Original Research Article

A comparative assessment of soil series wise fertility in Bheramara upazilla of Kushtia District of Bangladesh between the years 1995 to 2016

ABSTRACT

Aims: An experiment to quantify the changes in soil fertility in terms of available nutrient content was carried out between 1995 to 2016.
Study Design: The design of the study was a Randomized Complete Block Design (RCBD).
Place and Duration of Study: Bheramara upazilla of Kuahtia district in Bangladesh; between the years 1995 (considered as base line database) to 2016.
Methodology: Soil Resource Development Institute (SRDI) conducted semi-detailed soil survey at Bheramara upazilla of Kushtia district in 1995 and collected 18 soil samples and analyzed in the laboratory for chemical parameters. These data considered as baseline information for the present study (2016) and 18 soil samples were collected from the same or adjacent sampling point in 1995. Land use, organic matter application, crop yield and fertilizer use related information were also collected during the survey. Chemical analysis was performed in the regional laboratory, SRDI, Kushtia by following standard methods.
Results: Results revealed that soil pH and boron decreased significantly in most of the soil series. Organic Matter in all the series except Ganges silt significantly increased over the year. The variation in potassium content over the year was insignificant in all soil series except Sara series. In some soil series phosphorus and sulfur either increased or decreased over the year while soil zinc content did not varied significantly over the year
Conclusion: Soil nutrient data of the study area revealed that most of the parameters assessed showed positive direction towards fertility development due to agricultural knowledge development and advance soil and fertilizer management practices.

Key Words: Soil Fertility; Soil Series; Nutrient Status; Soil pH; Organic Matter.

1. INTRODUCTION

The capacity of soil to supply essential nutrients to crops has long been a major concern to agriculturalists. Soil fertility decline occurs when the quantities of nutrients removed from the soil in harvested products exceed the quantities of nutrients being applied. Soil fertility change and or alteration; and land degradation over longer periods was examined and investigated by different researchers [1, 2]. The nutrient requirements of the crop are met from soil reserves until these reserves cannot meet crop demands. This results in a reduction of plant growth and yield. However, the problem of declining soil fertility is becoming one of the major challenges for sustainable agriculture production. Agricultural productivity per unit area of land is declining through time and food production could not keep pace with population growth all over the world especially in Sub-Sahara African countries [3]. In order to feed the growing population, agricultural production has to grow at least by 3-4% per annum [4]. This can be achieved either by bringing more land under cultivation (extensification) or by increasing productivity per unit area of land (i.e. intensification). The first option has been less feasible due to shortage of land. The remaining feasible option is to increase productivity per unit area through improved soil fertility management accompanied with the use of improved crop varieties and better agronomic practices [5]. However, in many places, farmers continue mining soil nutrients without adequate replacement of nutrients conservation. There is widespread perception that per hectare yield of most of the crops in Bangladesh are either declining or stagnating. It might be the casual effect of crop intensification without fallow period, cultivation of modern varieties, without recommended soil and fertilizer management practices, removal of crop residues etc. Food and Agriculture Organization first reported that yield of major crops in Bangladesh are either declining or have stabilized [6]. However, a few research works has been done on the changing soil fertility status in Bangladesh at Bheramara upazilla of Kushtia District. The present study seeks:

i) to quantify the changes in soil fertility over time period in terms of available nutrient content,
ii) to determine the changes in organic matter content over time period and
iii) to assess the changes of soil P^H over time. The findings from the comparison of initial and current soil fertility status will be helpful for determination the nature and extent of changes of soil fertility over time.

