International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X

NAAS Rating (2025): 5.20
www.agronomyjournals.com
2025; SP-8(12): 324-327
Received: 21-10-2025
Accepted: 23-11-2025

Dr. Nawal Kishor Singh
Krishi Vigyan Kendra (ICAR VPKAS Almora), Kafligair, Bageshwar, Uttarakhand, India

Dr. Kamal Kumar Pande
Krishi Vigyan Kendra (ICAR VPKAS Almora), Chinyalisaur, Uttarkashi, Uttarakhand, India

Neeraj Joshi
Krishi Vigyan Kendra (ICAR VPKAS Almora), Kafligair, Bageshwar, Uttarakhand, India

Harish Chandra Joshi
Krishi Vigyan Kendra (ICAR VPKAS Almora), Kafligair, Bageshwar, Uttarakhand

Corresponding Author:
Dr. Nawal Kishor Singh
Krishi Vigyan Kendra (ICAR VPKAS Almora), Kafligair, Bageshwar, Uttarakhand, India

Economic and ecological transformation through mixed-culture vermicomposting: A nine-year longitudinal case study of vermicomposting adoption in Bageshwar, Uttarakhand

Nawal Kishor Singh, Kamal Kumar Pande, Neeraj Joshi and Harish Chandra Joshi

DOI: https://www.doi.org/10.33545/2618060X.2025.v8.i12Sd.4412

Abstract
This case study explores the impact of adopting on-farm vermicomposting by a marginal farmer in the Bageshwar district of Uttarakhand, comparing baseline data (2015-16) to post-intervention results (2023-24). The principal element of intervention is replacing costly inorganic fertilizers with self-produced vermicompost, by utilizing a mixed culture of *Eisenia fetida* and *Eudrilus eugeniae*, ensuring system stability. The study shows that over the period of Nine-years farmer's Net Annual Income nearly doubled. This financial growth is attributed to the diversification into and intensification of high-value enterprises. The finding infers that small scale vermicomposting can serve as powerful economic tool for marginal farmers, contributing to ecological wellbeing and achieving self-reliance with significant income generation.

Keywords: Vermicomposting, doubling income, *Eisenia fetida* and *Eudrilus eugeniae*

Introduction

Modern agriculture faces two major, simultaneous pressures: to produces enough food to meet the demand for a rapidly growing global population, and it must manage the increasing volume of agricultural waste in an environmentally responsible way. Consequently, the only aim of farming can no longer be limited to high yields; it must also be ecologically sustainable. Non-judicious and excessive application of inorganic fertilizers and chemicals by farmers to gain higher yields from their agricultural produce is causing serious deterioration in ecosystem health, evident in the loss of soil fertility and disruption of microbial communities, apart from the risk of chemical residues accumulating in the produce for consumption. As noted by Sande TJ *et al*. 2024 [5], this calls the attention for Integrated Nutrient Management (INM), which combines various organic and inorganic inputs to maintain soil fertility and environmental quality. This holistic method incorporated FYM, bio-enriched rock phosphate, and vermicompost (produced by earthworms—the 'natural soil engineers'). Vermicompost has superiority in nutrient composition compared to raw farm manure and also often transforms soil quality positively.

According to Aira *et al.* 2016 [1], vermicompost results from the consumption and processing of raw organic materials by earthworms through their gut. The earthworms also play a role as effective bio-intensifiers, by their persistent physical activities like burrowing and bio-amendments like, casting and fluid excretion, which strengthen microbial population and decomposition rate in the composting system and nearby soil.

Vermicomposting is therefore a synergetic process with combined actions of earthworms and soil microorganisms in the medium, which cooperatively accelerates the process of decomposition of raw organic matter into fine compost (Ali *et al.*, 2015) [2]. The product of this joint action, vermicompost, thus comprises beneficial bacteria in it along with crop growth nutrients. The vermicompost thus performs as a biological organic fertilizer with promising potential in agriculture (Huang *et al.*, 2013) [3].

