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## ASSESSMENT OF SOIL FERTILITY AND FARMER'S LIVE STYLE IN SOUTH-WESTERN BANGLADESH

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# ASSESSMENT OF SOIL FERTILITY AND FARMER'S LIVE STYLE IN SOUTH-WESTERN BANGLADESH

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**ABSTRACT**

Kibria MG, Islam ABMS, Basak KD, Hossain M, Hoque MA (2015) Assessment of soil fertility and farmer's live style in south-western Bangladesh. *J. Soil Nature* 8(3), 1-6.

The present investigation was carried out during January to June, 2015 to assess the soil fertility and farmer's livelihood status in Kaliganj upazilla (Bharashimla and Moddho-Kalikapur) under Satkhira district and Batiaghata upazilla (Titukhali and SMRC) under Khulna district. Soil pH, electrical conductivity (EC), and N, P, K, S and Zn contents were determined to assess the fertility status in the study areas. Data concerned with livelihood status were collected using structured questionnaires. Thirty farmers were included from two upazilla (15 from each) in this study who were directly involved in agricultural farming practices. Higher EC values of soil were observed in Bharashimla, Moddho-Kalikapur and Titukhali villages except Salinity Management Research Centre (SMRC). Soil pH was found lower in Kaliganj compared to Batiaghata. Nitrogen, potassium, zinc and sulphur contents in soil were belonged to lower category in all locations. Phosphorus content was very low in Batiaghata upazilla, and lower level of phosphorus was also found in Kaliganj upazilla. In Batiaghata, most of the farmers were belonged to the age category of 41 to 50 years and education was up to primary level, represented by 60% farmers having medium family. Average annual income of majority of the farmers was around taka 36,600 with 46% of the total farmers had small farm size. In Bharashimla and Moddho-Kalikapur, most of the farmers were belonged to the age category of 31 to 40 years and 73% farmers have education up to primary level, represented by 67% farmers having medium family. Average annual income of majority of the farmers was around taka 33,700 with 47% of the total farmers had small farm size. Aman rice-til-wheat and Aman rice-mungbean-wheat were the commonly followed cropping patterns in the study areas. Vegetables, oils, fibre and pulse crops were greatly affected by salinity due to higher salinity problem in dry season. Deep tube-well was one of the main sources of fresh water for drinking and irrigation purposes, and 47% farmers supplied fresh water from far distance with an average of 276 meter. Rice crop was mainly cultivated in aman season, and BR23 and BR10 cultivars were mostly cultivated. On the other hand, salt-tolerant rice cultivars Binadhan-8 and BRRIdhan 47 were recently popular in the boro season. Lack of governmental and organizational support, poor linkage between local community and institution, poor economic condition and unavailability of fresh water for irrigation were the major problems in the study areas.

***Key words:*** *living standard, nutrient status, constraints, salinity*

## INTRODUCTION

Among the natural resources, soil is the greatest resource of Bangladesh. Over the last 2-3 decades, enormous pressure has been exerted on the soil resource to produce more food for its vast population. Intensification of agricultural land use has increased remarkably, along with increasing use of modern crop varieties, which in turn has resulted in deterioration of soil fertility. Depletion of soil fertility is mainly due to exploitation of land without proper replenishment of plant nutrients. The problem is enhanced by intensive land use without appropriate soil management. The situation is worse in areas where high yielding variety (HYV) crops are being grown using low to unbalanced doses of mineral fertilizers, with little or no organic recycling. Because of increasing cropping intensity (presently 198%) and cultivation of modern varieties of crops, the net removal of plant nutrients is far from the nutrient supply through fertilizers and manures. Ali *et al.* (1997) reported that the total N content on an average decreased by 12%, pH decreased by 4% and the exchangeable acidity increased by 30%. The exchangeable K content in soil decreased by 31% and available P showed a 9% decrease over 27 years (1967-1995).

