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BEHAVIORAL ANALYSIS OF THE FARMERS, AS END USERS, TOWARDS ORGANIC FERTILIZER: AN EMPIRICAL STUDY IN BANGLADESH

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ABSTRACT

Production efficiency in the field of agriculture can be attained through the balanced application of its inputs. Chemical fertilizer is widely used almost everywhere in the world to maximize yield from limited land but it depletes the organic matter of the soil. Organic fertilizer, better known as compost fertilizer in Bangladesh, ensures yield of crops along with retention of soil nutrients. In Bangladesh farmers have practiced applying organic fertilizer from ancient time but with the advent of chemical fertilizers the rate of usage of organic fertilizer has declined sharply. Currently farmers in Bangladesh are reluctant to apply organic fertilizer on a regular basis. The farmers are well aware of the positive sides of organic fertilizer yet they can't or don't use organic fertilizers. This paper has endeavored to explore the buyers' (farmers) behavioral analyses regarding the organic fertilizer.

KEYWORDS

Adoption process, Organic Fertilizer.

INTRODUCTION

Agriculture depends heavily on the natural environment. Farmers are the most direct victims in the economic losses and ecological damage caused by the pollution of any resource of the nature. However, farmers use lots of fertilizer to improve production outputs driven by the market economy, resulting in a vicious circle. At this point, the analysis of the farmers' decision-making and willingness of fertilizer application is of great significance. Agricultural production was highly dependent on fertilizer sourced from nature with organic contents. To enhance the production of crops, inorganic fertilizer was developed and introduced. Though immediate productivity is being enhanced through appropriate application dosage of inorganic fertilizer, organic fertilizer is highly needed for the maintenance and enhancement of soil productivity. It is said that the organic fertilizer is the food for the soil.

It has been found that in almost all the Agro Ecological Zones (AEZ) of Bangladesh, organic matter in the soil is depleting at an alarming rate. To increase and at least to sustain the productivity of the soil there has to be a balance in terms of application of organic and inorganic or chemical fertilizer onto the soil. Balanced fertilization is the key to successful crop production and maintenance of good soil health. Outcome of different studies suggested that use of organic fertilizer increases productivity as well as helps retain soil fertility. Not only for the soil but also for the entire environment the usage of organic fertilizer is positive. But day by day the farmers are becoming reluctant to use organic fertilizer. The broad objective of the study is to analyze the behavior of the farmers towards organic fertilizer.

SPECIFIC OBJECTIVES

1. Understanding the level of awareness of the farmers regarding organic fertilizer
2. Decision making process of the farmers regarding the organic fertilizer
3. Identification of factors for non adoption of organic fertilizer

METHODOLOGY

The nature of the study demanded extensive consultation of the *secondary data* sources. Rigorous review of the literature was conducted to shed light in this case to gather knowledge about the ins and outs of nonorganic fertilizer industry, its production process and technology, farmers' perception and attitude towards the product and the market situation. Reports from Bangladesh Fertilizer Association (BFA), Department of Agriculture Extension (DAE) were consulted along with different articles which were sourced from the web.

Before launching the survey over the farmers few qualitative techniques were attempted for gap analysis. On the onset seven Key Informant Interviews (KIIs) were conducted over policy makers, Agriculturalist, Academicians, with a semi structured questionnaire. The KIIs took place in Bangladesh Agriculture Research Council (BARC), Department of Agriculture Extension (DAE), Bangladesh Agriculture University (BAU), Sher-e-Bangla Agriculture University, Bangladesh Agriculture Research Institute (BARI). Apart from the KII nine group discussions were conducted in various districts.

Survey data were sourced through field visits in various parts of the northern and south-western areas of Bangladesh. The sample unit of this study is the farmers who purchase fertilizer for agricultural purpose. Non probabilistic sampling technique, specifically convenient sampling, is used for this study. A total of 220 farmers were surveyed from the districts of Natore, Rangpur, Rajshahi, Chapainababgonj, Pabna, Noakhali, Jessore, Borguna, Narail, Bogra and Mymensingh. The data collection instrument was a structured questionnaire with questions of various types like dichotomous, five point likert scale and multiple choice questions.

Data have been analyzed using both descriptive and inferential statistical tools. Descriptive statistics such as mean standard deviation, frequency, etc were used. Factor Analysis, a Multivariate Analysis technique, was used to reduce the data and identify the factors that impede the farmers in adopting organic fertilizer. The Principal Factor Analysis with Orthogonal rotation (Varimax), using the SPSS, was executed to separate the factors.