2. MATERIALS AND METHODS

Soil Resource Development Institute (SRDI) is the key governmental organization in Bangladesh provides soil test and fertilizer recommendation based on soil analysis results at farmer level [7], this organization conducted semi-detailed soil survey at Bheramara upazilla of Kushtia district in 1995 which is located between 23^0 59` to $24^0$ 08` N latitude and 88^0 54` to $89^0$ 4` E longitude [8]. During that survey, SRDI collected 18 soil samples and analyzed in the laboratory for both physical and chemical properties. These data served as a baseline for the present study. To quantify the change in soil quality over time period in terms of available nutrient content, changes in organic matter content and changes of soil P^H over time. Subsequently, a new semi detailed soil survey was conducted using previous map in the year 2016. During this survey 18 soil samples were collected from the same or adjacent sampling point of 1995. Land use, use of organic matter, crop yield and fertilizer use related information was also collected during the survey. Agricultural constraints and development possibilities were discussed in Farmers/Focus Group Discussion. Chemical analysis was performed in the regional laboratory, SRDI, Kushtia by following standard methods. Soil P^H was determined by Glass Electrode P^H meter method with soil water ratio 1:2.5 [9], Organic matter was determined by Walkley-Black method [10], Potassium was determined by ammonium acetate extraction method [11], available sulfur was determined by Turbidimetric method [12], available zinc was determined by DTPA Extraction method [13] and boron was determined by Calcium chloride extraction method [14]. Statistical analysis was performed by using Statistics 10 software. P values were separated by Least Significance Difference (LSD) test.

3. RESULTS AND DISCUSSION

The soil series identified in this upazilla were Sara, Gopalpur, Iswardi, Ghior along with Ganges sand and Ganges silt in both the survey.

Significant variation in soil pH was observed among soil series and over the year (Fig. 2). In 1995, the highest soil pH was observed in Ganges Sand Series which was statistically similar with Ganges Silt, Ghoir, Gopalpur and Sara soil series. After 21 years in 2016, soil pH significantly decreased in Ganges Sand and Sara soil series, while in other soil series the variation in pH over the year and soil series was not significant (Fig. 1).The decrease in soil pH was due to decalcification or removal of lime and other bases from soils and addition of nitrogen and sulfur fertilizers in soils. The similar observation was also made by [15].

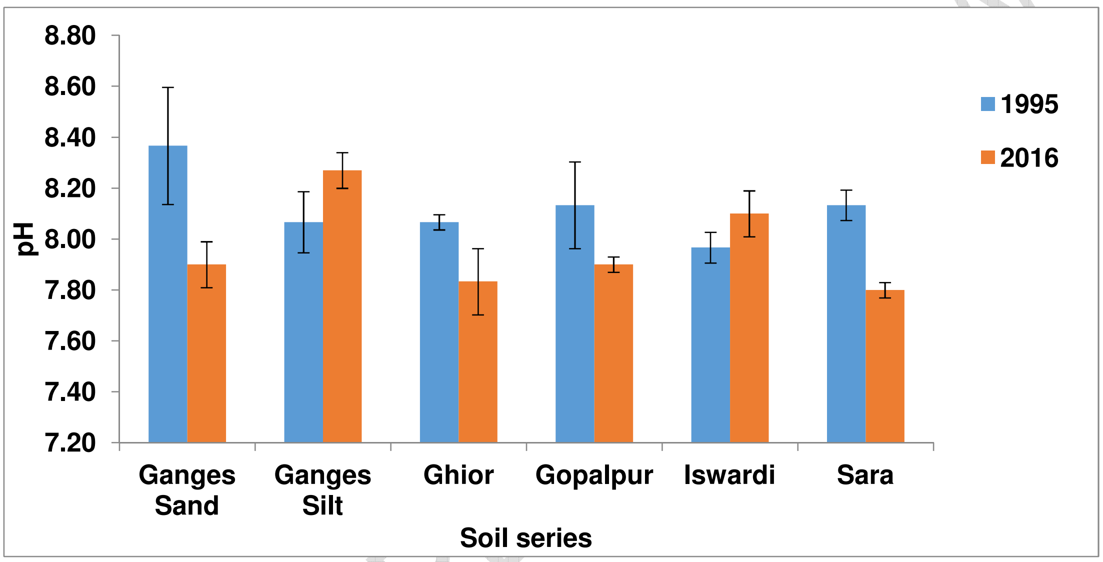

Fig. 1. Changes of Soil P^H between the years 1995 to 2016 period in studied soil series

Significant variation in soil organic matter (OM) was observed among soil series and over the year (Fig. 2). Among all the soil series except Ganges Silt, soil OM significantly increased in 2016 compared to 1995. In 1995 the lowest (0.73%) soil OM content was observed in Ganges Sand while in 2016 the highest (2.66%) OM content was found in Ghoir soil series. The increased OM after 21 years might be due to higher cropping intensity resulting in higher root biomass and crop residues, wet land cultivation viz. rice-rice cropping pattern which might have positive influence on soil OM.

