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INNOVATING WITH WASTE: SUCCESS STORIES IN SUSTAINABLE PRACTICES -A MINI REVIEW

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Abstract

The volume of solid trash increased rapidly as a result of urbanization and industrialization, and managing it is now one of the main issues. There are several ways to get rid of solid waste, including landfilling, burning, turning into recycling, biogas and composting. However, excessive manufacturing has led to inappropriate disposal methods, such applying it to agricultural regions carelessly and at the wrong time, which ultimately pollutes the soil and water. However, these organic materials can be utilized for vermicomposting if they are managed appropriately. An environmentally beneficial fertilizer is vermicomposting. This is the most beneficial element for plant growth. This paper focuses on the vermicomposting of paper waste. The experiment, which involves the earthworms (*Eisenia fetida*) turning paper waste into vermicasts, focuses on stability using kitchen trash, cow manure, and *Eisenia fetida* earth. Total organic carbon is significantly reduced and total nitrogen is increased as a result of vermicomposting. The worm's midgut examination further demonstrates how the microbiota changes during vermicomposting. Despite having a lot of arable land and enough water for this plant, we still can't meet everyone's fundamental needs. Hunger and related conditions are thought to be the cause of 24,000 deaths every day. However, our output is better than it would be without vermicomposting when we use it in both our horticultural and agricultural fields. Vermicomposting inhibits plant diseases, improves soil porousness and microbial activity, and encourages water retention and aeration. By reducing the amount of waste which end up in landfills and the need for chemical fertilizers, vermicomposting also benefits the environment. Vermicomposting, also known as worm cast or black gold, is the process by which earth worms consume organic waste, process it through their digestive tract, and then release it as granules.

Keywords- *Vermicompost, earthworms, Eisenia fetida, waste management, sustainable agriculture.*

INTRODUCTION

Ten years ago, the majority of businesspeople and public officials considered waste products including sludge, cow dung, food scraps, kitchen garbage, and grass chipping to be issues that needed to be disposed of. However, when they are turned into compost (eco-friendly vermicomposting with paper waste), this former issue is increasingly being turned into a profit with environmental benefits by public agencies and entrepreneurs (organic up to 70%)[1]. Understanding the fundamentals of composting, including how it operates, what kinds of facilities can manage it, what raw materials work best, how to control odours, and how to produce for the market, is essential to starting a profitable composting business. A significant rise in organic waste coming from homes, businesses, and agriculture has been caused by the world's population growth and increased consumption of products and services[2]. Because they include a wide range of harmful microorganisms, a large portion of organic waste is highly infectious.

There are major environmental problems when organic garbage is dumped in open spaces. For instance, heavy metal buildup in the soil and nutrient runoff and leaching can contaminate surface and ground waterways. Direct application of these organic wastes to agricultural areas results in issues with the soil ecology, such as python toxicity[3]. These wastes are precious organic resources that might be recycled and used to make soil conditioner or fertilizers that are high in nutrients[4-5]. Additionally, interest in organic agriculture has grown as a result of greater understanding of the harmful impact that agricultural chemicals have on human health[6]. One of the best ways to reduce and control environmental pollution is through vermicomposting[7]. Many research has been conducted recently to prove that vermicomposting is one of the best organic alternatives to chemical fertilizers[8-9]. More abundant in nitrogen, phosphorus and potassium , micronutrients, and beneficial soil microbes (bacteria that fix nitrogen and phosphate), vermicomposting is a great way to safeguard and encourage crop plant growth[10-11].

An essential component of agricultural productivity is farmland nutrient management. Vermicompost, an organic fertilizer made by earthworms using a biological process to break down organic feed, transforms organic waste, such as municipal garbage [12-13],wastes from agriculture[14], sewage sludge[16], animal waste[15]. It is abundant in plant-available micro and macronutrients, such as nitrate (NO^{3-}), phosphate (PO_4^{3}), sulphate (SO_4^{2}), potassium (K+), and others, and it promotes plant development, which raises agricultural productivity[17]. Additionally, it has a high number of microorganisms (fungi, bacteria, and actinomycetes) that generate phytohormones (Giberellic acid, Indole-3 acetic acid)[18] and enzymes (Dehydrogebeasem urease)[19]. Chemical fertilizers are utilized in large quantities these days, which eventually degrades soil quality[20]. Vermicompost application has been shown by numerous researches to improve soil quality and productivity when compared to chemical fertilizers[21], and numerous people have attested to the fact that preparing household garbage greatly increases crop yields[22].