This paper is a case study (at the local level) of successful adoption of vermicomposting by one marginal farmer over a period of about Nine years, using combination of high-efficiency earthworm species, *E. fetida* and *E. eugeniae*. The selection was done based on the main biological differences and their availability locally. More specifically, *E. fetida* has a high reproductive rate and is mesophilic (Venter and Reinecke,1988; Nguyen, 2022) [7, 4], while *E. eugeniae* has the essential advantage of superior resistance to higher temperatures (Vasanthi, K., 2013) [6]. This combination was chosen with the objective of optimizing operational stability.

Case study objective

1. To demonstrate the effectiveness of replacing conventional inorganic fertilizers with organic vermicomposting for nutrient management.
2. To assess how on-site vermicompost production can reduce input costs and improve soil health.

This successful adoption was then leveraged as an inspirational model to encourage neighbouring farmers to assess the financial benefits and the long-term gains of self-sufficiency.

Methodology

1. **Study Area:** The case study was conducted in the fields of a farmer, Mr Manoj Bharara Son of Mr Kesar Singh, covering approximately 6 acres in Village Kansyari-Gagrigol, Garur Block, Bageshwar District, Uttarakhand, India.
2. **Materials and Method**

a. **Earthworm Culture**: Two earthworm species were used in this study, *E. fetida* and *E. eugeniae* procured from G.B. Pant University of Agriculture and Technology (GBPUAT), Pantnagar, Uttarakhand and were transferred to KVK, Bageshwar (ICAR-VPKAS). for multiplication. After sufficient earthworm biomass was generated, the need-based trainings were provided and earthworms were distributed to the collaborating farmer for introduction into the on-site vermicomposting unit.

b. **Stocking Density:** The stocking density was initiated with 15-20 earthworms per kilogram of substrate. The major feedstock was cattle dung, which was drawn daily from the farmer's own cows, goats, and buffaloes. This was supplemented with other readily available organic material such as daily kitchen wastes, crop residues, and farm discards. The farmer maintained a mixed population of both *E. fetida* and *E. eugeniae* species together. Thus, the pits contained a mixed culture, whose proliferation was influenced by the quality and temperature profile of the diverse substrate.

c. **Unit Structure:** The farmer constructed a total of six rectangular vermicomposting pits directly in his field, with uniform dimensions of 10 x 3 x1 ft (Length x Width x Height) and were built with concrete. These were dual-purpose pits:

- large-scale multiplication of the introduced earthworm species
- Adequate production of vermicompost for its use in the farmer's own field.

Data Collection

Selection was limited to farmers who had successfully completed the training at KVK Bageshwar and were intrinsically motivated for the adoption of vermicomposting as a sole nutrient management strategy, completely replacing inorganic fertilizers. Time-to-time guidance and technical support were provided throughout the study period. A systematic record was maintained on the crop health, overall production, and income generated from the intervention farms that had enabled a robust comparative account on the efficacy and cost benefit analysis of the intervention at farm level.

The scale of observation in the current study is limited to a single farmer's field. A key objective was to successfully establish the selected participant as an exemplary figure in the local peer group to facilitate influence among fellow farmers for the adoption of similar sustainable practice.

Observation

Before intervention, the farmer relied on raw, backyard-produced FYM for nutrient management. This practice frequently attracted insects and pests to the main crops and failing to deliver nutrients from the compost as expected. As a result, there was always a requirement to purchase inorganic fertilizers, which added to his financial burden. Moreover, high local demand for organically produced red rice motivated the farmer to seek a sustainable alternative. After knowledge transfer and practical training on vermicomposting by KVK Bageshwar, the farmer voluntarily decided to adopt vermicomposting and switched to this organic practice for his nutrient management.

