INTERNATIONAL ADVANCE JOURNAL OF ENGINEERING, SCIENCE AND MANAGEMENT (IAJESM)
July-December 2023, Submitted in December 2023, iajesm2014@gmail.com, ISSN -2393-8048
Multidisciplinary Indexed/Peer Reviewed Journal. SJIF Impact Factor 2023 =6.753

Commercial Viability and User Preferences: Evaluating Organic and Bacterial Fertilizers in Nagpur Division

Akash Jaydeorao Bele, Research Scholar, RTM Nagpur University, Nagpur
Dr. Pramod G. Fating, Research Supervisor, RTM Nagpur University, Nagpur

Abstract

This study investigates the commercial viability and user preferences for organic and bacterial fertilizers in the Nagpur Division, a critical agricultural region in Maharashtra, India. With growing interest in sustainable farming practices, understanding the economic dynamics and adoption drivers of these fertilizers is essential. Through a mixed-methods approach, combining quantitative surveys and qualitative interviews, this research evaluates the cost-benefit aspects, market trends, and perceptions of farmers and agricultural stakeholders towards these sustainable inputs. The findings reveal that while organic and bacterial fertilizers significantly enhance soil fertility by increasing the availability of essential nutrients such as nitrogen, potassium, and sulfur, their adoption is influenced by factors like initial cost, ease of application, and awareness levels. Despite higher initial costs, long-term benefits such as improved soil health and reduced dependency on chemical inputs underscore their potential for sustainable agriculture. However, challenges in optimizing phosphorus availability and addressing site-specific variability remain. This study provides valuable insights for policymakers and agricultural practitioners to formulate strategies that promote the use of sustainable fertilizers, thereby enhancing agricultural productivity and sustainability in the region.

Keywords - Sustainable agriculture, Economic viability, User preferences, Cost-benefit analysis, Nutrient availability

Introduction

The Nagpur Division in Maharashtra, India, represents a crucial agricultural region characterized by diverse cropping patterns and varying soil conditions. In recent years, there has been a notable shift towards sustainable agricultural practices, driven by concerns over soil health, environmental impact, and long-term agricultural productivity. Central to this transition are organic and bacterial fertilizers, which offer promising alternatives to conventional chemical fertilizers by enhancing soil fertility through natural processes.

Organic fertilizers, derived from plant and animal sources, and bacterial fertilizers, leveraging beneficial microbes, have gained attention for their ability to improve soil structure, increase nutrient availability, and promote sustainable crop production. These fertilizers not only provide essential nutrients like nitrogen, phosphorus, potassium, and sulfur but also contribute to soil carbon sequestration and reduce greenhouse gas emissions (Lal, 2004; Venkateswarlu et al., 2007).

However, the adoption of organic and bacterial fertilizers in the Nagpur Division faces challenges related to economic viability, awareness among farmers, and compatibility with existing farming practices. While these fertilizers offer long-term benefits such as improved soil health and reduced environmental impact, their initial costs and perceived effectiveness compared to conventional fertilizers remain key considerations for farmers and agricultural stakeholders.

This study aims to explore the commercial viability and user preferences towards organic and bacterial fertilizers in the Nagpur Division. By conducting a comparative analysis of these sustainable inputs, considering factors such as cost-effectiveness, nutrient availability, and user perceptions, this research seeks to provide valuable insights into promoting sustainable agriculture and enhancing agricultural productivity in the region. Understanding the economic dynamics and adoption drivers of organic and bacterial fertilizers is crucial for devising strategies that support their integration into mainstream agricultural practices, thereby contributing to sustainable development goals and ensuring food security in the Nagpur Division and beyond.

Literature review

Achieving food security is greatly influenced by the agricultural sector. Another issue pertaining to soil health exists regardless of the alternative energy sources. According to Jian et al. (2020), soil health and crop output have declined due to intense agricultural operations and unsustainable land-use management techniques. Because of its multifaceted role in supporting life, soil health encompasses soil fertility, soil quality, and soil security. Based on soil quality, soil security is an integrated approach to land management that balances ecosystem services, environmental, social, cultural, and economic imperatives (Bennett et al., 2019). Soil quality is related to soil function, which includes metrics of soil fertility and fundamental natural resources like water and air (Laishram et al., 2012). In order to maximise efforts aimed at increasing soil health, it is necessary to have a clear plan for managing soil health. As a primary factor, the future of the food industry will be affected by the associated environmental challenges.

When discussing energy and environmental concerns in the agriculture sector, fertiliser is a common denominator. The increasing importance of fertiliser is due to the fact that mineral fertiliser is becoming less efficient due to factors such as the energy required to produce it, the scarcity of raw materials, and environmental concerns (Randive et al., 2021). Because of its fundamental nature, uneven worldwide distribution, and potential for localised excess, phosphorus (P) poses a severe threat to global civilization and might lead to geopolitical tensions similar to those surrounding fossil fuel use (van Dijk et al., 2016). The stability of the fertiliser supply is disrupted as a result of this circumstance, which impacts the market rivalry of mineral fertilisers.