DIFFERENT KINDS OF EARTHWORMS

These about 3600 earthworm species are separated into two categories: burrowing and non-burrowing. The most effective species of earthworms for creating compost are red ones, such as *Eisenia fetida*. Compared to burrowing earthworms, non-burrowing earthworms consume 90% organic waste and 10% soil, which they then turn into vermicompost more quickly. The burrowing earthworms, on the other hand, only emerge onto the soil surface at night. They consume 90% soil and 10% organic waste to produce 5.6 kg of casts from their 3.5-meter-deep burrows. Each earthworm weighs between 0.5 and 0.6 grams. The incubation period lasts 26–27 days.

RESULTS AND DISCUSSION

Case studies

This section provides real-life success stories of people who have adopted organic farming and vermicomposting as environmentally friendly livelihood options to demonstrate their influence and practical use.

2.1: Case study 1

Title- Pramod Saharan: Engineering a Green Revolution

Location- Kaimri village, Hisar , Haryana.

Pramod Saharan, a civil engineer from Kaimri village, Hisar (Haryana), transformed his gardening hobby into a successful vermicomposting business during the COVID-19 lockdown. While working as an assistant professor, he began experimenting with *Eisenia fetida* earthworms and cow dung in his home garden. Despite initial challenges, such as worm deaths due to chlorinated water, he quickly learned and improved his methods. In March 2021, Pramod left his job to start vermicomposting full-time. He began with five beds and 60 kg of worms, producing 4,000 kg of compost in three months and earning Rs 26,000 in profit. Encouraged, he expanded to 120 beds on one acre of land. Today, his unit produces 2.7 lakh kg of compost annually, with an income of Rs 22 lakh from compost and Rs 7–8 lakh from earthworm sales. He has also added machines for sieving, packing, and storage. Pramod markets his compost locally in 1 kg and 5 kg packs and saves costs through direct farm sales. Beyond business, he trains farmers and promotes organic practices. With plans to expand to 150 beds, Pramod is a shining example of sustainable, rural entrepreneurship and the potential of waste-to-wealth initiatives[23].

Figure 2.1: Vermicompost facility of Pramod Saharan in Hisar, Haryana.

2.2: Case study 2

Title- Azhaku Dheeran: A Homemaker's E-commerce Success in Vermicompost

Location- Kottiyal village in Ariyalur, Tamil Nadu.

Azhaku Dheeran, a 36-year-old homemaker from Kottiyal village, Ariyalur district (Tamil Nadu), turned the COVID-19 lockdown into an opportunity by launching a successful vermicomposting business. Inspired by her agriculturist father and armed with a Master’s in Chemistry, she began her venture in August 2019 with ₹1 lakh and just 5 kg of earthworms. Initially facing market resistance, Azhaku shifted to online sales, branding her product as **"Soil Spirit"** and later trademarking **"Aerboreal."** Using platforms like Amazon and WhatsApp, she reached urban gardeners in cities like Chennai and Bengaluru. She now sells nearly 1 ton of compost weekly, overcoming logistical challenges with dedication and consistency.

Employing four workers and partnering with local farmers, her business generates ₹5 lakh annually with a monthly profit of ₹25,000. Azhaku’s journey highlights how rural women can build successful, sustainable enterprises from home, combining tradition with technology[24].

Figure 2.2: Azhaku Dheeran at her vermicomposting unit in Ariyalur, Tamil Nadu.

2.3: Case study 3

Title- Kavya Dhobale: From Critical Care Nurse to Organic Farming Pioneer

Location- Datkhilewadi village in Junnar, Maharashtra

Kavya Dhobale, a nurse-turned-agri-entrepreneur from Datkhilewadi village in Junnar, Maharashtra, left her government job after a life-altering battle with COVID-19. While recovering, she realized the deep connection between health, nutrition, and the harmful effects of chemical-based food systems. Motivated to bring change, she shifted to organic farming in 2022, despite having no formal training. Starting with a ₹5 lakh investment and 0.2 acres of land, she built a vermicompost shed with 10 beds. Using *Eisenia fetida* worms and cow dung, she produced high-quality compost in 45–60 days. Her compost, rich in essential nutrients, is packaged in 50 kg bags and sold at ₹500 each. Encouraged by demand, she expanded to 20 beds, producing 20 tonnes monthly and generating over ₹30 lakh annually with a 50% profit margin.