Soil fertility is largely maintained by the application of compost and manure, but in recent years a decline in soil fertility has been reported (Shrestha *et al.* 2000). The decline in soil fertility is a major concern for most farmers (Turton *et al.* 1995), their adoption of improved techniques has been limited (Shrestha *et al.* 2000). Although much of this is due to poor dissemination pathways resulting from inadequacies in the agricultural extension system, an important factor may be the different ways that farmers, extension workers and researchers all perceive and assess soil fertility, leading to differences in the problems perceived and solutions required. Assessment of fertility status of soil could provide important information on proper management of soil for sustainable agricultural development.

Livelihood comprises the capabilities, the assets (natural, physical, human, financial and social capital), the activities and the accesses to these (mediated by institutions and social relations) that together determine the living gained by the individual household (Chambers and Conway, 1992). A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in future, while not undermining the natural resource base (Chambers and Conway, 1992).

For sustainable rural development and poverty elimination, different approaches have been adopted and the "Sustainable Livelihood Approach" has been gradually expanded with its own core and principles for poverty focused development activities (DFID 1998). The approach basically based on the fundamental principle analysis of capital assets (i.e. human capital, physical capital, financial capital, social capital and natural capital)

in the context of the external environment. According to Carney (1999), a sustainable livelihood approach is a way of thinking about the objectives, scope and priorities for development, in order to enhance progress in poverty elimination (Scones 1998). Considering the financial hardship and other complexities of the rural farmers in coastal belt of Bangladesh, it is important to analyze their livelihood status. In view of the above consideration, the present study was undertaken to determine the fertility status of soil and to assess the livelihood status of the farmers and to identify the socio-economic problems/constrains associated with crop production in coastal areas of Bangladesh.

## MATERIALS AND METHODS

### Collection and preparation of soil samples

Total twenty four soil samples (six from each location) were collected at 0-15 cm depth from two different locations of both Batiaghata (Titukhali and SMRC) and Kaliganj (Bharashimla and Moddho-Kalikapur) upazilla under Khulna and Satkhira district, respectively. After collecting, the soil samples were air-dried and then a composite sample was prepared by mixing unit samples. The four composite samples were used for chemical analysis.

### Analysis of soil samples

Collected soil samples were analysed for N, P, K and S content of soil following standard method. Some chemical properties like pH, electrical conductivity (EC) were measured following standard methods as described by Khanam *et al*. (2001).

### Selection of the study areas and target groups

Two upazilla under Satkhira and Khulna districts (Kaliganj and Batiaghata) were selected for the study, because; crop production is heavily retarded in this area, various NGOs and DAE have been working with the farmers to increase crop production and livelihood status in this area. Data were collected during January to June, 2015 in Kaliganj and Batiaghata Upazilla. Thirty farmers were randomly selected from two upazilla of Satkhira and Khulna district. Farmers age, educational level, number of family member, annual family income level, farm size, major crops and cropping pattern, climatic hazards, fresh water source and distance from crop field, performance of crop varieties against salinity, crops most affected by salinity, challenges faced by the farmers to overcome salinity problem, etc. were included in the sample.

For data collection, a set of interview schedule was designed. Data were collected from the farmers using questionnaire, Participatory Rural Appraisal (PRA) tools such as Focus Group Discussion (FGD) and Cross-check interview with key informants. Data were processed and finally analyzed using tabular and graphical method.

## RESULTS AND DISCUSSION

### Fertility status of soil in the study areas

### Chemical properties

### Soil pH

It was found that pH value was lower in Bharashimla (6.58) and Moddho-Kalikapur (6.48) villages of Kaliganj upazilla under Satkhira district whereas compared to higher pH value was found in Titukhali (6.79) and SMRC (6.85) of Batiaghata upazilla under Khulna district (Table 1). Lower pH value was also observed by Haque (2006) where salinity problem was much higher in coastal areas of Bangladesh.

