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Utilization of Endogenous Farming Resources by Resource Poor Farmers towards Integrated Plant Nutrient System

M Golam Mostafa[1], M Zulfikar Rahman[2], M Abul Kashem[3] and A Z M Moslehuddin[4]

[1]National Agriculture Training Academy, Gazipur, Bangladesh
[2]Dept of Agric Extension Education, Bangladesh Agricultural University, Mymensingh, Bangladesh
[3]Haji Md. Danesh Science and Technology University, Dinajpur, Bangladesh
[4]Dept of Soil Science, Bangladesh Agricultural University, Mymensingh, Bangladesh
E-mail: [1]kbdmostafa@gmail.com, [2]zulfikarbau64@gmail.com, [3]kashem1953@gmail.com, [4]abunazia@yahoo.com

Abstract—*The prime purpose of the study was to determine the extent of utilization of endogenous farming resources (EFRs) by the resource poor farmers towards integrated plant nutrient system (IPNS). The average utilization of EFRs towards IPNS was 54%. The overall utilization indicated that overwhelming majority (95%) of the farmers had medium utilization and 5% had high utilization. The average score for non-manure utilization and dumping or undeliberate use were 39.52% and 6.56% respectively. All the respondent farmers utilized poultry excreta, kitchen waste (plant origin), kitchen waste (animal origin) and ash with other EFRs. In utilization of prepared manure, involvement of women was low (13.28%) and male performed the higher portion (86.72%). Stepwise multiple regression indicated that the out of eleven characteristics, only six characteristics namely, participation in EFRs management, perception of IPNS, availability of EFRs, use of information source, perceived benefits of utilization of EFRs and farm size were the effective predictors having significant contribution to the farmers' utilization of EFRs towards IPNS and jointly explained 77.70% of variation of EFRs utilization towards IPNS. Evidently, the utilization of EFRs towards IPNS is decreasing and trend of fertilizer use is increasing dramatically day by day. Yet, a sensible use of organic materials and chemical amendments are crucial for establishing IPNS towards achieving sustained farm production.*

1. INTRODUCTION

Bangladesh is a very small country of 147570 square kilometers area having a population of 142.32 million and the country has only 8.44 million hectare cultivable land against this huge population [1]. Agriculture is the dominant economic activity in Bangladesh and regarded as the life of the Bangladesh economy and plays a vital role in achieving self-sufficiency in food production, reducing rural poverty and fostering sustainable economic development. The land area of the country is decreasing because of population growth, rapid pressure of urbanization, industrialization and other infrastructure development. There is no scope for horizontal expansion of cultivation area for more food production. It is estimated that the agricultural land is declined by 1 percent per year and that the land is deteriorating owing to degradation of soil fertility (e.g. nutrient imbalance), soil erosion and soil salinity [2]. Soil is the greatest resource of a country. "The wealth of a nation lies in her soils and their intelligent development", says a philosopher, Richard Gordon Moores. Soil organic matter is a key factor for sustainable soil fertility and crop productivity [3]. The shortages of organic matter of the soils are becoming worse in a more or less sustaining circle. A good soil should have at least 2.5 percent organic matter, but in Bangladesh most of the soils have less than 1.5 percent, and some soils even less than 1 percent organic matter [4]. Available data indicated that fertility of most of our soils has deteriorated over the years [5 and 6].

At present 45 percent of total cultivatable land of Bangladesh has organic matter content below 1 percent and 83 percent of cultivable land has less than 3.5 percent organic matter [7]. The production of crops in a system with high yield targets cannot be sustainable unless nutrient inputs to soil is at least balanced against nutrient removal by crops. Apparent nutrient mining which is currently going on in Bangladesh, especially for Nitrogen and Potassium, and which is aggravated by the increasing cropping intensity and the use of high yielding varieties (HYVs) that take up even higher quantities of nutrients that are not being replaced.

Due to the shortage of fuel, farmers have to burn crop residues and up to 80 percent of their cow dung [8]. Crop residues and dung are widely used as fuel and fodder and not returned to the soil. Endogenous farming resources (EFRs) are the materials and wastes that are generated within the farm and household by the daily activities. These include crop residues, poultry excreta, cow

dung, kitchen wastes (plant and vegetables), kitchen wastes (fish and animal), harvest residues, ash, rice husk, unfilled grains, weeds, plant debris, foliage etc. Human activities generate huge amount of EFRs everyday both in city and rural areas. Farm and household wastes constitute about 70 percent of the sources of solid waste [9]. The major sources of nutrients to be recycled to soils are household wastes, industrial wastes, crop residues and animal manures [10]. The utilization of this huge resource principally by the resource poor farmers is quite decisive towards maintaining sustainable and ecologically friendly agriculture.

