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Adoption of sustainable organic waste management practices: Impact of farmer FIRST programme in Punjab

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ABSTRACT

The current investigation was designed to analyze the impact of Farmer FIRST Programme implemented by GADVASU Ludhiana on sustainable organic waste (agricultural, household and livestock) management practices. Two districts of Punjab namely, Barnala and Ludhiana were selected for the study. A total of 120 farmers were selected randomly, 60 from each district and categorized as beneficiaries and non-beneficiaries from adopted villages of Barnala and non-adopted villages of Ludhiana, respectively. An *ex-post facto* research design was used with control-experimental research methodology. The results being eloquent revealed that there was a significant difference ($p<0.05$) in the practices of the respondents related to management of paddy straw, paddy stubbles, wheat straw, livestock dung, livestock urine, and animal bedding and feed leftovers. The adoption index was calculated to be 0.69 for the beneficiaries and 0.48 for the non-beneficiaries which inferred that the level of adoption of sustainable organic waste management practices among beneficiaries was significantly higher than the non-beneficiaries, which highlighted the positive impact of the Farmer FIRST Project. Vermicomposting helped the farmers to cut expenses on chemical fertilizers and optimized their farming returns. The annual returns from one rhino bed were calculated to be INR 9933.28. The study concluded with the impression that the Farmer FIRST Programme has been instrumental in bringing a desirable change in the behavioural aspects of the beneficiaries regarding waste management, therefore, such programmes need to be bolstered and endorsed by the government time to time.

Keywords: Adoption, Agriculture, Farmer FIRST Programme, Impact, Livestock, Waste management

The Government of India through its various welfare projects and programmes have envisioned developed India. As the Indian agriculture is at helm for rural development, any project which led to agricultural development can prove to be instrumental for chalking out the strategy for the development of nation. Livestock, being a major sub-sector of agriculture, has shown a remarkable growth over the years. In 2022-23, the contribution of livestock to national gross value added (GVA) was estimated to be 5.50 percent and 30.23 percent to agricultural GVA (BAHS, 2024). Milk being the highest grossed agricultural commodity, forms the most critical component of Indian livestock sector employing 8 crore farmers directly. Due to the tireless efforts of Indian farmers supported by novel initiatives by the government, India stands at number one in milk production, second in egg production and fifth in meat production globally (Singh, 2024).

To augment the farmers' income, focus was made on primary produce whereas, the sustainable management of organic waste emanating from farm operations which could be transformed to useful products for wealth generation was a secondary focus (Singh *et al.* 2017). Paddy straw can be used as animal feed, baled for energy production, fuel production, pellet production, etc. (Singh *et al.* 2018a), whereas from livestock dung, vermicompost is one of the very remunerative products. In addition to this, biogas, dung logs, compost, vermi-wash, etc. are other avenues wherein livestock dung can be converted for remunerative purposes (Singh *et al.* 2020). In rural areas of the country, agricultural and livestock waste is largely organic which can be easily converted to manure without much efforts. Keeping this in mind, the beneficiaries of the project area were trained for vermicompost production (Singh *et al.* 2016).

Farmer FIRST Programme was formulated as a bottom-up strategy by ICAR, New Delhi in 2016 in interest of the farming community. Conceptually, it was formulated with farmers in a central role for identifying research problems, setting priorities, conducting trials, and managing them under farm settings. Farmer's Farm, Innovations, Resources, Science, and Technology (FIRST) are the main paradigms of this programme (Kemekar and Salunkhe, 2024). Through vitalizing the interactions between farmers

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and scientists, the Farmer FIRST Programme is a novel method that prioritizes smallholder agriculture going beyond production and productivity (Venkatesan *et al.* 2023). Over the years, Farmer FIRST Programme has had a positive impact on the behavioural attributes of the farming community regarding organic waste management. Further, Farmer FIRST Programme has also played an instrumental role in technology transfer and adoption at grassroots (Manjeet *et al.* 2020).