REVIEW OF LITERATURE

Organic fertilizers, which are now being used in the country, can be broadly classified as concentrated organic fertilizer, Nutrient enriched organic fertilizer, Bulky organic fertilizer and Green manure. The adoption and application of organic fertilizers for producing different crops is being done by the farmers from an unknown period of time. This organic fertilizer is adopted in the form of cow dung, poultry manure, compost, crop residues, and green manure that were traditionally and preferentially used solely in the country until 1950 when the chemical fertilizers were introduced through a project entitled "Rapid Soil Testing and Popularization of Chemical Fertilizers" (Islam, 2008,). In early 1950's, farmers applied organic manures such as cow dung, bone meal to Aus & Aman rice and farmyard manure (FYM), mustard oil cake and fishmeal to mustard and vegetable crops (EPBS 1964). Ahmed (2004) pointed out that the use of inorganic fertilizer 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 in Bangladesh inorganic fertilizer was introduced at the farm level in 1959. Fertilizer consumption began to increase rapidly with the introduction of HYV rice (i.e. IR5 & IR8). 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 higher fertilizer dose than local low yield rice varieties. The HYV acreage and irrigation have a significant positive influence on fertilizer consumption (Hossain, 1987). Though the requirement of fertilizer has increased substantially the supply of organic fertilizer did not shoot up in that speed.

Therefore the farmers began to apply non organic fertilizer vehemently for producing HYV crops. Bruce (1987) reported that the fertilizer consumption per hectare in Bangladesh is considerably lower than that in many developed countries, but it is higher than the average level in many of developing countries. It has been observed that on total crop area basis about 198 kg nutrients were used for crop production, which was higher than in India, Pakistan, Sri Lanka, Thailand and even Philippines (BARC 2005).

Various researches have showed that the use of properly composted organic fertilizer has produced many desirable soil properties – greater plant water-holding and cation exchange capacity, lower bulk density of soils, and is an inducer of beneficial micro organisms (Lin et al. 1973; Parr et al. 1986; Chao et al. 1996). Incorporation of moderate amounts of animal manure and other organic materials into the field was an established agricultural practice generally recognized to have beneficial effects on the soil's physical, chemical, and microbiological properties. Adequate amount of soil organic matter greatly reduces the difficulties of good crop production (Allison 1978). There is also a close relationship between the nutrient status of soils and the organic matter content. Researches have shown that under long-term treatments, adding farmyard manure has raised soil fertility and yields to levels greater than those under synthetic fertilizer treatments (Parsa and Wallace 1979). Benefits of compost amendments to soil also include pH stabilization and faster water infiltration rate due to enhanced soil aggregation (Stamatoados et al. 1999). The levels of mycorrhizal colonization were greater under organic treatments than under the conventional chemical based cropping. Organic matter increased the available phosphorus in the soil through the organic anion, preventing P fixation and replacing the P bound to the soil (Swenson et al. 1949; Nagarajak et al. 1970; Kafkafi et al. 1998). It has been shown that microbial activity and biomass are higher in fields with organic amendments than fields with conventional fertilizers (Drinkwater et al. 1995). Soils with compost application have higher propagule densities of Trichoderma species than soils amended with synthetic fertilizers regardless of their production system history (Bulluck et al. 2002).

The intense cultivations with indiscriminate use of chemical fertilizer have reduced the organic matter of the soil significantly over last few decades. Every day significant part of agricultural land goes to urbanization and home stead area expansion in rural area. Moreover due to the growth of commercialization of agriculture, soil fertility in Bangladesh is declining rapidly. This is posing a serious threat to long term sustainability of agriculture in Bangladesh. Because soil fertility is reducing rapidly and as a result decreasing yield appears to be a major concern for all crops. The situation has been aggravated further due to the reduced supply of cow dung and other organic matter in the soil all over the country. The ideal organic substance of soil is supposed to be around 5% though the soil of Bangladesh contains very low organic substance which is in some cases even less than 1 % (Eusuf M. A. and Faruque O, 2009). The current cropping practice of Bangladesh is almost entirely a chemical fertilizer dependent cultivation process where the use of organic fertilizer is uncomfortably low or absent. Ali *et al.* (1997) observed that soil organic matter in Bangladesh has been depleted by 5% to 36% during 1967-1995. A detailed study on organic matter content of Bangladesh's soil by BARC (1998) revealed similar finding – organic matter content of most of the Bangladesh soils is very low, the majority being below the critical level (1.5%).

