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Optimizing windrow method vermicomposting practices for enhancing income generating of formers in Mahrajganj District of Uttar Pradesh: " A Research Perspective."

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Abstract

Vermicomposting is an ecofriendly biological process involving the joint action of earthworms and mesophilic microorganism for the bio-oxidation and stabilization of organic wastes into nutrient rich vertices. The process effectively converts agricultural residues and cattle dung into high quality organic fertilizer while reducing waste volume by 40-60 per cent. Vermicompost is widely recognized as a valuable bio-fertilizer due to its balanced nutrient composition, rich microbial population and positive effects on soil physical, chemical and biological properties. The present study was conducted into two villages, namely Nandana and Pakadiyar Bishunpur of Maharajganj district, Uttar Pradesh, with the objective of optimizing windrow method vermicomposting practices for income generation among farmers. Thirty farmers were initially trained on various aspects of Vermicompost production, out of which eight interested farmers were selected for practical Vermicompost production under front line demonstration (FLD), socio- economic data of the respondents were collected prior to the intervention. Training on windrow method vermicomposting technology was imparted and farmer's knowledge levels were assessed before and after the training programme. Under FLD, windrows of size 12 X 4 X 2 feet were prepared and 56 kg of Eisenia foetida earthworms were provided to each beneficiary. Result revealed that farmers had a low level of knowledge regarding vermicomposting practices before training, which increased significantly to nearly 98 % after training. The average production of Vermicompost and earthworms per six months (two cycles) was recorded as 2.27 tones and 20 kg, respectively. The activity generated an average gross income of Rs. 28,750.00 with a benefit- cost ratio of 7.32, indicating high profitability. The study clearly demonstrates that optimizing windrow method vermicomposting supported by capacity building and technical guidance can generating enterprises for small and marginal farmers.

Keywords: *Bio-oxidation, Eisenia Foetida, Front Line Demonstration, Mesophilic microorganism, capacity building, Vermicompost.*

Introduction

Agriculture in Uttar Pradesh generates a substantial quantity of crop residues, animal wastes and organic by-products every year. Improper management of these wastes often leads to environmental pollution, nutrient losses and deterioration of soil health. Traditional disposal practices such as open dumping or burning of crop residue not only waste valuable organic resources but also contribute to air and soil pollution. In this context, sustainable waste management technologies are essential for maintaining ecological balance while enhancing farm productivity and income. Vermicomposting is an efficient biological method of converting organic wastes into stabilized, nutrient rich organic manure through the action of earthworms and associated microorganisms. Earthworms fragment organic matter, increase microbial activity and accelerate the decomposition process, resulting in high quality Vermicompost. Among various species, Eisenia Foetida is widely preferred due to its high reproductive rate, rapid biomass accumulation and adaptability to different organic substrates. The windrow method of vermicomposting involves preparing elongated beds of organic materials on the ground surfaces. This method is simple, cost effective and require minimal farmers. Proper management of windrow dimensions, moisture, aeration and earthworm population plays a critical role in improving compost quality and production efficiency. Despite the availability of abundant raw materials such as agricultural residues and cattle dung in Maharajganj district, adoption of vermicomposting remains limited. Lack of technical knowledge, inadequate training and limited exposure to scientific vermicomposting practices are major constraints. From an income- generation perspective, vermicomposting not only reduces dependency on chemical fertilizers but also offers opportunities for farmers to earn additional income through the sale of Vermicompost and earthworms. Therefore, the present study was undertaken to optimize windrow method vermicomposting practices through front line demonstrations and capacity building interventions, with the aim of enhancing farmers income and promoting sustainable waste management in Maharajganj district if Uttar Pradesh.