The integrated plant nutrient system (IPNS) approach is the way to address the soil fertility related challenges and provide the pre-conditions for sustainable and environmentally friendly production increase. EFRs are receiving increased attention in developed as well as in developing countries. So, proper utilization of EFRs as organic manure by resource poor farmers may be an avenue to stabilize the crop productivity and as well as soil fertility. In achieving the major goal of IPNS the wastes generated in the farm, home and homestead play pivotal roles in Bangladesh farming community. Recycling of different organic wastes in agriculture could improve the organic matter status of soils, thus improve the soil physical and chemical properties and help to increase nutrients availability in soils [11]. If the majority of rural farmers could prepare organic manure by decomposing their homestead wastes, cattle excreta and different crop residues, it would meet the 50-70 percent of their organic manure need [12].

Since the resource poor farmers are using EFRs in different ways rather than using as manure, it is essential to know the extent of utilization of EFRs towards IPNS and to assess the recycling status of EFRs in the farming system. This is necessary in order to develop an extension strategy by which the EFRs become motivated towards sustainable agriculture that would not create problems to environment. Utilization of EFRs towards IPNS is the crying need for the success of any farming activities. Through the utilization of EFRs towards IPNS by resource poor farmers, they would learn to change their living status in personal, social and economic dimensions. The purpose of the present study is to have an understanding on the extent of utilization of EFRs by resource poor farmers towards IPNS. However, the following specific objectives were undertaken for the present study:

a) To find out the extent of utilization of endogenous farming resources (EFRs) towards IPNS by the resource poor farmers.

b) To explore contribution of selected characteristics of the resource poor farmers on their perceived utilization of EFRs.

c) To find out the problems of resource poor farmers in generating and utilizing EFRs towards securing IPNS in their farming.

2. METHODOLOGY

2.1 Study area, population and sampling

The study was conducted in Kumargata union of Muktagachha upazila of Mymensingh district. The upazila has a total 51,326 farm households of whom 45,417 (88.49 percent) are resource poor, intensive agricultural extension program and cultivation of modern varieties of rice are in operation and this upazila was the project area of Integrated Soil Fertility and Fertilizer Management Project (SFFP) of Department of Agricultural Extension (DAE). The resource poor farmers of five villages in Kumargata union were considered as the population of the study. The resource poor farmers were consider as farmers who had at best one hectare of own land. This is in accordance with the criterion set by the Bangladesh Bureau of Statistics, 2012.

Twenty five percent of resource poor farmers were randomly selected which were two hundred and thirty in number and constituted the sample for the study.

Table 1: Distribution of population and sample size of the respondents

Sl. No.	Name of village	Population	Sample size	Reserve list
1	Garaikuti	502	126	12
2	Chak Narayanpur	85	21	2
3	Gandharbapur	109	27	3
4	Satrasia	164	41	4
5	Malatipur	61	15	2
	Total	921	230	23

2.2 Variable and their measurement

Selected socio-economic characteristics of the resource poor farmers i.e. age, years of schooling, household size, annual household income, farm size, farming experience, participation in EFRs management, credit received, perception of IPNS, benefit of utilization of EFRs, availability of EFRs, organizational participation, use of information source and environmental

pollution awareness were considered as the independent variables of the study. The dependent variable was the utilization of endogenous farming resources by resource poor farmers towards integrated plant nutrient system.

2.3 Data collection and analysis

Based on the objective of the study a structured interview schedule was used to collect data for the study. Data were collected by the first author himself from the selected resource poor farmers by using the questionnaire in face to face situation during 2013. Pearson's Product Moment Correlation (r) was used to determine relationship between the concerned variables. The step-wise multiple regression analysis was used to determine the amount of variation in dependent variables due to per unit change in independent variables, with only those variables which contributed significantly. The predictive power of multiple regression equation was evaluated by the help of multiple correlation coefficient (R) and coefficient of multiple determination (R^2) analysis. The coefficient of determination measures the proportion of variability in the dependent variable.