To spread awareness and empower others, Kavya launched the **Krushi Kavya Agro Vermicompost Training Centre**, offering one-day workshops for ₹1500. She has trained over 3,000 farmers, helping them adopt low-cost, eco-friendly composting techniques and access markets and government support. Her trainees, like Varsha Mane and Khushal Shinde, now run successful compost ventures of their own.

Kavya's work has gained national attention, making her a symbol of sustainable agriculture, women's empowerment, and rural entrepreneurship [25].

Figure 2.3: Kavya Dhobale at her vermicompost production unit in Datkhilewadi village, Junnar, Maharashtra.

2.4: Case study 4

Title- Kanika Talukdar: Assam's Trailblazer in Vermicompost Entrepreneurship

Location- Village: Borjhar, P.O. Barama, Blok: Tihu, District: Nalbari, State: Assam

Kanika Talukdar, a 42-year-old widow from Borjar village in Assam's Nalbari district, turned personal hardship into success through vermicomposting. With limited education and the responsibility of raising her child alone, she struggled with various small jobs until 2014, when training from Krishi Vigyan Kendra (KVK), Nalbari, introduced her to vermicompost production. With guidance from KVK and minimal investment, she started using bamboo tanks to produce compost. Her brand, **"Jay Vermicompost,"** gained popularity for quality and affordability. Using local markets, word-of-mouth, and digital tools, Kanika scaled her business rapidly—selling 200 quintals in 2017, 500 in 2018, and 1,000 in 2019. Her annual income now ranges between ₹5–6 lakh.

Recognized across Assam, she is the only woman licensed by the State Agriculture Department to supply vermicompost. Kanika now plans to expand to 20 composting units, symbolizing women-led rural development and the potential of sustainable farming.

Her journey is a testament to resilience, grassroots innovation, and the power of women in transforming rural India[26].

Figure 2.4: Kanika Talukdar managing her vermicompost unit in Assam's Nalbari district.

2.5: Case study 5

Title- Mr. Vigyan Shukla's Organic Farming Success

Location- Bundelkhand, Uttar Pradesh

Through innovation and sustainable agricultural methods, 42-year-old Mr. Vigyan Shukla, an agriculture graduate from Aatara Tehsil in Banda district, Uttar Pradesh, changed his farming methods. Traditionally, Mr. Shukla used chemical fertilizers to grow crops like wheat, paddy, chickpeas, and vegetables on his 8 acres of land and simple farm equipment. When he met Krishi Vigyan Kendra (KVK), Banda, in 2018 while participating in a skill-development training program on "Quality Vermicompost Production," his path took a dramatic change. He started vermicomposting on his property after being inspired by the possibilities of organic farming. KVK scientists helped him with site selection, earthworm species selection, temperature and moisture control, and upkeep.

Consequently, Mr. Shukla built four vermipits and started making high-quality vermicompost. In three months, his initial harvest produced 210 kilograms from a single pit; successive batches produced 920 kg in total. With a Benefit-Cost (B:C) ratio of 2.04:1 and a net income of ₹8,800, the business proved to be financially successful. In addition to the financial benefit, this project improved soil health, maintained helpful soil bacteria, and decreased reliance on chemical inputs. In addition to providing compost for his own farm, Mr. Shukla now provides nearby farms, non-governmental organizations, and governmental organizations. He actively encourages other farmers to vermicompost, which helps to create a more lucrative and sustainable rural economy [27].

Figure 2.5: Vigyan Shukla's vermicompost production setup in Banda, Uttar Pradesh.