Table 1. Chemical properties of soil of different locations of Kaliganj and Batiaghata

| Locations of study area | | pH | EC (dS/m) |
|---|---|---|---|
| Kaliganj (Satkhira) | Bharashimla | 6.58 | 9.65 |
| | Moddho Kalikapur | 6.48 | 9.25 |
| Batiaghata (Khulna) | Titukhali | 6.79 | 6.40 |
| | SMRC | 6.85 | 4.65 |

### Electrical conductivity (EC)

Electrical conductivity (EC) of soil was also found lower in Khulna district than Satkhira district. From Table 1, it is evident that EC value was higher in Bharashimla (9.65 dS/m) and Moddho-Kalikapur (9.25 dS/m) of Kaliganj upazilla under Satkhira district. On the other hand, lower EC value was found in Titukhali (6.40 dS/m) and SMRC (4.65 dS/m) which indicated lower level of salinity. So, it was evident that salinity problem was higher in Satkhira district than Khulna district. It was found that Singaraval *et al*. (1996) also found that coastal areas had higher EC value which indicted lower level of soil fertility in the coastal areas.

### Nitrogen content

Nitrogen status of soil in the study areas was low (0.091-0.18%). In Satkhira, nitrogen content was 0.14% in both Bharashimla and Moddho-Kalikapur village under Kaliganj upazilla. On the other hand, it was found that

nitrogen content was higher (0.16%) in Titukhali and in SMRC also 0.14% nitrogen was found in Batiaghata under Khulna district (Table 2). Because of low level of organic matter, the nitrogen status of Bangladesh soils is substantially low. Nitrogen content was also found lower in the coastal areas of Bangladesh (Haque 2006).

**Phosphorus content**

The available phosphorus in coastal areas of Bangladesh soils could be considered between very low to low. The result of this study showed that phosphorus content in Kaliganj upazilla belonged to low (7.51-15 ppm) category as 14 ppm and 12 ppm phosphorus was found in Bharashimla and Moddho-Kalikapur under Kaliganj upazilla, respectively. But, in Khulna district, phosphorus content was belonged to very low category (≤7.5 ppm). In Titukhali and SMRC, 3.85 ppm and 7.4 ppm phosphorus content was found, respectively. Phosphorus availability is pH dependent (Table 2). It was evident that phosphorus content was higher in Satkhira district that Khulna district. Due to lower pH value in the study areas, may be phosphorus content was much lower in these areas. The same observation was also found by Haque (2006) that phosphorus availability was very much lower in the coastal areas of Bangladesh.

**Potassium content**

In this study, potassium content of the coastal soils of Bangladesh was belonged to low category (0.091-0.18 meq/100g). Equal amount of potassium (0.14 meq/100g) was found in Titukhali and SMRC of Batiaghata upazilla under Khulna district. On the other hand, 0.12 and 0.13 meq/100g potassium content was found from Bharashimla and Moddho-Kalikapur village of Kaliganj upazilla under Satkhira district (Table 2). Potassium deficiency was also explored by Singaraval *et al.* (1996) who also concluded that lower level of potassium was the major problem in coastal areas of Bangladesh.

**Sulphur content**

In this study, sulphur content was also much lower (7.51-15 ppm) in the study areas. In Bharashimla and Moddho-Kalikapur village under Kaliganj upazilla, only 13 and 11 ppm sulphur content was found whereas 14 ppm and 12 ppm sulphur content was found in Titukhali and SMRC from Batiaghata under Khulna district (Table 2). Due salinity problem in the coastal areas sulphur content was also found lower in the coastal areas of Bangladesh (Karim *et al*. 1990).

**Zinc content**

Zinc content of soil in the study areas also belonged to lower category (0.451-0.9 ppm). Zinc availability was higher in Bharashimla village (0.86 ppm) than Moddho-Kalikapur village (0.77 ppm) of Kaliganj upazilla under Satkhira district. On the other hand, 0.71 and 0.82 ppm sulphur content was found in Titukhali and SMRC from Batiaghata upazilla under Khulna district (Table 2). Widespread Zn deficiency has also been observed in the coastal regions (Karim *et al*. 1990).

Table 2. Nutrients contents of soil of Kaliganj and Batiaghata upazilla

| Nutrient contents | Kaliganj (Satkhira) | | Batiaghata (Khulna) | |
|---|---|---|---|---|
| | Bharashimla | Moddho-Kalikapur | Titukhali | SMRC |
| Total N (%) | 0.14 | 0.14 | 0.16 | 0.14 |
| Available P (ppm) | 14.0 | 12.0 | 3.85 | 7.40 |
| Exchangeable K (meq./100g soil) | 0.12 | 0.13 | 0.14 | 0.14 |
| Available S (ppm) | 13.0 | 11.0 | 14.0 | 12.0 |
| Available Zn (ppm) | 0.86 | 0.77 | 0.71 | 0.82 |

**Livelihood status of the farmers**

**Age distribution**

Out of total 30 farmers, 37% belonged to the age group of 41 to 50 years and 33% of the farmers were belonged to the age group of 31 to 40 years whereas only 6% are found in the group of above 51 years and 3% respondent farmers belonged to the age group 20-30 years (Table 3).