3. RESULT AND DISCUSSION

3.1 Farmers' overall utilization of EFRs towards IPNS

The score of overall utilization of EFRs as manure could range from 0 to 100, while the observed scores ranged from 40 to 70. The average was 53.92 with a standard deviation of 6.19 (Table 2). On the basis of utilization scores the resource poor farmers were classified into three categories as low, medium and high as shown in Table 2.

Table 2: Farmers' category according to their overall utilization of EFRs towards IPNS

Respondents Farmers			Mean	SD
Category	Number	Percent		
Low (≤33)	0	0	53.92	6.19
Medium (34-67)	218	94.78		
High (>67)	12	5.22		

Data presented in Table 2 shows that an overwhelming majority (94.78 percent) of the farmers fell into category of medium utilization of EFRs compared to 5.22 percent being high utilization category and no farmers were in low utilization category. The findings showed that resource poor farmers were trying to make moderate utilization of EFRs towards IPNS.

3.2 Ways of utilization of EFRs

Three ways of utilization of EFRs were made based on diversity of utilization *i.e.* utilization for manure/compost preparation, utilization as non-manure (e.g. animal/ fish feed, fuel, household use, etc.) and utilization as waste in other avenues/ undeliberate use/dumping (Table 3). The score for utilization for manure/compost preparation was 48.70, 54.72 and 58.34 percent for landless, marginal and small farmers, respectively with an average of 53.92.

Table 3: Ways of utilization of EFRs

Categorization	Utilization by resource poor farmers (percent)			
	Landless	Marginal	Small	Mean
Utilization for manure/compost preparation	48.70	54.72	58.34	53.92
Utilization as non-manure	45.36	38.72	34.48	39.52
Utilization as waste in other avenues/undeliberate use/dumping	5.94	6.56	7.18	6.56

Similarly, the score for non-manure utilization was 45.36, 38.42 and 33.48 percent for landless, marginal and small farmers, respectively with an average of 39.52. The score for undeliberate use or dumping was 5.94, 6.56 and 7.18 percent for landless, marginal and small farmers, respectively with an average of 6.56. From the above Table, it is clear that utilization of EFRs as manure or compost was comparatively high for small farmers whereas low was in landless farmers. Again, non-manure utilization of EFRs was high for landless farmers and low for small farmers. The marginal farmers were comparatively in middle position in the three categories of utilization of EFRs.

3.3 Comparative extent of utilization of EFRs towards IPNS

The utilization of one EFR of a respective category farmer was computed and mean utilization of each EFR was calculated and finally comparative utilization of ten EFRs was measured and presented in Table 4.

Table 4: Comparative extent of utilization of EFRs

EFRs	Utilization of EFRs by resource poor farmers (percent)				SD	Rank order
	Landless	Marginal	Small	Mean		
Poultry excreta	88.28	85.14	86.23	86.55	0.66	1
Ash	72.83	82.85	87.76	81.15	3.50	2
Cattle shed excreta	76.33	81.76	84.38	80.82	3.96	3
Cow dung	63.17	76.46	83.77	74.46	7.38	4
Kitchen waste (plant origin)	65.45	67.24	70.58	67.76	1.45	5
Kitchen waste (animal origin)	52.46	63.58	67.42	61.15	1.95	6
Unfilled grain	32.76	40.52	46.48	39.92	6.87	7
Harvest residues	14.54	23.67	25.92	21.38	2.71	8
Plant debris	12.67	15.47	17.58	15.24	2.25	9
Rice husk	8.46	10.48	13.27	10.74	4.17	10
Mean	48.70	54.72	58.34	53.92	4.39	

Data furnished in the Table 4 reveal that among the ten EFRs, the highest utilization (ranked first) towards IPNS was for poultry excreta (86.55 percent) followed by ash (81.15 percent), cattle shed excreta (80.82 percent), cow dung (74.46 percent), kitchen wastes (plant origin) (67.76 percent), kitchen wastes (animal origin) (61.15 percent), unfilled grain (39.92 percent), harvest residues (21.38 percent), plant debris (15.24 percent) and rice husk (10.74 percent). The landless farmers utilized comparatively lower in all ten EFRs and the small farmers utilized a bit higher than marginal farmers. As the farm size of landless and marginal farmers was smaller than that of small farmers, the outcome or generation of EFRs was also lower in quantity for them.