GADVASU Ludhiana has been sanctioned an extra-mural project entitled "Integrated Approaches for Livestock Development: Farmers' Context" under Farmer FIRST Programme, herein referred to as 'project' in which various modules for the development of livestock was conceptualized and implemented. The current investigation was made to assess the impact of the trainings and demonstrations conducted under the project for adoption of sustainable organic waste management practices with a focus on vermicomposting.

MATERIALS AND METHODS

An ex-post facto research design was employed with control-experiment research methodology. Barnala and Ludhiana districts were selected purposively in Punjab for the current study. Barnala was selected as the Farmer FIRST Project was implemented in the district whereas Ludhiana was selected due to the fact that Ludhiana has high number of progressive farmers along with highest dairy production, and hence the waste (Singh *et al.* 2019; Singh *et al.* 2020). From Barnala, village Moom which was adopted under the project for interventions related to sustainable organic waste management was selected and from Ludhiana, village Daad was randomly selected. From both the villages, 60 farmers each were selected for the study. The farmers from adopted village Moom were termed as 'beneficiaries' and those from non-adopted village Daad were termed as 'non-beneficiaries' and the study was based on management of bio-degradable waste emanating from agriculture, household and dairy animals. Thus, the farmers having agriculture land and dairy animals were recruited as sample in the study.

A semi-structured interview schedule was pre-tested and used for data collection. Independent variables like age, education, land holding, herd size, family size, annual income and training were obtained; and communication variables like extension agency contacts and mass media exposure were taken for data collection. Data were also collected for organic waste management practices, and the utility of vermicompost which forms core of the present study. The data for the variables were analysed using the statistical tools like frequency and percentage. For independent variables, t-test given in equation (1) was used as test of significance, whereas for analysing the data regarding organic waste management practices, Mann Whitney U Test given in equation (2) was used. The adoption index for overall adoption of the waste management practices was calculated using the formula given in equation (3). For relational analysis between independent variables and adoption was calculated using correlation and regression coefficients. The analysis was done using Statistical Package for Social Sciences (SPSS) and Microsoft Excel.

$$t = \frac{x_1 - x_2}{\sqrt{\frac{(s_1)^2}{n_1} + \frac{(s_2)^2}{n_2}}} \quad (1)$$

Where, x_1 is the mean of sample 1, s_1 is the standard deviation of sample 1, n_1 is the sample size of sample 1, x_2 is the mean of sample 2, s_2 is the standard deviation of sample 2, n_2 is the sample size in sample 2

$$\text{Mann Whitney U Test} = \sum_{i=1}^{n} \sum_{j=1}^{m} S(X_i, Y_j) \quad (2)$$

Where, , ... were supposed to be independent and identically distributed sample from *X*, and , ... were supposed to be independent and identically distributed sample from *Y* with

$$S(X,Y) = \begin{cases} 1, if\ X > Y \\ \frac{1}{2}, if\ X = Y \\ 0, if\ X < Y \end{cases} \quad (3)$$

In the present study, a total 36 sustainable organic waste management practices were included in the interview schedule.

RESULTS AND DISCUSSION

Socio-personal and communication variables: Data were collected for socio-personal and communication variables viz. age, education, land holding, herd size, family size, annual income, training obtained, extension agency contact and mass media exposure and are presented in Table 1. Results revealed that the mean age of beneficiaries and non-beneficiaries was calculated to be 51.06 and 42.36 years, respectively. However, in the pooled sample, the mean age was 46.71 years and more than half (52.50%) of the respondents were middle aged. The t-test analysis revealed non-significant relationship between the age of beneficiaries and non-beneficiaries. Similar results were observed by Singh *et al.* (2018b) and Singh *et al.* (2020), wherein more than half of the respondents were middle aged. There is a growing concern in Punjab regarding retention of young generation into agriculture and allied sectors, as they tend to migrate to foreign countries for better job opportunities. The mean education level among beneficiaries and non-beneficiaries was 10.10 and 12.36 schooling years respectively with non-significant difference. The results were in line with Manjeet *et al.* (2019) while evaluating the Farmer FIRST Project in which the majority respondents were having education level upto matriculation level. The education level was higher in respondents of Ludhiana due to high literacy rates and better education infrastructure in the district.