Ishaque (2001) reported that farmer used higher amount of all necessary type fertilizers in Boro season than in Kharif 1 and Kharif 2 seasons. Sidhu et al. (1982) also pointed that the average level of fertilizer use was higher during the Boro season (220 kg fertilizer/ha) and lower during the Aus (162 kg/ha) and Aman (142 kg/ha) seasons (Shah and Aziz, 2008). The most common practice is to apply all fertilizers including organic manure at the time of final preparation of land for rain fed crops. For irrigated crops, nitrogen fertilizer is applied in two to three installments depending on the life cycle of crop. At present more than 4.3 million tons of chemical fertilizers pricing to more than US $ 5538 millions are being used along with 70 million tons of organic manure (Islam, 2008,). According to Razzak (2006) and 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 fertilizers can be converted into bioslurry, we can fulfill a great portion of our huge fertilizer 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 fertilizer 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 fertilizer in the fiscal year 2008-09. If the total organic fertilizer 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 (Basak 2006).

It is now a reality that the farmers are informed about the application of mixed fertilization in the field. Even a decade earlier the benefits of mixed fertilizer use (chemical and organic fertilizer) on yields and soil health had to be proved by the agriculturists at field experiments. With so many countries embracing mixed fertilizer usage, the results are now found in the average productivity of the country statistics. The socio-economic analysis shows that farmer's income increase by using mixed fertilizer is generated from three sources: *first,* decrease in fertilizer cost – this was around 10% in Thailand while more than 30% in Philippines. (Philippines replaced more chemical fertilizer with organic fertilizer and there is no subsidy on chemical fertilizer in Philippines). *Second,* Yield is increased – in case of Philippines this was around 8-10% and Thailand by around 10%. And *finally,* when soil gets its health back, it will regain its water holding capacity and the demand of irrigation will reduce (Eusuf M. A. and Faruque O., 2009). The practice of balanced fertilization is receiving top priority to sustain/increase crop productivity as food security is so crucial for poverty stricken people, when the country is facing challenges of increasing population and shrinking natural resources including agricultural land and also when there exists big gap between research and farmer's yield (Islam, 2008). Proper processing of organic wastes and residues for use in agriculture appears to be promising and this can reduce the environmental pollution to a great extent.

Different findings suggest that organic fertilizer should be an essential part for Bangladesh to increase yield further and also making the cropping more sustainable by improving soil nutrients. The field experiment on maize, which took two years (2006-2008), was conducted in Rangpur. A dosage of 3 t/ha compost (from poultry manure) have increased the yield by 19% percent (from 6.98 t/ha to 8.31 t/ha) (Noor *et al.* 2008). A three year (2002 to 2005) long study found that yield of tomato increased because of 2.5 t/ha cow dung and poultry manure usage stands at 1.2 t/ha and 8.9t/ha respectively (Noor *et al.* 2006). Due to changing scenario of soil fertility, management with emphasis on organic matter replenishment, the organic fertilizers could play a vital role in restoring fertility as well as organic matter status of the soils. However, the economic value of organic fertilizer to a farmer is the value of increase in crop yields and/or crop quality that is derived from its use. The cost benefit ratio will determine the economic aspects of its use. It is to be remembered that besides supplying essential plant nutrients, organic fertilizer, irrespective of its sources, produces desirable physical, chemical and biological changes in soils.