Objectives of the study:

The present study was undertaken with the objective of optimizing vermicomposting practices for enhancing income generation among farmers of Maharajganj district of Uttar Pradesh through the windrow method. The specific objectives of the study were as follows:

- To study the socio-economic profile of the respondent farmers with respect of gender, education, occupation, income level and training exposure related to Vermicompost production.
- To assess the existing knowledge level of farmers of Vermicompost production practices before the training programme, including awareness about process, methods, input requirement, bed management
- water application and packaging techniques.
- To evaluate the impact of training on farmers' knowledge regarding Vermicompost production by comparing pre and post training knowledge levels on various technical aspects of vermicomposting.
- To study the cost of inputs, gross return, net return and B:C ratio of Vermicompost production under the windrow method for assessing its economic feasibility.

Methods and Materials:

The present study was carried out in two villages (Nandana and Pakadiyar Bishunpur) of Maharajganj District of Uttar Pradesh to assess the effectiveness of vermicomposting through the windrow method for enhancing farmer's income. A total of 30 farmers were selected purposively from different villages of the district, who were either practicing vermicomposting or showed interest in adopting it as an income generating actively. The study followed a descriptive and analytical research design. Primary data were collected through personal interviews using a pre-tested structured interview schedule. The schedule included information on socio-economic characteristics of respondents, knowledge regarding Vermicompost production, training exposure and economic aspects of vermicomposting. To assess the impact of training, farmers' knowledge regarding Vermicompost production was recorded before and after the training programme. The training focused on various aspects such as importance of Vermicompost, windrow method, preparation of beds, input requirements, water application, cleanliness, harvesting, storage and marketing.

Selection of Respondents:

A total of 30 farmers were selected purposively from different villages of the district based on their interest in vermicomposting and willingness to participate in income-generating activities. Among them, 8 farmers who showed greater interest and readiness were selected for practical Vermicompost production under front line demonstration (FLD). The remaining farmers participated in training and awareness programmers.

Research design and data collection:

The study followed a descriptive and analytical research design. Primary data were collected through personal interviews using a pretested and structured interview schedule. The schedule was designed to collect an information on socio-economic characteristics of respondents such as gender, education, occupation, income level and previous training exposure regarding the above subjects. In addition, data related to farmer's knowledge of Vermicompost production practices and economic parameters were recorded.

Vermicompost Production methods:

Vermicomposting was carried out using the windrow method under field conditions. Agriculture waste and cattle dung were used as raw materials. Windrow beds were prepared at suitable locations ensuring proper drainage and shade. Layering of agricultural waste and cattle dung was done systematically, followed by inoculation of earthworms at the recommended rate. Regular watering was carried out to maintain optimum moisture levels throughout the composting period and care was taken to avoid waterlogging. Mulching was practiced to conserve moisture and regulate temperature within the beds. Two production cycles of approximately six months each were completed at the same location to evaluate production consistency and economic performance.

Terms related to vermicomposting:

Vermicomposting is a method of making compost, with the use of earthworms, which generally live in soil, eat biomass and excrete it in digested form. This compost is generally called Vermicompost or Worm compost.

- **Vermiculture:** Vermiculture means scientific method of breeding and raising earthworms in controlled conditions.
- **Vermitechnology:** Vermitechnology is the combination of Vermiculture and vermicomposting.

Nutrient content in Vermicompost:

Table 1. Nutrient content of vermi-compost

Nutrient	Content
Organic carbon	9.5 to17.98%
Total nitrogen	1.5 to 2.10%
Total phosphorous	1.0 to1.50%
Total potassium	0.60%
Ca and Mg	22.00 to70.00 m.e /100g
copper	100 ppm
iron	1800 ppm
zinc	50 ppm

NPK content in vermicompost, FYM and bacterial compost:

Table 2. NPK Content in basic manure

Element	vermicompost	FYM	Bacterial compost
N%	2.1-2.6	1.1-1.5	1.2-1.5
P%	1.5-1.7	0.7-0.8	0.7-0.9
K%	1.4-1.6	0.6-0.7	0.6-0.7