Table 3. Age distribution of the farmers in the study area

| Age group (years) | Kaliganj (Satkhira) (N=15) | Batiaghata (Khulna) (N=15) | Total (N=30) |
|---|---|---|---|
| 20-30 | 2 (13%) | 1 (7%) | 3 (10%) |
| 31-40 | 2 (13%) | 8 (53%) | 10 (33%) |
| 41-50 | 7 (47%) | 4 (27%) | 11 (37%) |
| 51 and above | 4 (27%) | 2 (13%) | 6 (20%) |

**Figure in the parenthesis indicates percentage of total, ***** Average age: 43.7 years

**Education**

Sixty seven percent of the respondent farmers had education up to primary level, while 10% had S.S.C level of education. About 10% of the farmers were illiterate, 3% of the respondent farmers possessed bachelors' degree, 3% possessed masters' degree and 7% farmers had education up to H.S.C. level (Table 4).

Table 4. Educational level of the farmers in the study area

| Educational level | Kaliganj (Satkhira) (N=15) | Batiaghata (Khulna) (N=15) | Total (N=30) |
|---|---|---|---|
| No education | 3 (20%) | 0 (0%) | 3 (10%) |
| Up to primary | 9 (60%) | 11 (73%) | 20 (67%) |
| SSC | 1 (7%) | 2 (13%) | 3 (10%) |
| HSC | 2 (13%) | 0 (0%) | 2 (7%) |
| Bachelor | 0 (0%) | 1 (7%) | 1 (3%) |
| MA | 0 (0%) | 1 (7%) | 1 (3%) |

**Figure in the parenthesis indicate percentage of total, average educational level: up to primary

**Family size**

The family size of the farmer's was divided into three categories according to the number of the family members (Table 5). About 63% of the respondents had medium family with 5 to 6 family members, 30% had small family with 3 to 4 members, while 7% had more than or equal 7 family members.

Table 5. Family size of the farmers in the study area

| Family size (no.) | Kaliganj (Satkhira) (N=15) | Batiaghata (Khulna) (N=15) | Total (N=30) |
|---|---|---|---|
| 3-4 | 5 (33%) | 4 (27%) | 9 (30%) |
| 5-6 | 9 (60%) | 10 (67%) | 19 (63%) |
| ≥7 | 1 (7%) | 1 (6%) | 2 (7%) |

**Figure in the parenthesis indicates percentage of total,* Average family size: 5 members

**Annual family income**

The selected farmers were grouped into five categories based on the level of their annual income. The first category included the farmers having annual income up to 15,000 Tk. The second, third, fourth and fifth categories had income levels of Tk. 15,001-30,000; Tk. 30,001-45,000; Tk. 45,001-60,000 and > 60,000 respectively (Table 6). Average annual income of the farmers was higher in Batiaghata than Kaliganj upazilla. It is evident that majority of the respondent farmers belonged to second category in both Batiaghata and Kaliganj upazilla. The second category had the highest proportion (33.3% and 53.3%) of farmers in both Batiaghata and Kaliganj upazilla, respectively. Only 13.3% farmers had higher annual income belonged to fifth category in Kaliganj upazilla but no farmers was found from Batiaghata upazilla having the highest annual income. Selvaraju (2006) also conducted an experiment to assess the livelihood status of people against vulnerable climate and also concluded that annual income belonged to lower category due to lower level of production.