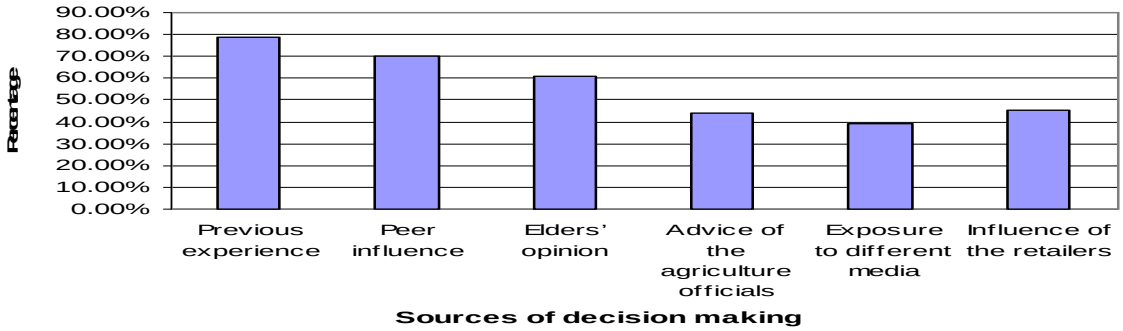
The previous researches of other scholars studied the farmers' act of using fertilization from three type's factor: market environment, personal characteristics and public policy. Nunez, et al. (2004) examined the impact of the fertilizer prices, agricultural products prices, expected earnings and regional market environment factors on the farmers' decision-making of using fertilizer. Xiang LU Bo, et al. (2000), Ji MA and CAI Xiao-yu (2007) analyzed the impact of the individual characteristics of farmers and public policy, and influencing factors included: the cultural quality of farmers, the farmers' awareness of whether there is excessive use and pollution in using fertilizer, whether the farmers have received fertilizer guidance provided by Agricultural Extension Station, farmers' attitude towards risk. Liu Yu, et al. (2009) contributed that the following factors influence the farmers' adoption of fertilizer—Scale of operation, Fragmentation of land, Distance of arable land away from residence, Transfer of information, Production experience, Willingness of farmers. It is understood that there is a huge potential of organic fertilizer in Bangladesh but this fertilizer sector is experiencing impasse mainly because of different stumbling blocks. The Licensing procedure is complicated and time-consuming in Bangladesh. The market for composting technology is really a weak one. The awareness level of the farmers regarding this issue is not so promising. All these variables are resulting in weak demand from farmers' end. The farmers of Bangladesh hardly follow any scientific methods to produce organic fertilizers. The farmers usually dispose the animal wastes mainly dung in open pit at their farmyard and leave them at least three months before they use for their crop fields. However, many private companies are now coming forward to produce organic fertilizers commercially. For commercial marketing the government has so far standardized about 28 organic and organochemical fertilizers. It is learnt that another 20 companies have applied for standardization of their organic and nutrient enriched organic fertilizers. Therefore, it is important that standard methodology should be followed by the companies as well as by the farmers in producing quality organic fertilizers (M S Islam, 2008).

FINDINGS

DECISION MAKING REGARDING ORGANIC FERTILIZER

In case of agriculture inputs the farmers primarily depend on their prior experience. Apart from that the farmers interact with other farmers to come to any decision. Influence of fellow farmers is also a key factor for the farmers incase of decision making specifically for fertilizer. As the figure1 depicts that near about 80% of the respondents make fertilizer related decision based on their previous experience. Peer influence (70%) and Elders' opinion (61%) are also important influencers for the farmers in case of fertilizer related decision making.

FIGURE 1: SOURCES OF DECISION MAKING OF THE FARMERS REGARDING FERTILIZER



LEVEL OF AWARENESS REGARDING ORGANIC FERTILIZER

All the responding farmers agreed on the positive sides of the organic fertilizer. The following table (Table 1) delineates the farmers' level of awareness of organic fertilizer.

TABLE 1: LEVEL OF AWARENESS OF ORGANIC FERTILIZER

Awareness level	Percentage
Aware of it	92.73%
Unaware of it	7.27%
Use it regularly/yearly	11.36%
Used occasionally/yearly	14.55%
Used once/yearly	19.09%
Aware but never used	47.73%

Source: Primary data—survey

Most of the farmers (over 92%) are aware of the ins and outs of organic fertilizer. It has been observed that only 11.36% of the responding farmers use organic fertilizer. Around 48% of the respondents state that they are aware of the organic fertilizer but they never used. Amazing issue of this table is that more than 7% respondents are unaware of the ins and outs of the organic fertilizer. The farmers who use organic fertilizer either regularly or occasionally prefer cow dung most. Table 2 depicts that organic fertilizer farmers mostly use cow dung, poultry manure, farmyard manure, wastages of crops etc. Of them cow dung is most widely used. Elements like water hyacinth, maize stove, sugarcane trash and tobacco stems are available in specific areas. They are not widely available like rice and wheat straw.

TABLE 2: KINDS OF ORGANIC FERTILIZER THE FARMERS USE

Rank	Type of fertilizer	Percentage
1	Cow dung	94.35%
2	Poultry manure	77.70%
3	Compost (common)	69.38%
4	Farmyard manure	61.37%
5	Ashes	59.62%
6	Rice straw	55.46%
7	Wheat straw	54.65%
8	Maize stove	39.76%
9	Sugarcane trash	33.35%
10	Water hyacinth compost	29.87%
11	Tobacco stems	26.06%

Source: Primary data—survey

Most of the users (farmers) rely on their own production process to generate organic fertilizer as depicted in table 3. This product is not widely available on a regular basis in the village areas. In some places only on the haat days the organic fertilizers are available.