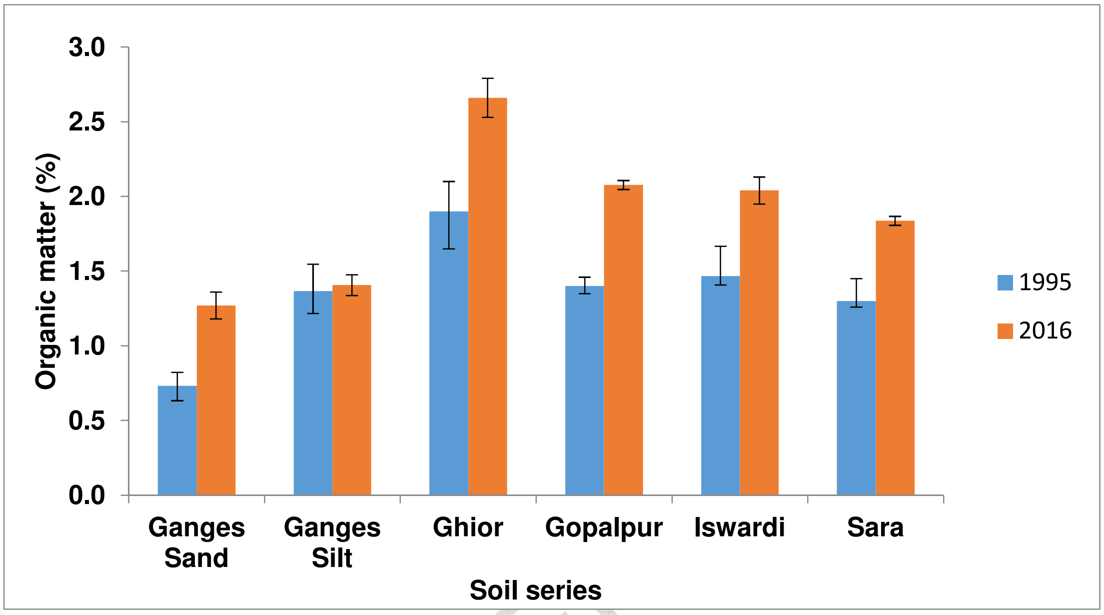

Fig. 2. Changes of Soil Organic Matter (OM) between the years 1995 to 2016 period in studied soil series

Potassium (K) is very mobile element both in soils and plants. This element also quickly changes its existence from active site to soil solution. The variation in K content was significant among the soil series and over the year (Fig. 3). In the both years, the highest exchangeable potassium was observed in Ghior series which was statistically similar with Ganges Silt, Gopalpur, Iswardi and the Sara soil series while the lowest exchangeable potassium was in Ganges Sand soil series. In Sara soil series K content increased significantly over the year while in other series the variations were statistically similar.

