RESEARCH ARTICLE

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Assessment of the Farmers' Perception on Vermicompost as Waste Management Practice and Economic Return in Some Areas of Bangladesh

Shaikh Shamim Hasan, Sidhyartha Roy, Soumitra Saha, and Muhammad Ziaul Hoque

ABSTRACT

A study was conducted to determine the farmers' perception on vermicompost as waste management practice and economic return at the Baliadangi and Sadar upazila of Thakurgaon district of Bangladesh. Utilizing the survey method and pretested interview schedule, data were collected by face-to-face interview from proportionate randomly selected 115 respondents. The findings of the study exhibited that on an average the respondents were 40 years of age with 4 members in their family and about 90% of them were educated either primary, secondary, or tertiary level. The respondents' average family annual income was about 2870 USD and they earned an additional income of about 115 USD annually from vermicompost. Out of all the respondents 70% and 86% of them participated agricultural and vermicompost related training, respectively. Participation of different training programs helped the respondents to improve their knowledge on vermicomposting and vermiculture which was exhibited by their 88% moderate to better knowledge. Furthermore, 79% respondents exhibited moderately to highly favorable perception towards vermicompost as waste management practice and economic contribution. In addition, out of the selected attributes, five attributes, namely, respondents' family size, family annual income, income from vermicompost, training received on vermicompost and knowledge of the respondents on vermicompost had significant contribution on the perception of vermicompost. As a whole, the findings of the study offer new empirical evidence on the farmers level perception to vermicompost as waste management practice which may be utilized by the policy makers to develop future policy to adopt and disseminate of the vermiculture technique to the general farmers of the country.

Keywords: Assessment, vermicompost, farmers' perception, waste management.

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I. Introduction

At the time of green revolution huge amount of chemical inputs (fertilizers, insecticides and pesticides) were used to increase the crops yield and although, the production was higher initially but the soil productivity was getting reduced over the time [1], [2]. Consequently, consumer demand for more healthier and environment friendly organic products have been increased [3].

Additionally, the rising of world population resulting higher consumption as well as are producing a bulk volume of households, agricultural and industrial wastes to the environment demand to develop sustainable strategies to treat these wastes [4]. Moreover, organic fraction of these wastes can be recycled and transformed into organic resources and nutrient [5], [6]. Biological degradation of these wastes during composting and vermicomposting is a great strategy to convert nutrient-fertilizers from wastes [7].

Vermiculture is the scientific method of breeding and raising earthworms in controlled conditions [8]. Utilizing earthworms, vermicomposting is the compost producing process where through biotechnological process organic wastes mainly convert into high-quality compost which consisting mainly of worm cast and decayed organic [9], [10]. During this conversion process in vermiculture both composts and worms are produced simultaneously [11], and the vermicompost consists of decomposed vegetable or food wastes, vermicast and worm manure [12].

Around the globe many studies [13]-[15] were conducted on to identify the extent of adoption of vermicompost by the

farmers. Some studies [16], [17] focused on the economic beneficial side of vermicompost. Meanwhile, some studies also showed the impact of vermicomposting on crop production [18], [19], growth and yield of crops [20]-[22]. Although, in Bangladesh, very few studies had been conducted on vermicompost and were mostly focused on the potentiality of vermicompost as a good fertilizer source, soil health and yield issues [23]-[25], and benefits and limitations [26]. But no study related to farmers' perception on the vermicomposting as waste management practice and economic contribution has been seen in Bangladesh.

In Bangladesh, only four species (namely, Eisenia, Perionyx, Eudrilus, and Pheretima) out of 500 identified earthworm species are used for vermicomposting [27], which mainly like to settle on the topsoil, like to eat organic wastes and produces cast (about half of wastes volume it consumes) in a day [28], [29]. Farmers mainly use any types easily decomposed materials like, cow dung, vegetables and fruits wastes, crop residues etc. for vermicomposting [30], [31]. Through a study, [32] identified that the soils which have been supplemented by vermicompost have better aeration, better water retention capacity, enhanced soil pH, good organic matter and nutrient content. Meanwhile, the production cost of vermicompost applied crops is lesser than that of chemical fertilizers applied crops [33]. In recent years, due to its simple production technique and great output, the Bangladeshi farmers are showing interest on vermicomposting and it has started to practice in many regions of the country [34]. The farmers can produce this throughout the year as it requires only 30-40 days for a complete cycle [27]-[35]. Moreover, vermicomposting can create income generation for the rural youth and from selling vermicompost and earth worms they are seen to achieve economic solvency [36], [37]. However, investigating the farmers perception issues on waste management practices and economic contribution of vermicompost have not given much concern that may be crucial in future policy formulation. Hence, we conducted the current study in Thakurgaon district in Bangladesh for examining the farmers perception of vermicomposting as waste management practice and economic contribution of it. We also measured how different socioeconomic factors of the farmers could influence their perception.