As far as land holding was concerned, the mean land holding among beneficiaries and non- beneficiaries was found to be 6.11 and 4.64 acres respectively with significant difference ($p<0.05$). The land holdings in Ludhiana district

Table 1. Distribution of respondents according to their socio-personal and communication variables

Variable	Range	Beneficiaries (n=60)		Non-beneficiaries (n=60)		Pooled (N=120)		t-test value
Age (in years)		f	%	f	%	f	%	
Young	30-45	18	30.00	14	23.33	32	26.67	4.381
Middle	45-60	29	48.33	34	56.67	63	52.50	
Old	60-75	13	21.67	12	20.00	25	20.83	
Mean±SE		51.06±3.39		42.36±2.14		46.71±2.69		
Education Level								
Illiterate	0	1	1.67	0	0.00	1	0.83	6.597
Primary	1-5	5	8.33	4	6.67	9	7.50	
Secondary	5-10	30	50.00	22	36.67	52	43.33	
Senior Secondary	10-12	19	31.67	27	45.00	46	38.33	
Graduate and above	15 and above	5	8.33	7	11.67	12	10.00	
Mean±SE (in schooling years)		10.10±0.67		12.36±0.62		11.23±0.64		
Land Holding (in acres)								
Landless	0	1	1.67	3	5.00	4	3.33	6.689*
Marginal	0-2.5	4	6.67	38	63.33	42	35.00	
Small	2.5-5	29	48.33	11	18.33	40	33.33	
Medium	5-10	22	36.67	5	8.33	27	22.50	
Large	10 and above	4	6.67	3	5.00	7	5.83	
Mean±SE		6.11±0.40		4.64±0.23		5.37±0.30		
Herd Size (animal heads)								
Small	1-5	37	61.67	34	56.67	71	59.17	0.898
Medium	5-10	20	33.33	24	40.00	44	36.67	
Large	1-15	3	5.00	6	10.00	9	7.50	
Mean±SE		5.75±0.38		4.72±0.23		5.23±0.30		
Family Size (members)								
Small	Upto 4	28	46.67	38	63.33	66	55.00	-8.701*
Medium	4-8	31	51.67	15	25.00	46	38.33	
Large	8-12	1	1.67	7	11.67	8	6.67	
Mean±SE		4.75±0.31		4.52±0.22		4.60±0.26		
Annual Income (in INR Lakhs)								
Low	0-8	27	45.00	45	75.00	72	60.00	1.305*
Medium	8-16	27	45.00	7	11.67	34	28.33	
High	16-24	6	10.00	8	13.33	14	11.67	
Mean±SE		5.02±0.33		4.17±0.21		4.63±0.26		
Training Obtained								
Yes	Yes (1)	60	100.00	6	10.00	66	55.00	12.738**
No	No (0)	0	0.00	54	90.00	54	45.00	
Extension Agency Contact								
Low	0-4	7	11.67	10	16.67	17	14.17	36.357*
Medium	4-8	44	73.33	36	60.00	80	66.67	
High	8-12	9	15.00	14	23.33	23	19.17	
Mean±SE		9.17±0.61		8.44±0.42		8.81±0.50		
Mass Media Exposure								
Low	0-6	0	0.00	11	18.33	11	9.17	1.815*
Medium	6-12	29	48.33	30	50.00	59	49.17	
High	12-18	31	51.67	19	31.67	50	41.67	
Mean±SE		18.88±0.96		14.44±0.95		16.66±1.14		