Figure 1. Vermiculture

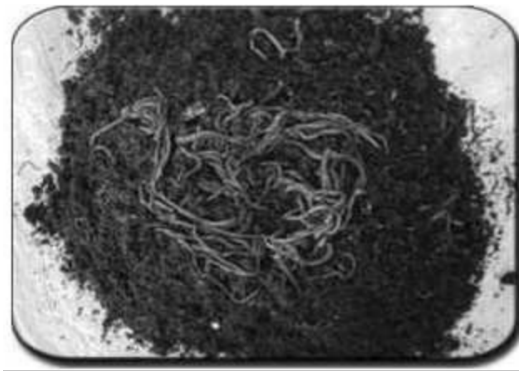

Figure 2. earthworms

Source of plant nutrients:

Earthworms consume various organic wastes and reduce the volume by 40%-60%. each earthworm weights about 0.5 to 0.6 g, eats waste equivalent to its body weight and produces cast equivalent to about 50% of the waste it consumes in a day. These worm castings have been analyzed for chemical and biological properties. The moisture content of castings ranges between 32 and 60% and the pH is around 7.0. the worm castings contain higher percentage (nearly two fold) of both macro and micro nutrients than the garden compost (Table 3)

Economic analysis:

Data of quantity of Vermicompost and earthworm produced, cost of inputs, gross return, net return and benefit- cost (B:C) ratio were calculated to assess economic feasibility. Simple statistical tools such as frequency, percentage and ratio analysis was used for inter preparation of results.

Table 3. Shows nutrient compositions of vermicompost

Nutrient element	Vermicompost (%)
Organic carbon	9.8 - 13.4
nitrogen	0.51- 1.61
phosphorous	0.19 - 1.02
potassium	0.15 - 0.73
calcium	1.18 - 7.61
magnesium	0.093 - 0.568
sodium	0.058 - 0.158
zinc	0.0042 - 0.110
copper	0.0026 - 0.0048
iron	0.2050 - 1.3313
manganese	0.0105 - 0.2038

Result and Discussion:

0.1 Socio-economic profile of the respondents:

The socio-economic characteristics of the selected respondents are presented in Table 1. The profile includes gender, educational status, occupation, per capita income and training exposure related to income generating activities. The analysis of these parameters helps in understanding the background of farmers involved in Vermicompost production and their potential to adopt improved vermicomposting practices.

0.2 Knowledge level of farmers regarding Vermicompost production:

The pre training knowledge of farmers regarding Vermicompost production was found to be low. The data related to pre and post training knowledge of farmers on various aspects of Vermicompost production through the windrow method and presented in Table 2. The table depicts the level of awareness among farmers before training and the improvement in their knowledge after attending the training programme, highlighting the effectiveness of capacity building intervention.

0.3 Production and economic performance of vermicomposting through windrow method:

The details regarding production of Vermicompost and earthworms, cost of inputs, gross return, net return and benefit cost ratio obtained under the windrow method are presented in Table3. The table reflects the economic feasibility of vermicomposting as an income generating activity and its profitability under farmer's field condition.

0.4 Impact of Vermicomposting training on adoption behavior:

The results of the study clearly indicated that the training programme played a crucial role not only in enhancing the knowledge level of farmers but also in positivity influencing their adoption behavior. Prior to training, most of the respondents were unaware of scientific vermicomposting practices such as proper windrow dimensions, moisture management and earthworm handling. After training and practical exposure through front line demonstration, farmers gained confidence in adopting the windrow method independently. This behavioral change suggests that capacity-building interventions are essential for transforming vermicomposting from a subsidiary activity into a reliable income generating enterprises at the farm level.

Role of windrow method in improving compost quality and production efficiency:

The windrow method adopted in the present study proved to be efficient in terms of ease of management, aeration and moisture regulation. Proper windrow size facilitated uniform decomposition of organic material and enhanced earthworm activity, resulting in higher Vermicompost yield. Regular turning and adequate moisture maintenance minimized anaerobic conditions and foul odor, thereby improving compost quality. These findings highlight that optimization of windrow management practices significantly contributes to better nutrient stabilization and faster composting under farmer's field conditions.