II. Methodology

A. Research Design and Sample

To conduct this study, we utilized a descriptive survey research. Our main targets of this research were to observe the farmers' perception of the contribution (both economic and waste management) of vermicomposting and also to determine farmers' various sociodemographic characteristics which affected on their perception. To fulfill the target of the research, we conducted face to face interview with the farmers to collect relevant information by means of interview schedule. We undertook the study in two upazilas (lower administrative unit) namely, Baliadangi and Thakurgaon Sadar of Thakurgaon district of Bangladesh. More specifically we selected four villages under the two upazilas to conduct the study. The villages were, Aamtola and Choto Palashbari of Baliadangi upazila, and Jangalipara and Baliadangi of Thakurgaon Sadar upazila. These areas were selected as good number of vermicompost practicing farmers were available there. Total number of vermicompost practicing farmers in these four villages were 286 which we considered as the population of the study and out of which we selected 115 (40.20%) respondents as sample following proportionate random sampling technique.

B. Selection of Variables and Their Measurement Technique

Based on the assessment of the previous study and review [17], [38], [39] identified eight (08) variables as independent variables of this study. The variables were the farmers age, family size, educational qualification, family annual income, income from vermiculture, extension media communication, training received on agriculture, training received on vermiculture and knowledge on vermiculture.

C. Measurement Technique of the Independent Variables

We determined the respondents' age as the time from birth to the time of interview and put a score of one (1) to each year of age. While we meant educational qualification in terms of formal education obtained by a respondent and we assigned a score of one (1) for each year of passing of the respondent in any formal educational institution. Furthermore, the respondents who could not read and write or who did not have any formal education was assigned a score of zero (0). We calculated family size by putting a score of one (1) for each member of the family who jointly lived and ate together. Additionally, we computed the extension media communication by assigning different scores against different extension communication sources by the respondents, like, communication with Sub Assistant Agriculture Officers (SAAOs), contact with seed dealers, and contact with others of agricultural offices. We determined the family annual income of the respondents based on their total earnings from various sources, like, agriculture, service, business, and others and these were expressed in BDT (Bangladeshi Taka). Meanwhile, the income from vermiculture was measured based on the respondents' income from selling vermicompost and earthworms to the customers and it was also expressed in BDT. We computed the agricultural training receive and vermiculture training receive of the respondents by giving score of one (1) for each day of agriculture and vermiculture related training received of a respondent from different agriculture related organizations. In addition, the respondents' knowledge on vermiculture was calculated after giving scores against 10 questions asked to the respondents and assigned a score of '2', '1' and '0' for each correct, partially correct and incorrect answer, respectively.

D. Measurement of Dependent Variable

We recognized the farmers' perception of vermicomposting as waste management practices and economic contribution as the dependent variable of this study. For recognizing this issue, we set a total number of 15 statements, accordingly, the respondents were asked to give their responses on those perception statements. These statements also contained three negative statements which we arranged randomly. To calculate the level of agreement, we took a five-point Likert-type scale, as, strongly agree, agree,

undecided, disagree, and strongly disagree for positive statements and the reverse score was assigned for negative statements [38]-[44].

1) Measuring the respondent's perception of vermiculture

We created a vermiculture perception index (VPI) through a simple two step procedures considering the following Formula 1:

$$\text{VPI} = \sum_{j=1}^{15}, \sum_{m=0}^{5}, \sum_{q=0}^{1} E_j R_m W_q \quad (1)$$

A total number of 15 vermiculture perception statements were read to sample respondents and were asked their opinion (Ej). These 15 statements were selected on the basis of prior discussion and pretesting of the interview schedule. Then we assigned a value of 01 for each recognized perception, and if not assigned 0. In the second step, we asked the respondents to expose their opinion on a five-point scale (Rm), hence, they were assigned a score of 05 for each strongly agree opinion and 1 was assigned for each strongly disagree opinion. After that, we converted these ranks into weighted score (Wg). Then, we allocated 02 to the lowest rank of 01 and 01 was assigned to the highest rank of 05. While, the VPI for each of the respondents was calculated by summing up the weighted score. This formulation and equation were also followed by [45] and [46].