TABLE 3: SOURCES OF PROCURING ORGANIC FERTILIZER

Procurement options	Percentage
Self preparation	64.34%
Commercial producers of the village	55.76%
Nonregular producers of the village	31.07%
Available in the Thana market (regularly)	29.98%
Available in the Thana market (on Haat days)	41.54%

Source: Primary data--survey

Our factor analysis is appropriate as KMO test result is greater than 0.5 (actual value is 0.539) and it is valid as Bartlett's test indicates .000 probability which is less than the significance level (.05) (Table 4).

Altogether 15 variables were identified which were responsible for the farmers' non adoption of organic fertilizer. Factor Analysis was conducted (Extraction Method: Principal Component Analysis) to isolate major five factors. The following table (Table 5) depicts the factors with cumulative variances. These five factors are responsible for defining more than 74% variances of non adoption of the organic fertilizers. Of the factors production and operational problem has the highest Eigenvalue followed by scarcity, financial constraint, poor knowledge level and deferred return.

TABLE 4: KMO AND BARTLETT'S TEST

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.539
Bartlett's Test of Sphericity	Approx. Chi-Square	729.66
	df	105
	Sig.	.000

TABLE 5: FACTORS THAT DISCOURAGE THE FARMERS' NONADOPTION OF ORGANIC FERTILIZER

Factor no.	Name of factor	Rotation Sums of Squared Loadings		
		Eigenvalue	% of Variance	Cumulative %
1.	Production and operational problem	8.207	20.567	20.566
2.	Scarcity of organic fertilizer	6.751	16.918	37.484
3.	Financial Constraint	6.453	16.171	53.656
4.	Poor knowledge level of the users	6.321	15.840	69.496
5.	Deferred Return	2.052	5.137	**74.634**

Extraction Method: Principal Component Analysis.

The following table (Table 6) delineates the factor, variables constructing the factor and the factor loads. Production and operational problem comprises of five variables whereas Scarcity of organic fertilizer, Financial Constraint and Poor knowledge level of the users are comprised of three separate variables. Deferred return is a single variable factor.

TABLE 6: VARIABLES THAT CONSTRUCT THE FACTORS FOR NON ADOPTION OF ORGANIC FERTILIZER

Name of factor	Name of Variable	Factor load
1. Production and operational problem	1. Lengthy production time	0.879
	2. Inadequacy of the ingredients	0.810
	3. Not suitable for the crops that the farmers produce	0.782
	4. Problem in carrying	0.716
	5. Difficult to store	0.702
2. Scarcity of organic fertilizer	1. Unavailability	0.871
	2. Supply is inconstant,	0.676
	3. Nonstandardized quality	0.620
3. Financial Constraint	1. Financial constraint	0.858
	2. Expensive compared to chemical fertilizer	0.656
	3. High application dosage	0.630
4. Poor knowledge level of the users	1. Indifference of the agro officials	0.846
	2. Peer discourage	0.645
	3. Poor level of knowledge	0.641
5. Deferred Return	1. Non immediate outcome	0.853

CONCLUSION AND RECOMMENDATIONS

Organic fertilizers, as the nutrient supplier for the soil, can not be substituted with any other kind of fertilizer. Organic fertilizer provides food for the soil which is required to maintain the productivity of the soil. Chemical fertilizers work as the food for the plants. The nutrient level of the soil of Bangladesh is depleting at an alarming rate as various research show. Outcome of different studies suggest that organic fertilizer should be an essential part for Bangladesh to increase yield further and also making the cropping more sustainable by improving soil nutrients. It is also realistic that only organic fertilizer can hardly attain the desired level of output. There should be balanced fertilization comprising both organic and chemical fertilizers. Organic fertilizer is applied by the farmers in different forms though not always in the form of compost. The farmers are to be accustomed of using organic fertilizer for every possible crop. In many situations and places it was found that organic fertilizer is at the top of their awareness list but due to some problems they become reluctant to procure and apply. After the analysis of the bottlenecks it is evident that to overcome the current situation and to increase the adoption of organic fertilizer among the farmers few measures should be chalked up and prioritized. Further study and analysis may be conducted to concrete the fact. In the following some of the recommendations that can be materialized for the betterment of the current situation are presented.

1. Endeavors are to be taken out and executed intermittently for increasing awareness of the farmers regarding the issue through integrated communication strategy.
2. Farmers are to be made visionary so that they don't become myopic and don't focus on the current need overlooking and sacrificing the future of their resources. They have to be made knowledgeable about the long run impact of applying organic fertilizer.
3. Capitalize the referral power of the Agricultural officials to motivate the farmers for choosing organic fertilizers.
4. Congenial business environment is to be ensured to encourage commercial production of organic fertilizer. In this regard legal issues in licensing and distribution are the primary bottlenecks to be handled.

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