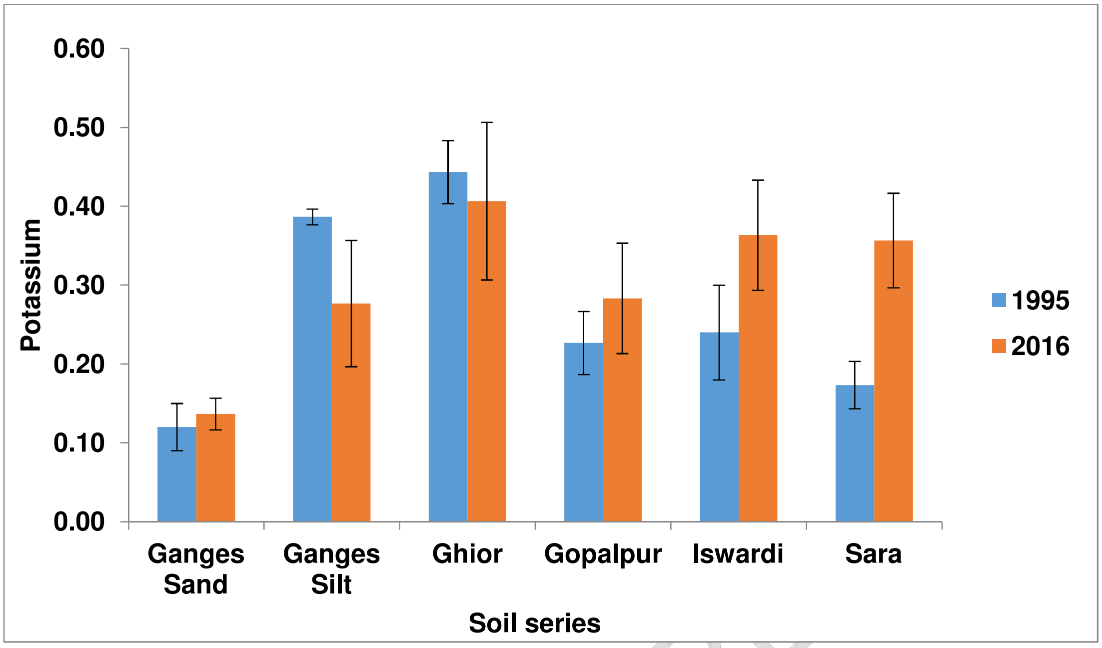

Fig. 3. Changes of Soil Potassium (K) between the years 1995 to 2016 period in studied soil series

The soil phosphorus content significantly varied among soil series and over the year (Fig 4). In 1995, significantly the highest soil P was observed in Ganges Silt Soil series while in 2016 there was no significant variation in soil P among different soil series. Significant increment of soil P was observed in Ghoir and Gopalpur soil series and significant decrease was observed in Ganges Silt soil series in 2016 compared to 1995.

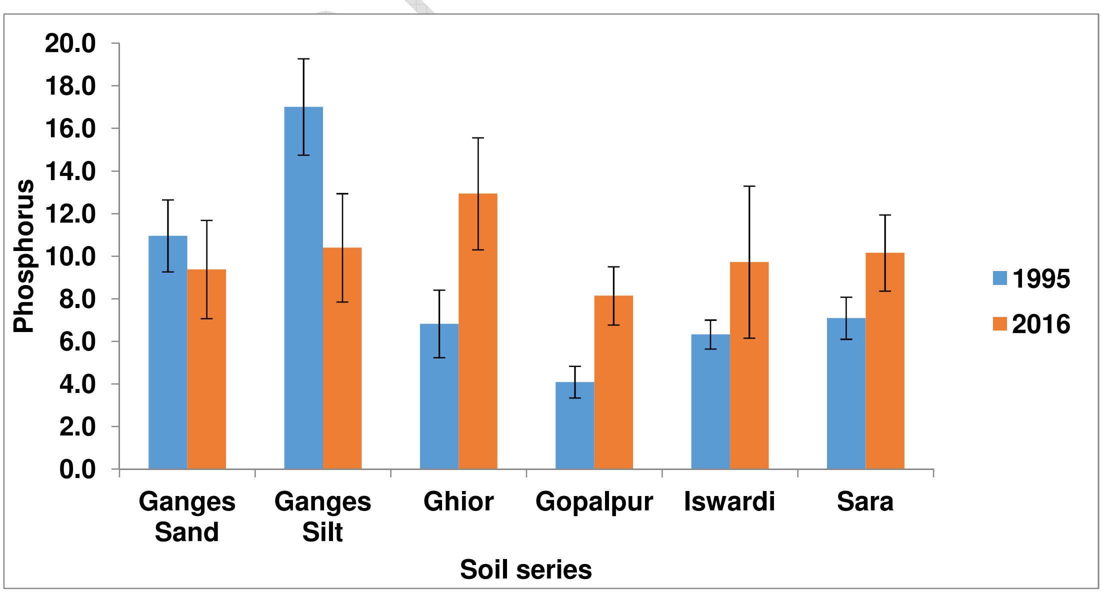

Fig. 4. Changes of Soil Phosphorus (P) between the years 1995 to 2016 period in studied soil series

The significant increment of soil sulfur (S) was found in Sara soil series while significant reduction of soil S was found in Ghoir soil series over the year (Fig. 5). In Other soil series the variation in soil S over the year was not significant.