2) Multiple linear regression procedure

To determine the attributes influencing the respondents' perception on vermiculture, we took eight independent variables (respondents age, family size, educational qualification, family annual income, income from vermiculture, training received on agriculture, training received on vermiculture and knowledge on vermiculture) to full-model regression analysis. We then ran the linear regression model due to the nature of the dependent variable. Therefore, the latent equation (equation 2) which was utilized in this study were:

$$y=\beta_o+\beta_1 x_1+ \beta_2 x_2+\ldots\ldots\ldots+ \beta_8 x_8+\varepsilon \quad (2)$$

where, y was the dependent variable, β_0 was the intercept, $\beta_{1\text{-}8}$ was the coefficient, and $x_{1\text{-}8}$ was the independent variables.

The independent variables that influenced on the respondents' awareness to climate change were as follows:
X_1 = Age of the respondents in years;
X_2 = Family size of the respondents in numbers;
X_3 = Educational qualification of the respondents in years;
X_4 = Family annual income of the respondents in BDT;
X_5 = Income from vermiculture;
X_6 = Respondents agricultural training received;
X_7 = Respondents vermiculture training received;
X_8 = Respondent's knowledge score on vermiculture.

We categorized and classified the data as per the objectives of the study in view after collecting data from the respondents of the study area. Moreover, we executed the multiple regression analysis with 0.10, 0.05, and 0.01 level of significance to determine the influence of the attributes.

III. Results and Discussion

Data portrayed in Table I exhibited that most percentage of the respondents (73.7%) in the study area were female and majority of them (91.2%) adopted agriculture as their main occupation. We also observed that most percentage of them (63.1%) had their own land for cultivating different types of crops. The average age of the respondents were about 40 years which indicated good working ability of the respondents. [47] found almost similar types of finings as the average age of the respondents was about 39 years and [42] determined that young respondents were generally had more social contact, used to have wider viewpoint than older people. According to the findings of Table 1, the family size ranged from 2 to 7 members with an average of 4.12, it was lower than the national average of 4.2 [48]. Most percentage of the respondents (49.1%) received secondary level (6-10) of education. The highest proportion of the respondents (35.1%) fell under USD 1036 to 2500 income category with an average of USD 2869.76 and it was higher than the national average of USD 1871 [49]. Most percentage (40.4%) of them earned USD 50.01 to 100 from vermiculture with an average of USD 114.70. Most percentage of the respondents (43.9%) received 1 to 5 trainings on different issues of agriculture, while 80.7% of them received 1 to 3 trainings on vermicomposting. We asked a total number of 10 questions to judge the knowledge level of the respondents on vermiculture. Meanwhile, the highest proportion (75.4%) of the respondents possessed moderate knowledge on vermicomposting technology. In a Bangladeshi study conducted by [47] claimed that knowledge was a crucial factor influencing individual's alertness, and mental awareness.

A. Respondents' Perception Index of Vermicomposting

We observed the data furnished in Table II that the respondents had topmost perception towards vermicomposting as a waste management technique in respect of 'I want to persuade others towards vermicomposting' was the highest (Mean = 0.96) followed by 'In my opinion, farmers can produce vermicompost very shortly by themselves through utilizing household wastes and cow dung' (Mean = 0.94). Accordingly, 'In my opinion, utilizing household wastes and cow dung to produce vermicompost can keep clean the environment that reduce chemical fertilizers for crop production' (Mean = 0.89) ranked third. From the top-ranked statements, it was obvious that most of the respondents of the study area agreed to the positive effects of vermicompost practicing. Similar findings observed in the study of [50] in Nigeria and [26] in Bangladesh where the respondents positively perceived the beneficial effects of vermicomposting. As it is a good source of earning as well as generation of income and requires less time to produce. They were concerned about excessive use of chemical fertilizer in the soil and wanted to mitigate the negative impacts of it by applying vermicompost in their crop field.

The respondents showed less favorable perception to some statements as per their mean score, like 'I utilize the additional money from vermicomposting for my family welfare (Mean = 0.80) ranked 12th, while 'By applying vermicompost, barren land turned into fertile (Mean = 0.79)

ranked 13th, and 'In my opinion, cropland vegetables produced by vermicompost application can be sold with higher prices' (Mean = 0.73) ranked 14th.

