |
| T\(_2\)    | 75.14   | 79.6    | 77    | 2.99a  | 2.28a  | 2.63a | 2.29ab | 1.72a  | 2.01a  | 84.24ab | 68.44a | 77.31a |
| T\(_3\)    | 75      | 79.4    | 77    | 2.95a  | 2.31a  | 2.63a | 2.21ab | 1.67ab | 1.94ab | 83.29ab | 65.94ab | 74.28ab |
| T\(_4\)    | 74.71   | 80.2    | 77    | 3.03a  | 2.20a  | 2.61a | 2.24ab | 1.63ab | 1.94ab | 80.98ab | 65.32ab | 74.20ab |
| T\(_5\)    | 74.71   | 80.2    | 78    | 2.94a  | 2.15a  | 2.64a | 2.18b  | 1.55b  | 1.87ab | 79.02b  | 62.10b  | 71.54b |
| T\(_6\)    | 75      | 80      | 77    | 3.15a  | 2.32a  | 2.73a | 2.36a  | 1.73a  | 2.05a  | 86.62a  | 69.48a  | 78.89a |
| T\(_7\)    | 74.43   | 80      | 77    | 2.63b  | 1.93b  | 2.28b | 1.96c  | 1.35c  | 1.76b  | 70.65c  | 53.94c  | 63.44c |
| T\(_8\)    | 74.86   | 80.8    | 78    | 1.43c  | 1.22c  | 1.32c | 0.94d  | 0.79d  | 0.98c  | 36.05d  | 31.9d   | 33.92d |

CV (%) 0.97 1.19 1.57 8.03 7.74 8.53 5.46 6.21 10.1 6.08 6.33 6.03
LSD (0.05) NS NS NS 0.29 0.21 0.27 0.15 0.12 0.24 4.95 4.97 5.25

† T\(_1\)=100% NPKSZn from STB dose, T\(_2\)=T\(_1\)+ 25% N, T\(_3\)=T\(_1\)+ 25% NP, T\(_4\)=T\(_1\)+ 25% NK, T\(_5\)=T\(_1\)+ 25% PK, T\(_6\)=T\(_1\)+ 25% NPK, T\(_7\)=75% of T\(_1\), T\(_8\)=native fertility without addition of fertilizers

‡ In a column, means followed by same letter(s) are statistically similar at 5% level by DMRT, and NS=Not significant
Table 5. Cost and return analysis of cabbage production as influenced by different fertilizer doses†

| Treatment | Gross return (Tk ha$^{-1}$) | Nutrient cost (Tk ha$^{-1}$) | Gross margin (Tk ha$^{-1}$) |
|-----------|-----------------------------|-----------------------------|-----------------------------|
| $T_1$     | 762,100                     | 26,634                      | 735,466                     |
| $T_2$     | 773,100                     | 29,259                      | 743,841                     |
| $T_3$     | 742,800                     | 32,559                      | 710,241                     |
| $T_4$     | 742,000                     | 29,507                      | 712,493                     |
| $T_5$     | 715,400                     | 30,182                      | 685,218                     |
| $T_6$     | 788,900                     | 32,807                      | 756,093                     |
| $T_7$     | 634,400                     | 19,975                      | 614,425                     |
| $T_8$     | 339,200                     | 0                           | 339,200                     |

† Price of input (Tk kg$^{-1}$): Urea Tk 20.00, TSP Tk 22.00, MoP Tk 15.00, Gypsum Tk 8.00, Boric acid Tk 160.00, Zinc sulphate monohydrate Tk 150.00 Labor Cost (Tk labor$^{-1}$): 300.00 No. of labor required for 1 ha fertilizer application (3 times): 10 (2 labor needed for applying basal dose, 4 for one time fertilizer application by ring method) Average output price of cabbage (Tk kg$^{-1}$): 10.00

$T_1$=100% NPKSzn from STB dose, $T_2$=$T_1$+ 25% N, $T_3$=$T_1$+ 25% NP, $T_4$=$T_1$+ 25% NK, $T_5$=$T_1$+ 25% PK, $T_6$=$T_1$+ 25% NPK, $T_7$=75% of $T_1$, $T_8$=native fertility without addition of fertilizers