COMPARATIVE ANALYSIS OF VERMICOMPOSTING CASE STUDIES

PARAMETER	CASE STUDY 1	CASE STUDY 2	CASE STUDY 3	CASE STUDY 4	CASE STUDY 5
Waste Materials Used	Cow dung, vegetable waste, crop residue	Cow dung, chopped dry leafy/agricultural residues	Cow manure, soil, organic waste	Cow dung, kitchen waste, organic farm residue	Cow dung (not fresh), organic farm residue
Earthworm Species	*Eisenia fetida*	*Eisenia fetida*	*Eisenia fetida*)	*Eisenia fetida* (from KVK)	*Eisenia fetida*
Scale	Large-scale (120 beds on acre)	Started small, expanded to commercial scale (9 beds)	Started with 1 bed, expanded to team with 10 farmers, weekly 1 ton mix	Started small (1 tank), now 10 units; plans to expand to 20	Medium-scale (4 vermipits, 10x4x2 ft each)
Setup Method	4 ft x 30 ft raised beds; on-farm open and structured composting unit	Bed method; 6 ft x 2 ft x 2 ft for better aeration	12 m x 4 m bed initially; home-based unit with branding and packaging	Low-cost bamboo tanks, now concrete beds	Pit method (construction of vermipits)
Composting Duration	~3 months per cycle; 3 cycles/year	45–50 days	Weekly production of 1 ton (duration not specified)	45–60 days	3 months per composting cycle
Yield & Income	2.7 lakh kg/year; Rs. 22–30 lakh/year income	35–40 tons/year; ₹3.5L (vermicompost) + ₹0.5L (vermiwash) = ₹5L profit	1 ton/week; ₹5 lakh/year turnover, ₹25,000/month profit	2019: 1000q, ₹6L profit; 2018: 500q, ₹3.25L; 2017: 200q, ₹1.25L	First harvest: 210 kg from one pit Total: 920 kg in three batches Net return: ₹8,800 Benefit-Cost Ratio: 2.04:1
Benefits	Improves soil fertility, promotes macro/microorganisms	Enhances soil structure, microbial activity; supports rural women	Organic input for terrace gardens, sustainable home-based income	Created employment, enhanced rural livelihood, branded product	Benefits include additional income, soil health improvement, and use in personal farming
Challenges Faced	Chlorinated water killed worms; initial learning curve	Pests, dung heating, moisture/temp control, quality concerns	Logistics (20 km to nearest postal), local farmers' lack of interest	Poor finances, initial setup difficulty, awareness	Initial setup difficulty, finances issue.
Solutions	Used chlorine-free water; phased bed expansion	Used charcoal for pests, decomposed dung, added	Switched to e-commerce; hired labour for shipping, engaged 10 farmers	KVK support, branding, local + online marketing	Use of fresh cow dung was avoided Maintained aeration, moisture (50–60%), and temperature (25–32°C)

		biocontrol agents			Technical support provided by KVK Banda
Notable Innovation Practices	Scalable model with minimal transport; sells worms and compost	Collects vermiwash, enriches compost, builds women-led FPO	Online brand 'Soil Spirit' and 'Aerobesal'; tutorials and WhatsApp sales	'Jay Vermicompost' & 'Jay Vermiwash' brands; licensed seller	Motivated by KVK training Promoting vermicompost production among neighboring farmers and organizations Use of farm machinery and consistent quality maintenance

VERMICOMPOST'S IMPACT ON PLANT DEVELOPMENT, YIELD, AND SOIL FERTILITY

Vermicompost is known as soil management since its main purpose is to change the biological, chemical, and physical qualities of the soil through earthworm activity [23]. It stops soil erosion and significantly enhances soil structure, texture, and aeration. It strengthens the soil's water-air connection by expanding the macropore space between 50 and 500um, which has an impact on plant growth. The PH of the soil is also positively impacted. Its microbial community, the activity of soil enzymes, phosphates, exchangeable calcium, and soluble potassium[24]. Earthworm digestive canal-expelled mucus produces hormone-like biochemicals and certain antibiotics, which promote growth of plant [25] and improve the breakdown of organic matter in the soil [26]. Okra, tomatoes, sugarcane, brinjal, and paddy are among the crops whose growth and yield characteristics have been demonstrated to be positively impacted by vermicompost [27]. Thus, vermicompost inhibits diseases caused by soil-borne plant pathogens, boosts crop productivity, and enhances soil structure, fertility, and plant growth [30]. It also functions as a slow-release fertilizer [28] and a soil conditioner [29]. Vermicompost application has been shown to improve apple plant output by more than 15%.

CONCLUSION

Promoting sustainable agricultural practices and organic farming is necessary to protect the agro-ecosystem and protect human health from harmful chemical fertilizers, as the recently popularized concept of "organic farming" largely focuses on producing foods free of chemicals. More environmentally friendly fertilizers, such vermicompost, in conjunction with organic farming could save money, provide more marketable organic products, and replace chemical fertilizers.

Finally, we draw the conclusion that plant growth and productivity are a direct result of improved soil quality brought about by the application of vermicompost. For cost-effectiveness, the assessment also recommends that vermicompost be used at the right rate based on the kinds of crops grown and their nutrient requirements.

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