TABLE I: SOCIODEMOGRAPHIC CHARACTERISTICS OF THE RESPONDENTS

Characteristics	Categories	Respondents (%)	Observed score	Mean
Gender	Male	26.3	-	-
	Female	73.7		
Occupation	Agriculture	91.2	-	-
	Business	5.3		
	Service	3.5		
Farmer type	Own land	63.1	-	-
	Other's land	1.8		
	Both	35.1		
Age	<30 years	26.3	19 to 65 years	40.33
	31-40 years	35.1		
	41-50 years	17.5		
	>50 years	21.1		
Family size	<4	57.9	2 to 7	4.12
	5-6	36.8		
	>6	5.3		
Educational qualification	No education	10.5	0 to 13	7.18
	1-5	29.8		
	6-10	49.1		
	>10	10.5		
Family annual income	<1036 USD	17.5	1411 to 14823 USD	2959.76 USD
	1036-2500 USD	33.3		
	2500-3500 USD	19.3		
	>3500 USD	29.9		
Income from vermiculture (annual)	<10 USD	3.1	2.35 to 588 USD	114.70 USD
	10.01-50 USD	12.5		
	50.01-100 USD	39.1		
	100.01-250 USD	40.6		
	>250 USD	4.7		
Agriculture training received	No training	29.8	0-15	4.05
	1-5	43.9		
	6-10	19.3		
	>10	7		
Vermicompost training received	No training	14	0-5	1.45
	1-3	80.6		
	4-5	5.4		
Knowledge on vermiculture	Poor (8-12)	12.3	8 to 20	14.96
	Moderate (13-17)	75.4		
	Better (>17)	12.3		

TABLE II: RESPONDENTS PERCEPTION INDEX OF VERMICOMPOST

SL No	Statements	Mean	Rank
01	In my opinion, farmers can produce vermicompost very shortly by themselves through utilizing household wastes and cow dung (+)	0.94	2
02	The initial production cost of vermicomposting is lower (-)	0.84	7
03	Vermicompost is rich in nutrients (+)	0.81	11
04	By applying vermicompost, barren land turned into fertile (+)	0.79	13
05	In my opinion, utilizing household wastes and cow dung to produce vermicompost can keep clean the environment that reduce chemical fertilizers for crop production (+)	0.89	3
06	Applying vermicompost for crop and vegetable production increases the resistance of plants diseases (+)	0.84	7
07	In my opinion, cropland vegetables produced by vermicompost application can be sold with higher prices (+)	0.73	14
08	Vermicomposting provides an additional income for farmers (+)	0.85	6
09	I have found difficulty in selling vermicompost and earthworms (-)	0.83	9
10	Women can be involved in income generation activities through vermicomposting (+)	0.88	4
11	I utilize the additional money from vermicomposting for my family welfare (+)	0.80	12
12	There observed an increasing trend among others to vermicomposting for its profitability and easy production techniques (+)	0.86	5
13	I am not interested in using this technology in the future (-)	0.82	10
14	I want to take part in more training programs on vermicomposting (+)	0.83	8
15	I want to persuade others towards vermicomposting (+)	0.96	1

TABLE III: DISTRIBUTION OF THE RESPONDENTS ACCORDING TO OVERALL PERCEPTION OF VERMICOMPOST

Sl	Categories (Score)	Frequency	Percent	Mean	SD
1.	Less favorable perception (<120)	24	20.9		
2.	Moderately favorable perception (121-140)	83	72.1	64.77	4.42
3.	Highly favorable perception (>140)	8	7		

B. Respondents' Overall Perception on Vermicomposting

The respondents' perception scores towards vermicomposting as an environment-friendly waste management technology ranged from 53 to 72, with an average of 64.77. Based on the perception score, the respondents were classified into three categories as shown in Table III. This table revealed that the highest proportion (72.1%) of the respondents had a moderately favorable perception followed by less favorable (20.9%) and highly favorable perception (7%). A significant portion (93%) of the respondents showed less favorable to moderately favorable perception towards vermicomposting technology.

A fair amount of knowledge of the respondents regarding any technology leads to more favorable perception towards it [51]. Then favorable perception encourages people to adopt such practices that improve their living conditions. Vermicompost is the recently introduced practice in the study area. That is why, a portion of the respondents did not possess adequate knowledge on vermicomposting. Besides, the majority of them practiced it for only subsistence rather than commercial purpose. As a result, their earnings from vermicompost practicing are not noteworthy in proportion to their total annual income. Therefore, these reasons might have caused an impediment to the perception of vermicomposting as a waste management technique by the respondents. The findings are in line with the study of [26]. He observed that a major portion of the farmers showed less to moderate perception towards vermicomposting. [52] also found similar results in his study regarding farmers' perception on shrimp farming in Khulna district of Bangladesh.