f: frequency; %: percentage; **Significant at 1%; *Significant at 5%

tends to be decreasing because of rapid urbanization, whereas in case of Barnala, the farmers were found to be still practising agriculture with better mechanization. The data for calculation of herd size were analysed and the mean herd size for beneficiaries and non-beneficiaries was calculated to be 5.75 and 4.72 animal heads respectively with non-significant difference. The results reported by Singh *et al.* (2024) while doing an exploratory analysis of the project area seconds the findings of the current study. The mean of family size among beneficiaries and non-beneficiaries was calculated to be 4.75 and 4.52 members respectively, which were found to be varying significantly ($p<0.05$). In present study, it was found that the family size over the years has been witnessing a declining trend and modern families comprise of parents and their children largely with some families having one or two elders as well. Regarding annual income, it was found that beneficiaries and non-beneficiaries were earning around 5.02 and 4.17 lakhs respectively per year and the figures were significant at $p<0.05$. The beneficiaries were having higher levels of annual income because of the higher adoption levels of scientific practices and interventions made in the Farmer FIRST Project. The results are in concurrence with those reported by Singh *et al.* (2025) in which the mean annual income of the farmers of Ludhiana was reported to be INR 4.96 lakhs per year.

The results pertaining to trainings obtained were highly significant ($p<0.01$) among the beneficiaries and non-beneficiaries as cent percent of the beneficiaries were trained under Farmer FIRST Project. Whereas among the non-beneficiaries, only 10 percent of the respondents have undertaken training programme on organic waste management. This also shows the vitality of capacity building programmes in management of organic waste in particular and adoption of interventions in general (Singh *et al.* 2022a). Regarding extension contact and mass media exposure, a significant difference ($p<0.05$) was witnessed in the means among the beneficiaries and non-beneficiaries. The means of aforementioned communication variables among beneficiaries surpasses those in non-beneficiaries, as the beneficiaries in project area have first-hand access to information through literature like magazines, booklets and folders; digital technologies like mobile apps and social media; and field activities like awareness camps, welfare camps, demonstration drives, field days, etc. The results regarding communication variables partially corresponds to those reported by Singh *et al.* (2022b) in which the respondents were having low to medium communication profile whereas in present case, the respondents were having medium to high communication profile to the project activities undertaken in the project area.

Organic waste management practices followed by the respondents: An exploratory study was undertaken to observe and critically analyse the organic waste management practices followed by the respondents as these form the core of current investigation. The results of the are presented in Table 2 with implication of Mann-Whitney U Test as test of significance among the beneficiaries and non-beneficiaries. As trainings and awareness camps under the Farmer FIRST Project were organized for the beneficiaries, the level of practices was found to be higher than non-beneficiaries. In context of paddy straw management, it is evident from Table 2 that a significant difference ($p<0.05$) was present in the beneficiaries and non-beneficiaries regarding feeding wholesome straw to livestock and addition in dung cakes, whereas highly significant difference ($p<0.01$) was seen among the respondents regarding chaffing with greens and feeding to livestock, baling for power generation, in-situ burning, and use in mushroom cultivation. In case of management of paddy stubbles, highly significant difference ($p<0.01$) was found among the respondents. None of the beneficiary farmers in the project area burnt the paddy straw or stubbles and managed the same using mulching and agricultural machinery.

With regard to management of wheat straw, feeding of wheat straw to dairy animals is a common practice in Punjab and the results of the present investigation elucidated the same. A highly significant difference ($p<0.01$) was noticed among the beneficiaries and non-beneficiaries for the use of wheat straw for mixing with greens fed to livestock, and this difference was significant ($p<0.05$) for mulching. All the respondents reportedly mulched the wheat straw and none resorted to its burning. For management of kitchen waste, there was highly significant difference ($p<0.01$) in the responses of beneficiaries and non-beneficiaries for feeding wholesome waste to livestock, chaffing and feeding to livestock and using kitchen waste in biogas plants. However, significant difference ($p<0.05$) was noticed in the responses of the respondents for the use of kitchen waste in vermicomposting.

Livestock waste being highly organic in nature can be decomposed easily for monetary and entrepreneurial ventures as well. The current investigation recorded the various practices for management of livestock waste viz. livestock dung, livestock urine along with animal bedding and feed leftovers. In Farmer FIRST Project, vermicomposting was opted as a preferred activity for management of livestock waste, therefore, the beneficiaries were provided with training and inputs for adoption of vermicomposting, hence yielding a significant difference ($p<0.05$) among the beneficiaries and the non-beneficiaries as cent percent of the beneficiaries were found to be adopting vermicomposting through rhino-bed method. A highly significant difference ($p<0.01$) was elucidated in the adoption of biogas production and preparation of dung cakes among the respondents. For management of livestock urine, a highly significant difference ($p<0.01$) was noticed between the beneficiaries and non-beneficiaries regarding its use in vermicomposting and discarding the same in drains. For animal beddings and feed leftovers, a highly significant difference ($p<0.01$) was seen among the respondents for the practice of using the same in vermicomposting.