Table 6. Annual incomes of the farmers in the study area

| Annual family income (Taka) | Kaliganj (Satkhira) (N=15) | Batiaghata (Khulna) (N=15) | Total (N=30) |
|---|---|---|---|
| Up to 15000 | 3 (20%) | 0 (0%) | 3 (10%) |
| 15001-30000 | 5 (33.3%) | 8 (53.3%) | 13 (43.3%) |
| 30001-45000 | 3 (20%) | 5 (33.3%) | 8 (26.6%) |
| 45001-60000 | 2 (13.3%) | 2 (13.3%) | 4 (13.3%) |
| >60000 | 2 (13.3%) | 0 (0%) | 2 (6.7%) |

**Figure in the parenthesis indicates percentage of total,* Average family income: 35,166 taka

**Farm size**

The selected farmers from two upazilla (Kaliganj and Batiaghata) were grouped into five categories based on their farm size which included both household area and farm land. The first category included the farmers having farm size up to 0.49 acre (Landless). The second, third, fourth and fifth categories had farm size of 0.50-1.49 acre (Marginal); 1.5-2.49 acre (Small); 2.5-7.49 acre (Medium) and > 7.5 acre (Large) respectively (figure 1). It is found that majority of the respondent farmers belonged to third category in both Satkhira (46%) and Khulna (47%).

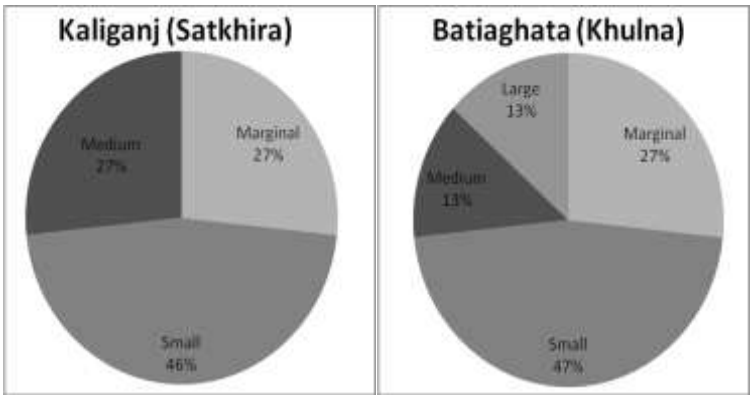


Fig. 1. Proportion of respondent farmers categories based on their farm size

That is most of respondents in both upazilla were small farmers having farm size 1.5-2.49 acre. No landless and large farmers were found in Kaliganj upazilla while in Batiaghata upazilla, 13% large farmers but no landless

were found among the respondents. Medium and large farmers were found in equal proportion (13%) in Batiaghata upazilla while marginal and medium farmers equally exhibited the lowest proportion of respondents (27%) in Kaliganj upazilla.

**Major crops and cropping pattern**

In both Kaliganj and Batiaghata upazilla, most of the respondent farmers cultivate cereal crops mostly rice, wheat, maize, oil crops like mustard, til, sunflower, pulse crop like mungbean, khesari, fibre crop mostly jute and some vegetables like brinjal, potato, Lady's finger etc. Some common cropping patterns were also found in both Kaliganj and Batiaghata upazilla. The cropping patterns were aman rice-til-wheat, aman rice-mungbean-wheat, aman-til-sunflower, aman-mungbean-sunflower, aman-til-mustard, aman-mungbean-mustard, boro-jute-aman, boro-til-fallow, boro-til-aman etc. But almost 80% farmers follow the first two cropping patterns frequently in both upazilla. But in Batiaghata, some farmers follow boro-til-aman cropping pattern where salinity problem is not much higher. Almost all the respondent farmers cultivate rice in aman season due to lower salinity problem.

**Major climatic hazards**

In both Kaliganj and Batiaghata upazilla, climatic hazards like drought, tidal flood and seasonal storm, cyclone, etc occurred at frequent intervals. Due to tidal flooding salinity problem is much higher in these villages of two upazilla. And salinity problem is much higher in dry season (November-March).

**Salinity effects on types of crops**

Crop production is much lower in these areas because of salinity problem. It is found from the study that vegetables, fruits and fibre crops are much affected by salinity in coastal areas of Bangladesh. Oil and pulse crops production are also equally hampered due to salinity. Cereal crops mostly rice is not grown in dry season as salinity problem is higher in this period.