C. Contribution of the selected characteristics of the respondents on their perception towards vermicompost as waste management practices and economic contribution

When we performed the full-model regression analysis (Table IV), it was found that out of 08 characteristics of the respondents, family size, family annual income, income from vermicompost, training received on vermicompost and knowledge of the respondents on vermicompost were found to have significant influence which meant higher the above-mentioned characteristic of the respondents distinguished vermicomposting better than the other members. The R^2 value was 0.39, which revealed that 39% of the variation on the perception towards vermicomposting as waste management practices and economic contribution.

We observed in Table IV that family size of the respondents showed a significant and positive influence on respondents' perception of vermicomposting as waste management practices and economic contribution as per the value of regression co-efficient (0.093) was significant at 10% level. Through a study in Bangladesh [42] observed that family size of the respondents had significant influence on the response towards floating agriculture for sustainable development. Meanwhile, through this study, we observed a significant and positive influence of the respondents' both family annual income and income from vermicompost as the 'β' values were 0.337 and 0.257 for family annual income and income from vermicompost, respectively. Similar type of significant and positive contribution of family annual income on the attitude of the farmers towards using agrochemicals in rice field was also found by [53], [54]. Subsequently, the value of regression coefficient (β) of training received on vermicompost was 0.300 which was significant at 5% level. This means if the vermicompost related training could be increased among the farmers then their perception of it towards waste management practices and economic site could be positively increased. Similar type of significant positive relationship agricultural training received, and attitude/perception were also observed by some other researchers [38], [42], [55]. Meanwhile, a significant positive influence of the respondents' vermicompost knowledge on their perception of it as waste management practices and economic contribution ('β' was 0.392). Similar types of significant contribution of knowledge of the farmers on their opinion towards poverty alleviation through income generating activities by [53].

TABLE IV: RESPONDENTS' SELECTED CHARACTERISTICS AND THEIR CONTRIBUTION TO PERCEPTION OF VERMICOMPOSTING

Characteristics of the respondents	Coefficient 'β'	SE	t - value	p (significant)
Age	-0.077	0.046	-0.595	0.555
Family size	0.204*	0.443	1.682	0.072
Educational qualification	0.127	0.152	0.968	0.338
Family annual income	0.337***	0.100	2.861	0.006
Income from vermicompost	0.257**	0.101	1.835	0.025
Agriculture training received	0.110	0.111	0.956	0.344
Vermicompost training received	0.300**	0.378	2.095	0.042
Knowledge on vermiculture	0.329***	0.122	2.878	0.007

Note: $R = 0.62$, $R^2 = 0.39$, Adjusted $R^2 = 0.31$, Critical Value of $F = 4.258$, and '***' '**' & '*' represent significant at 1%, 5% and 10% level of probability, respectively.

IV. CONCLUSIONS

About 60% of the respondents of the study area were young aged (19 to 40 years), 95% of them had a family size in between 2 to 6, and 90%vof them were educated spanning from primary to upper HSC level. Average family annual income of the respondents was 2870 USD, moreover, the respondents earned about 115 USD per year exclusively from vermicomposting as they sold both vermicompost and earthworms. Out of all of the respondents, about 70% of them received training on different agriculture related issues. Accordingly, 86% of them received training on vermiculture which helped them to boost up moderate to better knowledge on different issues of vermiculture. Although better adoption and dissemination of vermiculture requires to organize more and regular training on vermiculture.

Findings of the study exhibited that about 80% respondents of the study area had moderately to highly favorable perception towards vermicomposting as an environment-friendly waste management technology and a source of good economic return. Participating of the respondents in different vermiculture related training and better economic return of both vermicompost and earth worms accelerated the perception level of the respondents towards vermiculture.

Respondents' family size, family annual income, income from vermicompost, training received on vermicompost and knowledge of the respondents on vermicompost were the

contributing factors that influenced their perception of vermicomposting as waste management practices and economic contribution. Therefore, it may be concluded that any attempt to increase these selected characteristics would be helpful for the perception improvement of the respondents towards vermicomposting. The findings of the study will be useful for planning and execution of vermicompost as well as vermiculture technology and agriculture policy (both adoption and dissemination of vermiculture) of Bangladesh.

We only selected the Thakurgaon district (north-western part) of Bangladesh to conduct this study. To get more authentic picture similar study can also be conducted in other parts of the country which will be effective for better policy formulation. Moreover, more training and awareness program should be arranged for the local farmers of the country. Different government organizations (mainly Department of Agricultural Extension) and NGOs can play a vital role on this issue. Meanwhile, we took only eight socioeconomic characteristics of the farmers and observed those factor's contribution towards farmers' perception. Therefore, it is further study may be conducted with other independent and dependent variables.

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