Singh *et al.* (2020) explored the waste management

Table 2. Organic waste management practices followed by the respondents

Waste management practices	Beneficiaries (n=60)		Non-beneficiaries (n=60)		Pooled (N=120)		Mann-Whitney U Test
	f	%	f	%	f	%	
Paddy straw							
Feeding wholesome straw to livestock	20	33.33	9	15.00	29	24.17	1470.00*
Chaffing with greens and feeding to livestock	17	28.33	0	0.00	17	14.17	1290.00**
Animal bedding	41	68.33	37	61.67	78	65.00	758.50
Baling for power generation	35	58.33	12	20.00	47	39.17	1140.00**
Construction of animal shed	2	3.33	0	0.00	2	1.67	1740.00
In-situ burning	0	0.00	7	11.67	7	5.83	1590.00**
Mulching	11	18.33	2	3.33	13	10.83	1140.00
Use in mushroom cultivation	12	20.00	0	0.00	12	10.00	1370.00**
Addition in dung cakes	33	55.00	17	28.33	50	41.67	925.50*
Paddy stubbles							
Mulching	60	100.00	53	88.33	113	94.17	725.50
In-situ burning	0	0.00	7	11.67	7	5.83	1590.00**
Wheat straw							
Threshing straw and feeding to livestock	60	100.00	60	100.00	120	100.00	0.00
Mixing with greens and feeding to livestock	54	90.00	30	50.00	84	70.00	1080.00**
Mulching	12	20.00	4	6.67	16	13.33	1025.00*
Wheat stubbles							
Mulching	60	100.00	60	100.00	120	100.00	0.00
In-situ burning	0	0.00	0	0.00	0	0.00	0.00
Kitchen waste							
Feeding wholesome waste to livestock	4	6.67	37	61.67	41	34.17	750.00**
Chaffing and feeding to livestock	60	100.00	12	20.00	72	60.00	810.00**
Use in preparation of farmyard manure	34	56.67	15	25.00	49	40.83	1110.00**
Using along with other substrates in biogas plant	9	15.00	0	0.00	9	7.50	1530.00**
Preparing liquid manure	2	3.33	0	0.00	2	1.67	1740.00
Vermicomposting	6	10.00	0	0.00	6	5.00	1620.00*
Livestock dung							
Preparing farmyard manure by heap method	54	90.00	58	96.67	112	93.33	730.00
Preparing farmyard manure by pit method	6	10.00	2	3.33	8	6.67	1620.00
Vermicomposting by conventional method	1	1.67	1	1.67	2	1.67	1800.00
Multi-pit vermicomposting	1	1.67	3	5.00	4	3.33	1740.00
Vermicomposting in HDPE/Rhino Vermibed	60	100.00	3	5.00	63	52.50	90.00**
Biogas production	36	60.00	19	31.67	55	45.83	1080.00**
Preparing dung cakes	33	55.00	17	28.33	50	41.67	1070.00**
Direct application to soil	14	23.33	21	35.00	35	29.17	1590.00
Discarding in drains	2	3.33	4	6.67	6	5.00	1740.00
Livestock urine							
Using as liquid manure	3	5.00	2	3.33	5	4.17	1610
Use in vermicomposting	17	28.33	1	1.67	18	15.00	1290.00**
Discarding in drains	34	56.67	54	90.00	88	73.33	1050.00**
Animal bedding and feed leftovers							
Use in preparation of farmyard manure	60	100.00	60	100.00	120	100.00	0.00
Use in vermicomposting	33	55.00	1	1.67	34	28.33	840.00**

f: frequency; %: percentage; **Significant at 1%; *Significant at 5%

practices of the farmers in Ludhiana and reported that majority of the farmers were using paddy straw for animal bedding and also resorted to in-situ burning for clearing the fields on time. However, over the years, the number of farmers resorting to in-situ burning of paddy straw has reduced. Similar findings were reported by Roy *et al.* (2018). The kitchen waste was discarded for preparation of farmyard manure. However, a good number of dairy farmers were having biogas plants installed for management of livestock dung (Singh *et al.* 2020).