Farmer's Production Data

Below are Table 1 and Table 2, with component description along with coverage area and income generated, in both baseline year and year of observation, respectively:

Table 1: Benchmark Year (2015-16)

Component Description		Benchmark: Baseline year (2015-16)			
Component	**Names**	**Area (Acre) / Number**	**Production (Q/Liter/No.)**	**Gross Income (Rs.)**	**Net Income (Rs.)**
Field Crop - Kharif	Paddy, Finger Millet	2.0	2.5	30000	11000
Field Crop - Rabi	Wheat, Lentil	2.0	2.5	37500	15000
Hort. Crop - Fruits	Citrus, Peach	0.25	2	2000	1000
Hort. Crop - Vegetable	Onion, Pea, Cucurbits, Capsicum, Tomato	1.0	20	30000	16000
Livestock 1	Cow, Buffalo	05	8400	235200	115200
Livestock 2	Goat	02	0.20	6000	4000
Other enterprise - Poultry	Backyard Poultry	50	0.75	9000	5000
Other enterprise - Fishery	Grass carp, Common carp, Silver carp	0.05	4	60000	40000
Fodder	Fodder-Local	0.30	Used for livestock	00	00
Mushroom	Oyster Mushroom	5.0 kg	30	2400	1100
Total				412100	208300

Table 2: On implanting the intervention over span of Nine years: Period 2023-24

Components Description		Period year: 2023-24				% Increase Over Base Year	
Components	**Names**	**Area(Acre) / (Q/Liter/ No)**	**Production (Q/Liter/No)**	**Gross Income (Rs.)**	**Net Income (Rs.)**	**Production**	**Net Income**
Field Crop - Kharif	Paddy-Basmati, Pigeon Pea, Soybean, Finger millet	1.5	25	37500	13500	0	23
Field Crop - Rabi	Wheat, Lentil, Mustard	1.5	25	40000	15800	5	5
Hort. Crop - Fruits	Kiwi, Peach, Citrus	0.55	7.0	28000	12500	250	1150
Hort. Crop - Vegetables	Pea, Onion, Tomato, Capsicum, Cucumber, Cauliflower, Cabbage, Broccoli, Leafy vegetable	1.0	30	45000	19500	50	22
Livestock 1	Cow, Buffalo	08	13440	470400	245000	60	113
Livestock 2	Goats	10	1.0	45000	32000	400	700
Other enterprise - Poultry	Backyard Poultry	100	1.5	30000	16500	100	230
Other enterprise - Fishery	Grass carp, Common carp, Silver carp, Pangas	0.10	8.0	144000	105000	100	162
Fodder	Natural, Hybrid Napier	0.30	Used for Livestock	00	00	00	00
Mushroom	Button Mushroom	10 g	2	30000	16500	300	1400
Total				869900	476300		

The following analysis (Table 3) has been drawn from a comparative study of the performance of the farm over Nine years, comparing the baseline data of 2015-16 with the post-intervention results of 2023-24 to document the comprehensive impact of adopting vermicomposting and associated sustainable practices.

Table 3: Comparative Analysis from Impact of Interventions (2015-16 to 2023-24):

Component	Names (2023-24)	Benchmark Net Income (2015-16) (Rs.)	Post-Intervention Net Income (2023-24) (Rs.)	% Increase in Net Income (2023-24)	Observations
Field Crops (Kharif & Rabi)	Paddy-Basmati, Wheat, Lentil, etc.	26,000	29,300	Kharif: 23% Rabi: 5%	Modest increase
Horticulture - Fruits	Kiwi, Peach, Citrus	1,000	12,500	1150%	*Exceptional growth* due Kiwi introduction and area expansion (0.25 to 0.55 Acre)
Horticulture - Vegetables	Pea, Onion, Tomato, Cabbage, etc.	16,000	19,500	22%	Production increased (20 to 30 Q) with introduction of high-value crops (Cauliflower, Broccoli)
Livestock 1 (Cow, Buffalo)	Cow, Buffalo	115,200	245,000	113%	The largest contributor to net income overall
Livestock 2 (Goats)	Goats	4,000	32,000	700%	Multifold increase in goat numbers (2 to 10) and massive income rise
Fishery	Grass carp, Common carp, Silver carp, Pangas	40,000	105,000	162%	Increased area (0.05 to 0.10 Acre)
Mushroom	Oyster, button	1,100	16,500	1400%	Increase driven by a shift from Oyster to high-demand Button Mushroom

A comparative analysis was carried out using baseline data and post-intervention data to quantify the impact of adopting the technology.