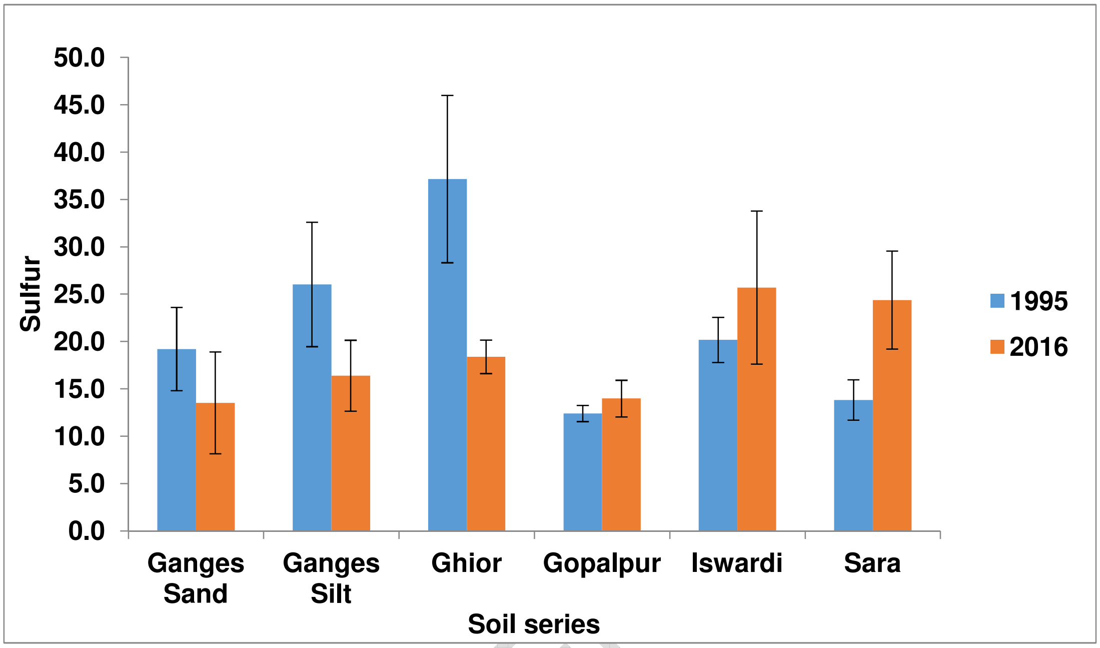

Fig. 5. Changes of Soil Sulfur (S) between the years 1995 to 2016 period in studied soil series

The change in soil available zinc (Zn) among the soil series and over the year was not significant (Fig. 6). In 1995, the available Zn ranged between 0.55-1.33 ppm while in 2016 it was between 0.73-1.00 ppm.

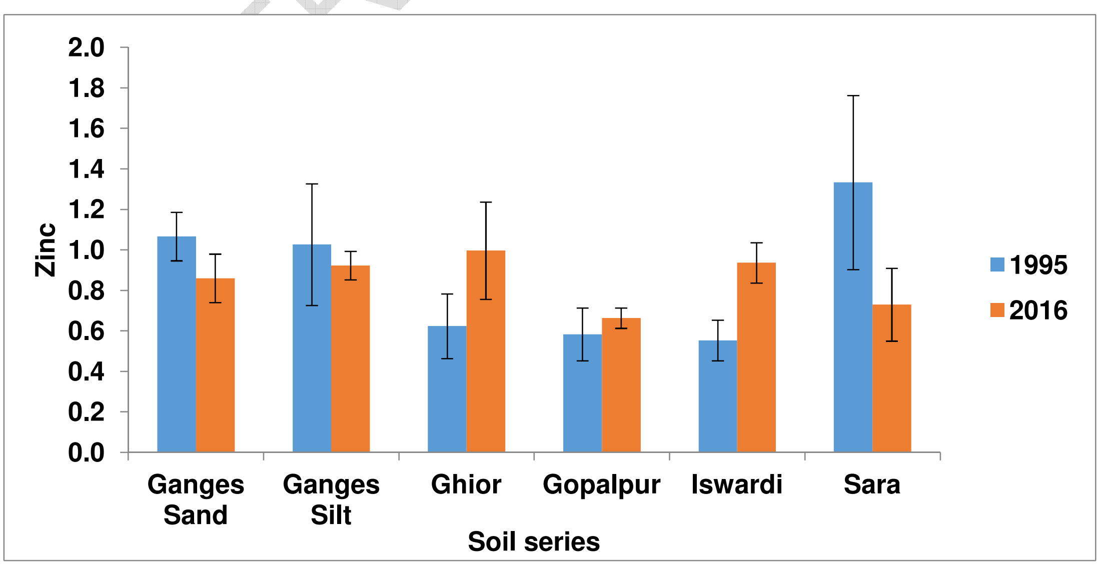

Fig. 6. Changes of Soil Zinc (Zn) between the years 1995 to 2016 period in studied soil series