Adoption levels and index: Analysis was done for reaching a conclusive inference for adoption of sustainable organic waste management practices, for which mean and adoption index along with test of significance i.e. Mann Whitney U Test was calculated. Perusing Table 3, it can be interpreted that the mean of sustainable organic waste practices for beneficiaries and non-beneficiaries was calculated to be 24.79 and 17.57 respectively with Mann Whitney U Test value of 598.00, reflecting highly significant difference ($p<0.01$) among the respondents. The adoption index was calculated to be 0.69 for the beneficiaries and 0.48 for the non-beneficiaries which infers that the level of adoption of sustainable organic waste management practices among beneficiaries was significantly higher than the non-beneficiaries which highlights the positive impact of the Farmer FIRST Project. Kapadiya *et al.* (2019) while working with the farmers reported the increased adoption of interventions of Farmer FIRST Project on the similar lines.

Relational analysis: To delve deep into the intricacies of adoption of organic waste management practices, a relational analysis i.e. regression and correlation of adoption was calculated with independent variables, like age, education, land holding, herd size, family size, annual income, training obtained, extension agency contacts and mass media exposure (Table 4). All the independent variables were having regression and correlation with the adoption except family size which may be due to the fact that increase in number of family members require more time and efforts for looking after, so respondents tend to give more time to families as compared to waste management practices. Further, trainings were found to be regressing on adoption with highly significant scale and difference ($p<0.01$). The perusal of Table 4 elicits that 3.414 units increase in trainings can increase the adoption by one unit. The practical relevance of this fact stands true for the positive impact of Farmer FIRST Project as for the adoption of new technologies, the beneficiaries are trained and demonstrations conducted. Further, land holding, extension agency contacts and mass media exposure were also found to have highly significant ($p<0.01$) impact on adoption. The education status of the respondents was also found to be exerting positive impact ($p<0.05$) on the adoption of organic waste management practices. The results of the current investigation were found in line with Kambale and Sankhala (2021), Maran *et al.* (2022) and Singh *et al.* (2023).

A case of vermicomposting – utility and economic returns: In the Farmer FIRST Project, vermicomposting was taken as a model activity as it ensures sustainable management of livestock waste fetching remunerative returns. The beneficiaries were trained for vermicomposting using rhino bed method and provided with one bed each. The utilitarian and economic returns of vermicomposting as reported by the beneficiaries are presented in Table 5. Regarding use of vermicompost, cent percent of the respondents reportedly used it in agriculture and vegetable production, 56.67 percent in horticulture and only 20 percent sold the vermicompost. Hasan *et al.* (2023) have reported the use of vermicompost as positive soil amendment. The amount of vermicompost used per acre was 125 kg which was less than the recommended dose of 1 to 2 tonne per acre (Ram *et al.* 2021). Around 95 percent of the respondents

Table 4. Relational analysis between adoption of organic waste management practices and independent variables

Variable	B	r
Age	0.070	0.332
Education	0.123*	0.218*
Land Holding	0.553**	0.299**
Herd Size	0.090	0.010
Family Size	-0.034	-0.215*
Annual Income	0.787**	0.056
Training Obtained	3.414**	0.307**
Extension Agency Contacts	0.639**	0.366**
Mass Media Exposure	0.782**	0.142**

**Significant at 1%; *Significant at 5%

Table 3. Adoption levels and index of respondents regarding organic waste management practices