At the advent of specialized farming the scope of integrated farming is increasingly becoming narrow. Even the poultry farming remained intact as a backyard venture. As a consequence every farm household has a considerable stuck of poultry excreta. In rural Bangladesh, every family culturally habituated for cooking with firewood. As a result, ash is a by-product of every farm family and traditionally they used it to the crop field. Although cow dung is the main source of organic manure, it has some alternative utilization for domestic fuel and fish feeding. Kitchen waste both plant and animal origin are available in every farm families, it is often disregarded as organic manure. Some farm families used kitchen waste as organic manure and many used it for other purposes. Unfilled grain usually has low use as organic manure because of germination problem. Harvest residues were mainly used as fuel and some extent to animal feeding. Rice husk has limited scope to use as manure as milling is done at husking mills and the rice husk is used for animal feeding and cooking. Collected plant debris is the daily source of household fuel for landless and marginal families.

3.4 Relationships between the selected characteristics of the resource poor farmers and their utilization of EFRS towards IPNS

Pearson's Product Moment Correlation Co-efficient 'r' was used to ascertain the relationship between the selected characteristics of the resource poor farmers and their utilization of EFRS towards IPNS. The result of correlation has been shown in the Table 5.

Table 5: Correlation co-efficient between dependent and independent variables

Dependent variable	Independent variables: selected characteristics of the respondents	Correlation co-efficient (r values)
Utilization of endogenous farming resources	Age	0.120
	Years of schooling	0.483**
	Household size	0.154*
	Annual household income	0.600**
	Farm size	0.656**
	Farming experiences	0.092
	Participation in EFRs management	0.817**
	Credit received	-0.066
	Perception of IPNS	0.660**

	Perceived benefit of utilization of EFRs		0.667**
	Availability of EFRs		0.805**
	Organizational participation		0.425**
	Use of information source		0.651**
	Environmental pollution awareness		0.660**

**Significant at 0.05 level of probability ** Significant at 0.01 level of probability*

Out of 14 independent variables, 11 showed significant positive relationship with their utilization of EFRs towards IPNS. However the rest three characteristics (age, farming experience and credit received) did not show any significant relationships with the same.

3.4 Contribution of the selected characteristics to the utilization of EFRs towards IPNS

Linear multiple regression analysis was computed in order to determine the contribution of the farmers' characteristics to their utilization of EFRs towards IPNS. Only those variables, which had significant relationships with utilization of EFRs, were included in the regression analysis model. The findings of the regression analysis are presented in Table 6.

Table 6: Regression co-efficient of utilization of EFRs of the resource poor farmers with their selected characteristics

Characteristics of the resource poor farmers	Unstandardized co-efficients		Standardized co-efficients (β)	t-value	Significance level
	β	Std. error			
Constant	20.095	2.298		8.744	0.000
Year of schooling	-0.110	0.081	-0.073	-01.362	0.175
Household size	-0.093	0.114	-0.027	-0.810	0.419
Annual household income	-0.019	0.014	-0.123	-1.321	0.188
Farm size	5.212	2.327	0.221	2.240	0.026
Participation in EFRs management	0.423	0.094	0.304	4.489	0.000
Perception of IPNS	0.304	0.112	0.151	2.713	0.007
Perceived benefit of utilization of EFRs	0.256	0.093	0.131	2.735	0.007
Availability of EFRs	0.723	0.216	0.218	3.338	0.001
Organizational participation	0.006	0.116	0.002	0.053	0.958
Use of information source	0.269	0.062	0.213	4.376	0.000
Environmental pollution awareness	0.008	0.243	0.002	0.034	0.973
R^2 = 0.783, Adjusted R^2 = 0.772, F value = 71.412 at 0.000 level of significance					

This analysis indicated that 78.30 percent of the total variation in utilization of EFRs was explained by these six variables namely, farm size, participation in EFRs management, perception of IPNS, perceived benefits of utilization of EFRs, availability of EFRs and use of information source and the remaining 21.7 percent remain unexplained.

Problem

The problem confrontation was measured through personal interviewing having 15 statements incorporated into the interview schedule. Each respondent (n = 230), was asked to give opinion on how much problem he/she faced by indicating in favor of any of the four responses such as high, medium, low and not at all problem on a 4-point scale. Problem confrontation indices (PCI) were computed and the ranking of the problems based on PCI are presented in Table 7.