**Sources of fresh water for irrigation**

All the farmers use deep tube-well water to supply irrigation water in the crop field to minimize the salinity problem. This deep tube-well is the only source of fresh water for irrigation purposes in crop production. Source of fresh water (Deep tube-well) are not near the crop field, as their cost of irrigation increases. The distance of fresh water for irrigation from crop field was divided into three categories according to the distance. The first category was low distance (150-200m), second one was medium distance (201-250m) and the third category was high distance (more than 251m). Among the respondent farmers 47% farmers supply irrigation water from high distance and 23% farmers can use fresh water from the distance of 201 to 250 meter. Only 30% of the respondent farmers had the irrigation source at low distance ranging from 150 to 200 meter (Table 7).

Table 7. Distance of fresh water source for irrigation of the study areas

| Distance of fresh water source for irrigation (m) | Kaliganj (N=15) | Batiaghata (N=15) | Total (N=30) |
|---|---|---|---|
| Low (150-200) | 6 (40%) | 3 (20%) | 9 (30%) |
| Medium (201-250) | 3 (20%) | 4 (27%) | 7 (23%) |
| High (>250) | 6 (40%) | 8 (53%) | 14 (47%) |

**Figure in the parenthesis indicates percentage of total,* Average distance: 276.7 meter

**Problems faced by the farmers to supply fresh water for irrigation**

It is evident that high price of pure fresh water and conflict in collecting water are the major two problems faced by the farmers to supply fresh water in their crop field. The farmers need to collect fresh water from far distance due to non availability of nearby fresh water source or deep tube-well in the study areas.

**Performance of different rice cultivars against salinity**

Almost all the respondent farmers cultivate BR23 and BR10 for rice production as they exhibited the highest yield performances compared to others. Some local varieties are also cultivated by them. Binadhan-8 and BRRIdhan 47 varieties are also cultivated by the farmers in little extent as these two varieties are cultivated in boro season (dry season) when salinity problem is much higher.

**Challenges faced by the farmers to overcome salinity**

The problems faced by the respondent farmers were categorized into five group based on the preliminary survey of the study areas (Table 8). Among the respondent farmers 70% faced medium extent of problem and 30% faced lower extent of problem due to lack of governmental and organizational support. Poor economic condition of the farmers caused high extent of problem among the 17% of the farmers while 50% and 33% farmers faced medium and low extent problem, respectively. Absence of fresh water for irrigation caused high, medium and low extent of problem among 33%, 40% and 27% farmers of the study areas. Fifty three percent farmers supposed that the poor linkage between community and institution causes medium extent of problem while 20% and 27% faced this problem in low and high extent. Social and/or political unrest caused medium extent of

problem among 43% of the total respondent farmers. On the other hand, 30% and 275 farmers faced this problem in high and low extent.

Table 8. Extent of problems faced by the farmers in the study areas

| Problems faced | Extent of problem | | |
|---|---|---|---|
| | Low | Medium | High |
| No governmental and organizational support | 9 (30%) | 21 (70%) | 0 (0%) |
| Poor economic condition | 10 (33%) | 15 (50%) | 5 (17%) |
| No saline free water source near crop field | 8 (27%) | 12 (40%) | 10 (33%) |
| The linkage between community and institution is poor | 6 (20%) | 16 (53%) | 8 (27%) |
| Social/political unrest | 8 (27%) | 13 (43%) | 9 (30%) |

**Figure in the parenthesis indicates percentage of total

## CONCLUSION

Soil salinity is a worldwide problem. In Bangladesh, salinization is one of the major natural hazards impeding crop production. Agricultural land use in these areas is very poor which leads to lower livelihood status of farmers of coastal areas. From this preliminary survey with a small population of the study areas, it was found that fertility status of soil was lower in Batiaghata compared to Kaliganj as nutrient availability was higher in Kaliganj upazilla. Farmer's livelihood status was low in both upazilla due to lower level of crop production. In saline areas the farmers mainly cultivate aman rice due to lower salinity levels during monsoon season. Lack of governmental and organizational support, poor linkage between community and institution, poor economic condition and unavailability of fresh water for irrigation were the major problems in the study areas.

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