Adoption level	Range	Beneficiaries (n=60)		Non-beneficiaries (n=60)		Pooled (N=120)		Mann Whitney U Test
		f	%	f	%	f	%	
Low	0-12	2	3.33	16	26.67	18	15.00	
Medium	12-24	16	26.67	38	63.33	54	45.00	598.00**
High	24-36	42	70.00	6	10.00	48	40.00	
Mean±SE		24.79±1.65		17.57±0.89		42.36±2.44		
Adoption index		0.69		0.48		0.58		

f: frequency; %: percentage; **Significant at 1%; *Significant at 5%

Table 5. Utilization and economic returns from vermicomposting reported by beneficiaries (n=60)

Utilization of vermicompost	f	%
Agriculture	60	100.00
Horticulture	34	56.67
Vegetable production	60	100.00
Sale	12	20.00
Amount of vermicompost used (kg/acre)	125	
Fertilizers used along with vermicompost		
Yes	57	95.00
No	3	5.00
Reduction in amount of fertilizers (kg/acre/annum)		
0-25	34	56.67
25-50	16	26.67
50-75	10	16.67
75-100	0	0.00
Market value of fertilizers which served as gain due to less usage of fertilizers (INR/acre/annum)		
0-200	29	48.33
200-400	23	38.33
400-600	7	11.67
600-800	1	1.67
Sale of vermicompost		
Yes	12	20.00
No	48	80.00
Vermicompost sold to		
Organic growers	8	66.67
Nurseries	4	33.33
Average yield of vermicompost per rhino bed (kg)	255	
Average price per kg of vermicompost (INR/kg)	10	
Quantity of vermicompost sold (kg)		
0-100	11	91.67
100-200	1	8.33
Average net economic gain due to vermicomposting per bed (INR)		
Self-utilization	1441.66	
Sale	1041.66	
Total	2483.32	
Number of times vermicompost obtained per year	4	
Total returns per rhino bed per year (INR/year)	9933.28	

f: frequency; %: percentage

used chemicals fertilizers but 5 percent relied only on vermicompost to fertilize their lands for crop production. Around 56.57 percent respondents stated the reduction in use of chemical fertilizers by 25 kg/acre/year whereas 16.67 reported reduction to the levels of 75 kg/acre/year. There were savings on the expenses incurred on the chemical fertilizers by the respondents which were reportedly reduced. Majority (48.33%) of the respondents save upto INR 200/acre/year whereas 1.33 percent respondents saved upto INR 800/acre/year using vermicompost produced by them. The vermicompost was sold by 20 percent of the respondents at the rate of INR 10 per kg prominently to the organic growers (66.67%) and nurseries (33.33%). The average yield per rhino bed was estimated to be 255 kg which is low due to reasons like inadequate moisture and low filling rates. The average gain obtained per rhino bed was estimated to be INR 2483.32 including the price of vermicompost used by self and vermicompost sold. As four harvests were obtained by the beneficiaries per year, therefore, the total returns per rhino bed per year were estimated to be INR 9933.28. while working on the economics of waste management techniques, Singh *et al.* (2021) reported the highest remunerative returns from vermicomposting to the tune of INR 2224.72 per tonne of dung compared with biogas production and traditional composting.

The present investigation was conducted to assess the impact of Farmer FIRST Project regarding the adoption of sustainable organic waste management practices. The mean age of the respondents was 46.71 years with majority respondents having secondary level of education. The average land holding was found to be 5.37 acres with average herd size of 5.23 animals. The mass media exposure and extension agency contacts were medium to high. As far as adoption of organic waste management practices were concerned, adoption index was calculated to be 0.69 for the beneficiaries and 0.48 for the non-beneficiaries which highlights significantly higher adoption in case of beneficiaries, hence the impact of the Farmer FIRST Project. Furthermore, it was found that 20 percent of the beneficiaries were selling the vermicompost and all the beneficiaries were using the same for one purpose or the other. The use of this vermicompost led to reduction in use of chemical fertilizers also. In nutshell, the study was concluded with the impression that Farmer FIRST Project had made a positive significant impact on the adoption of sustainable waste management practices and the implementation of such field related projects should be scaled-up to bring notable change in the behavioural attributes of the farming community.

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