Economic sustainability and livelihood support potential:

The high benefit cost ration obtained from Vermicompost production under the windrow method reflects its strong economic sustainability. Besides income from Vermicompost, additional earning from the sale of earthworms further improved overall profitability. The activity requires low initial investment and utilizes locally available agriculture waste, making it suitable for small and marginal farmers. Thus, vermicomposting can serve as a supplementary livelihood option, especially during lean agricultural season, while simultaneously promoting sustainable waste management and soil health improvement.

Table 4. Basic Profile of Respondents (N=30)

Particulars		Number	Percent %
Respondent Gender	Male	21	70%
	Female	09	30%
Education	Illiterate	22	73%
	Literate	08	26.66%
Occupation	Farmers	24	80%
	Employed	06	33.33%
Per capita income (Rs/month)	<1000	07	23.33%
	1000–2000	13	43.33%
	>2000	10	33.33%
Training attendant (1–5 no) (Income Generation)	0	18	60%
	1–2	10	33.33%
	3–5	02	06.66%

Table 5. Pre and post training knowledge of farmers regarding Vermicompost production

Particulars	Knowledge of Farmers			
	Before Training		After Training	
	N	%	N	%
What is Vermicompost & importance of it in sustainable agriculture	5	16.66%	30	100%
Process of Vermicompost production & different methods to make different types of pits	3	10%	27	90%
Appropriate location for installation of vermi pits	4	13.33%	30	100%
Why we choose windrow method	0	0%	29	96.66%
Input requirements for Vermicompost preparation	3	10%	29	96.66%
Methods of layering agricultural waste & cattle dung on bed	4	13.33%	28	93.33%
Water application techniques applied in vermibed	2	6.66%	30	100%
Mulching benefit in Vermicompost preparation	2	6.66%	30	100%
Importance of Vermicompost bed height, width & length	1	3.33%	29	96.66%
Cleanliness of beds & surrounding	7	23.33%	30	100%
Duration required for preparation of Vermicompost	6	20%	30	100%
Quantity of earthworm in pit	0	0%	30	100%
Separation of Vermicompost & earthworm	1	3.33%	29	96.66%
Keeping Vermicompost for 3–4 days in heap before storage	1	3.33%	29	96.66%
Suitable packaging for marketing and storage	2	6.66%	30	100%

Conclusion:

The study clearly demonstrates that optimized windrow method vermicomposting, supported by systematic training and front-line demonstrations, significantly improve farmer's knowledge, productivity and income. Vermicomposting not only offers an effective solution for organic waste management but also provides an economically viable enterprise for small and marginal farmers. Adoption of this technology can contribute to sustainable agriculture, environmental conservation and rural livelihood enhancement in Maharajganj District and similar ecological regions.

Authors contribution

This research work was carried out collaboratively by all the authors. The concept and design of the study were jointly developed. Field implementation, data collection, farmers training and front-line demonstration were executed collectively. Data analysis, interpretation of result and manuscript preparation were performed with equal contribution from all authors. All authors have read and approved the final manuscript.

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Table 6. Production of Vermicompost and Earthworm in Windrow Method (per unit / six months) almost two cycles

Year	No. of Locations	Production/Unit/ six months		Cost of Input/Unit (Rs.)	Gross Return (Rs.)			Net Return (Rs.)	B:C Ratio
		Compost (Ton.)	Earthworm (kg)		Vermicompost	Earthworm	Total		
2021 (June–Dec)	*04*	*2.20*	*20*	*5800*	*22000*	*6000*	*28000*	*22200*	*4.82*
2022 (Jan–June)	*04*	*2.35*	*20*	*3000*	*23500*	*6000*	*29500*	*26500*	*9.83*

Sale rate of earthworm: Rs. 300/kg & Sale rate of Vermicompost: Rs. 10/kg
(Second cycle done at same location/place)

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