Table 7: Rank order of the problems confronted by the resource poor farmers in utilization of EFRs towards IPNS

Problem faced	Extent of problem (percent)				PCI	Rank order
	High	Medium	Low	Not at all		
Lack of grazing land and fodder for cattle	43.48	47.82	8.70	0.00	234.78	1
Non-manure utilization of EFRs	43.48	39.14	13.04	4.34	221.76	2
The need to use crop residues as fuel	34.78	43.48	17.40	4.34	208.70	3
Decreased livestock population	26.09	43.48	30.43	0.00	195.66	4
Low production of cowdung	26.09	34.78	39.13	0.00	186.96	5
A generally lack of leaflets, booklets and other information on IPNS	21.74	39.13	34.78	4.35	178.26	6
Lack of demonstration on IPNS	17.39	43.48	30.43	8.70	169.56	7
Lack of knowledge about specific benefits of different EFRs towards IPNS	13.04	52.18	21.74	13.04	165.22	8

Unavailability of EFRs in desired amount	13.04	30.43	47.83	8.70	147.81	9
Lack of training facility for using EFRs in farming	8.70	34.78	26.09	30.44	121.75	10
High cost in adopting IPNS	13.04	21.74	34.78	30.44	117.38	11
Heavy rainfall at certain times of year makes preparing manure very difficult	8.70	21.73	43.48	26.09	113.04	12
More time consuming to prepare manure	4.35	17.39	52.17	26.09	100.00	13
The inability to attend training regularly	8.70	13.04	43.48	34.78	96.66	14
Doubt about the effectiveness of EFRs in adopting IPNS	4.35	21.73	34.78	39.14	91.29	15

The Table 7 showed that the problem, "Lack of grazing land and fodder for cattle" got the highest score of 234.78 and hence, was considered as the 1st ranked problem. The problem "Non-manure utilization of EFRs" got the 2nd highest score and hence, was considered as the 2nd ranked problem. The problem "The need to use crop residues as fuel" got the 3rd highest score and hence, was considered as the 3rd ranked problem. On the other hand, "Doubt about the effectiveness of EFRs in adopting IPNS" was considered as the lowest ranked problem by the resource poor farmers with the total score of 91.29 and thus got the last position in the order. Almost similar result was found from the SCDs.

The computed problem confrontation score of the respondents ranged from 25 to 40 with a mean and standard deviation of 33.08 and 3.33, respectively. Based on the observed scores the distribution of the respondents has been presented in Table 8.

Table 8 Farmers' category according to their extent of problem confrontation

(*Score range: Possible 0-45; Observed 25-40*)

Category	Farmers		Mean	SD
	Number	Percent		
Low (≤28)	25	10.87	33.08	3.33
Medium (29-34)	132	57.39		
High (>34)	73	31.74		

The findings reveal that more than half (57.39 percent) of the respondents faced medium problems, while 31.74 percent of them faced high problem and rest of them (10.87 percent) faced low problem. This might lead to conclusion that almost all the respondents confronted medium to high problems.

4. CONCLUSION

From the findings of the study it was explored that majority (95 percent) of the resource poor farmers were under medium utilization category and the average utilization of EFRs towards IPNS by the resource poor farmers was 53.92 percent. It is a fairly satisfactory sign, yet the resource poor farmers of the study area did not utilize about half of their EFRs towards IPNS. So, there remains scope to use their EFRs more towards IPNS for sustainable crop production. DAE in collaboration with other organizations may take necessary steps towards solving causes behind less utilization of EFRs towards IPNS.

Considering the relative contribution of characteristics, based on their direct effects, availability of EFRs has the highest and farm size has the lowest contribution on utilization of EFRs towards IPNS. The other characteristics were participation in EFRs management, use of information source, benefits of utilization of EFRs, perception of IPNS and farm size. It implies that, these characteristics of the resource poor farmers could have profound influence on their utilization of EFRs towards IPNS. Therefore, these characteristics bear the greatest importance for the resource poor farmers for more utilization of EFRs towards IPNS in a superior approach.

As perceived by the resource poor farmers, there were several problems for utilization of EFRs towards IPNS. Hence, DAE in collaboration with other organizations should take necessary steps towards solving these problems so that resource poor farmers can easily adopt proper utilization of EFRs towards IPNS. Some of the problems may be solved through awareness creation and practical training while others may need some physical and financial supports.

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