Table 6. Marginal analysis of cost undominated treatments applied in cabbage at FSRD site, Faridpur

| Treatment | Nutrient cost (Tk ha$^{-1}$) | Marg. increase in fert. cost (Tk ha$^{-1}$) | Gross margin (Tk ha$^{-1}$) | Marg. increase in gross margin (Tk ha$^{-1}$) | MRR (%) |
|-----------|-----------------------------|---------------------------------------------|-----------------------------|---------------------------------------------|--------|
| $T_8$     | 0                           | –                                           | 339,200                     | –                                           | –      |
| $T_7$     | 19,975                      | 19,975                                      | 614,425                     | 275,225                                     | 1,377  |
| $T_1$     | 26,634                      | 6,659                                       | 735,466                     | 121,041                                     | 1,818  |
| $T_2$     | 29,259                      | 2,625                                       | 743,841                     | 8,375                                       | 319    |
| $T_6$     | 32,807                      | 3,548                                       | 756,093                     | 12,252                                      | 345    |

$T_1$=100% NPKSzn from STB dose, $T_2$=$T_1$+ 25% N, $T_6$=$T_1$+ 25% NPK, $T_7$=75% of $T_1$, $T_8$=native fertility without addition of fertilizers

Figure 1. Net benefit curve for different fertilizer treatments in cabbage including cost dominated and cost un-dominated treatments
yield of cabbage could be explained by higher marketable head weight plant$^{-1}$ which might be due to the use of balanced fertilizers. Moreover, application of chemical fertilizer might helped in maintaining soil fertility and offered favorable response in the required nutrient uptake by the plants, which reflect greater yield. This treatment showed statistically identical yield with T$_1$ to T$_4$ treatments. The head yield production increased progressively with the increase amount of N-fertilizer along with phosphorus fertilizer which could be supported by the report of Humadi and Hadi (1988) and Mohans and Hossain (1998). Reduced fertilizer dose in treatment T$_5$ failed to show higher yield. Plants grown without added fertilizer (T$_8$) produced the lowest head yield (33.92 t ha$^{-1}$) presumably due to lower availability of nutrients.

3.7 Partial budget analysis

A partial budget was developed as a part of economic analysis to calculate the total costs that vary and the gross margin for each treatment of the fertilizer experiment. The highest gross return (Tk 788,900 ha$^{-1}$) and gross margin (Tk 756,093 ha$^{-1}$) was obtained from 100% soil test based fertilizer dose along with additional 25% NPK (T$_6$). The lowest gross margin (Tk 339,200 ha$^{-1}$) was obtained from control treatment (Table 5).

3.8 Dominance analysis

For dominance analysis, the treatments were listed in order of increasing total costs that vary (fertilizer cost). The gross margin also increased, except treatments T$_3$, T$_4$ and T$_5$ where gross margin were lower than in Treatment T$_2$ (Table 5). Farmers would not select treatment T$_3$, T$_4$ and T$_5$ in comparison with Treatment T$_2$ because former treatments had higher nutrient cost but lower in gross margin. Such treatments are called a cost dominated treatment. Therefore, from the net benefit curve in Figure 1, it showed that, treatments T$_6$= T$_1$+25% NPK, T$_2$= T$_1$+25% N, T$_3$=100% NPKSzn (STB), T$_7$=75% of T$_1$, T$_8$=Native nutrient (Control) were cost undominated. The treatments T$_4$=T$_1$+25% NK, T$_3$=T$_1$+25% NP and T$_5$=T$_1$+25% PK were dominated by cost.

3.9 Marginal rate of return (MRR)

The marginal rate of return for changing from T$_8$ to T$_7$ is 1378% (Table 6). This means, if farmer invest Tk 19,975, he could recover Tk 19,975, plus an additional amount of Tk 275,225. In this way, the other marginal rate of return found from T$_7$ to T$_1$ treatment, T$_1$ to T$_2$ treatment and T$_2$ to T$_6$ treatment were 1818%, 319% and 345%, respectively. The highest marginal rate of return was observed from T$_7$ to T$_1$ (1818%) i.e. for every Tk 100 of additional investment Tk 1,818 was returned. Application of 100% chemical fertilizers of NPKSznB from soil test based (T$_1$) appeared as the best treatment combination for cultivation of cabbage from economic point of view when considering MRR.

4 Conclusion

Two years’ consecutive study revealed that, the maximum (78.89 t ha$^{-1}$) marketable head yield was obtained from N$_{302}$P$_{150}$K$_{41}$S$_{19}$Zn$_{14}$B$_{3.6}$ Kg ha$^{-1}$ (T$_1$+25% NPK) treatment whereas application of N$_{242}$P$_{120}$K$_{33}$S$_{19}$Zn$_{14}$B$_{0.6}$ Kg ha$^{-1}$ of chemical fertilizer (100% chemical fertilizers of NPKSznB from soil test based) might be suitable and economically viable for cabbage cultivation in the Faridpur under Low Ganges River Floodplain (Agroecological Zone 12).

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