Over the Nine-year period, the farmer's net annual income increased from Rs. 208,300 in baseline year (2015-16) to Rs. 476,300 in the year of observation (2023-24). This shows an annual increase of Rs. 268,000, which is close to a two-fold increase in net earnings. These results highlight the strong economic potential of transitioning from conventional chemical-based nutrient management to a system centred on on-farm vermicomposting.

Results

The financial analysis demonstrates a considerable positive impact of the integrated interventions, including vermicomposting. Net annual income rose from Rs. 208,300 in the 2015-16 benchmark year to Rs. 476,300 in 2023-24, amounting to a near two-fold increase.

The income gains were contributed by shifting to high-value enterprises supported by improved soil health and nutrient availability by vermicompost. Over the period of study, net income from mushroom cultivation increased by approximately 1400%, fruits by 1150%, and goat rearing by 700%. These shifts suggest that integrating vermicomposting into the farm system enabled the farmer to successfully diversify and intensify profitable enterprises.

Conclusion

This case study documents a significant transformation in a small-scale farming system in Bageshwar district, Uttarakhand, following the adoption of on-farm vermicomposting. The use of a mixed culture of *E. fetida* and *E. eugeniae* formed the core of an Integrated Nutrient Management strategy tailored to local conditions. Together, these species provided a sturdy and adaptable vermicomposting system.

Over the study period of Nine years (2015-16 to 2023-24), the farmer's net annual income nearly doubled, from Rs. 208,300 to Rs. 476,300. This shift in income upgradation was closely linked to expansion of high-value enterprises such as mushroom production, fruit cultivation, and goat rearing, all of which were supported by vermicomposting.

The study indicates that small-scale, decentralized vermicomposting can serve not only as an ecological intervention for improved soil health but also as a powerful economic tool for marginal farmers. The positive transition of this farmer in Garur (Bageshwar) denotes that considerable income gains and self-reliance could be achieved by adopting relatively simple, nature-based technologies.

Future Prospects and recommendations

Successful farmers should be officially acknowledged as "Master Trainers," enabling them to mentor and influence their colleagues by shared experience, in order to optimize the initiative's impact. Although the current method mostly uses kitchen trash and cattle manure, there is a lot of room to diversify feedstock with the right training.

Future projects might make use of pine needles, invasive weeds and unwanted grasses from the fields. The scientific community should additionally monitor the long-term stability of mixed *E. fetida* and *E. eugeniae* cultures to ensure scientific efficacy.

Lastly, the implementation of subsidy programs would enable marginal farmers to get past their first financial obstacles and build long-lasting concrete vermicomposting plants.

References

1. Aira M, Olcina J, Pérez-Losada M, Domínguez J. Characterization of the bacterial communities of casts from *Eisenia andrei* fed with different substrates. Appl Soil Ecol. 2016;98:103-111.
2. Ali U, Sajid N, Khalid A, Riaz L, Rabbani MM, Syed JH, *et al*. A review on vermicomposting of organic wastes. Environ Prog Sustain Energy. 2015;34(4):1050-1062.
3. Huang K, Li F, Wei Y, Chen X, Fu X. Changes of bacterial and fungal community compositions during vermicomposting of vegetable wastes by *Eisenia foetida*. Bioresour Technol. 2013;150:235-241.
4. Nguyen TTP. Effect of temperature on the development of three types of organic waste treatment worms in the North of Vietnam. Int J Adv Res Innov Ideas Educ. 2022;8(3):2470-2475.
5. Sande TJ, Tindwa HJ, Alovisi AMT, Shitindi MJ, Semoka JM. Enhancing sustainable crop production through integrated nutrient management: a focus on vermicompost, bio-enriched rock phosphate, and inorganic fertilisers - a systematic review. Front Agron. 2024; DOI: 10.3389/fagro.2024.1422876.
6. Vasanthi K. Influence of temperature on growth and reproduction of earthworm *Eudrilus eugeniae*. Int J Curr Microbiol Appl Sci. 2013;2(8):202-206.
7. Venter JM, Reinecke AJ. The life-cycle of the compost worm *Eisenia fetida* (Oligochaeta). S Afr J Zool. 1988;23(3):161-165.