The available boron (B) content significantly influenced with soil series and over the year. Available B had significantly depleted from the Ganges Silt, Ghoir, Iswardi and Sara soil series from the year 1995 to 2016 (Fig. 7). However, the change in available B content over the year in Ganges sand and Gopalpur series was insignificant. Application of B fertilizers is very new to the farmers of the study area and they use it only on few crops, more over the unavailability of quality B fertilizers in local market might have contributed to B deficiency in soils. In the year 2016, the highest available boron was in Gopalpur series (0.96 ppm) which was statistically similar with Ganges Silt, Ghoir, Iswardi and Sara soil series while the lowest (0.44 ppm) in Ganges Sand series which was statistically similar with Ganges Silt, Ghoir and Iswardi soil series. Shaheed et al. (2002) reported that many soils in Bangladesh are deficient in micronutrients,especially Zn, B and Mo. Micronutrients deficiency become more evident due to increase of cropping intensity and production of HYV crops [16].

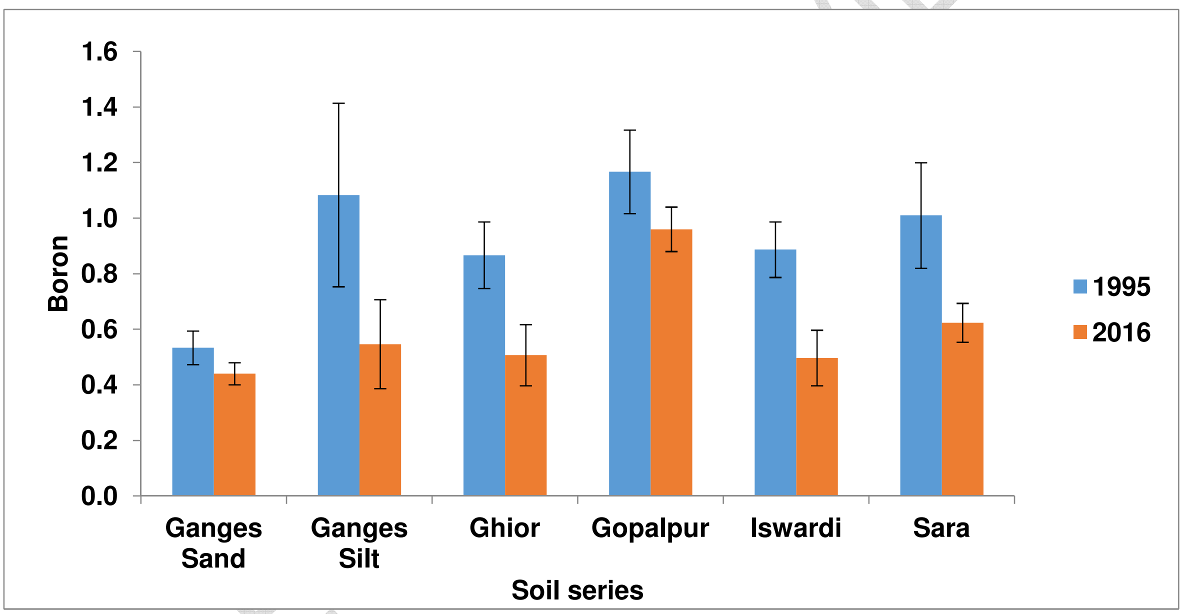

Fig. 7. Changes of Soil Boron (B) between the years 1995 to 2016 period in studied soil series

4. CONCLUSION

Soil nutrient data of the study revealed that most of the soil fertility parameters showed positive direction towards fertility development due to agricultural knowledge development and advance soil and fertilizer management strategies among the farmers by different Government and Non- Government agricultural program which helped to enhance fertility status in the field. Soil pH decreased in most of the series due to decalcification and soil leaching. Soil OM generally increased. Boron depleted from all the soil series due to inadequate use and unavailability of quality B fertilizers in local market. There is a need to establish soil testing laboratories in all the districts with modern facilities and adequate staff to generate accurate and reliable results. The concept of soil health and importance of maintaining soil fertility should be incorporated in all the training programs organized for farmers and Agricultural Extension Agents.

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