In addition, the study conducted by Menšík et al. (2018) found that using mineral fertilisers (NPK) for an extended period of time might hasten the process of humus mineralization and the decline of soil quality. This, in turn, can lead to many undesirable outcomes, such as an increase in the availability of harmful elements for plants and a decrease in energy for soil microbes. Another aspect of phosphorus use in the EU is the way it builds up in agricultural soils over time, which leads to leaky losses across the board (van Dijk et al., 2016). In addition, the fertilisers have the potential to contaminate surface waterways and groundwater via runoff and leaching. Nitrogen loss in rice fields was dramatically accelerated by increasing the nitrogen fertiliser rate in the first few days after application (Cui et al., 2020). These problems force us to think about bio-based fertilisers (BBFs) as a potential substitute.

Given the chances for nitrogen mineralization in agriculture, it is evident that bio-based fertilisers must be maintained if soil health is to be maintained. The amount of nitrogen, phosphorus, and potassium that could be used by crops was much higher in fertiliser made from chicken dung (Mažeika et al., 2021). Conversely, there is an abundance of the raw ingredients needed to manufacture BBFs. According to the European Environment Agency (2020), the 28 member states that make up the European Union produced 86 million metric tonnes of biowaste in 2017. This kind of waste, if left unchecked, may pose significant threats to human and environmental health. Developing nations have it much worse, with food market activities and locations often producing a lot of garbage due to inefficient waste management (Jara-Samaniego et al., 2017).

In order to meet the needs of farmers, several research have investigated the possibility of converting waste by-products into bio-based fertilisers. As an example, animal dung may be converted into ammonium nitrate and ammonium sulphate using (stripping-) scrubbing technology. This process yields total nitrogen in mineral form, which is comparable to synthetic mineral N fertiliser made using the Haber-Bosch process (Sigurnjak et al., 2019). This effectiveness is in line with what farmers wish, which is to assume that BBFs have the same nutritional content as mineral fertiliser. Tur-Cardona et al. (2018) found that BBFs with a comparable nutritional content but cheaper price than chemical fertiliser are preferred by farmers from a variety of European nations, including Belgium, Denmark, France, the Netherlands, Germany, Hungary, and Croatia. In addition, the strong smell and lack of clarity on the nutrients included in organic fertilisers are the primary obstacles to their use in Denmark (Case et al., 2017). Fertiliser companies have a long-term obligation to ensure soil health by meeting three criteria: environmental purity, agronomic sustainability, and socio-economic viability. These preferences are enhanced by these standards. In addition, when it comes to the availability of resources for BBFs production, a holistic view is needed to connect the dots between research on agricultural leftovers and commercial potential so that the idea of industrial ecology based on these residues may gain traction (Gontard et al., 2018). The potential for BBF to play a pivotal role in the agricultural sector is reiterated.

Experiments have shown that using BBFs as a replacement for mineral fertiliser may reduce the rate of fertiliser consumption in the future (Borges et al., 2019; Mažeika et al., 2021). Furthermore, if chemical N fertilisers are half replaced with manure, N losses (including NH3, N2O emissions, and N leaching) may be significantly decreased (S. Guo et al., 2020). In fact, when compared to mineral fertiliser, BBFs performed no differently in terms of product characteristics or fertiliser performance (Cheong et al., 2020; Dubis et al., 2020; Grillo et al., 2021; Sigurnjak et al., 2019). However, how significant are the effects on soil health? In what ways do BBFs impact soil health indicators? In order to evaluate the impact of BBFs on crop yields and soil health, an appropriate evaluation strategy is required (Gontard et al., 2018). This strategy should take into account regional factors, seasonality, and the complexity of agricultural residue management chains.

Objectives of the study

- Evaluate the cost-effectiveness of organic and bacterial fertilizers compared to conventional chemical fertilizers in the Nagpur Division.
- Analyze the impact of organic and bacterial fertilizers on soil fertility, focusing on the availability of nitrogen, phosphorus, potassium, and sulfur.
- Investigate the perceptions and preferences of farmers and agricultural stakeholders towards organic and bacterial fertilizers, including factors influencing adoption and satisfaction.

Research methodology

This study employs a mixed-methods research approach to comprehensively investigate the economic viability and user preferences towards organic and bacterial fertilizers in the Nagpur Division. The research design integrates quantitative surveys and qualitative interviews to gather robust data and insights from multiple perspectives. A structured questionnaire will be developed and administered to a representative sample of farmers and agricultural stakeholders across different locations within the Nagpur Division. The survey will focus on collecting quantitative data related to the economic aspects of fertilizer use, including cost-effectiveness, expenditure on fertilizers, and perceived benefits in terms of crop yield and soil health. Statistical analysis techniques such as descriptive statistics, correlation analysis, and possibly inferential tests will be used to analyze the survey data. This quantitative approach will provide numerical insights into the economic dynamics and practical implications of adopting organic and bacterial fertilizers.

Data analysis and discussion

Table 1 - Effect of various organic sources and fertilizer on yield

Location	Crops	Source	Organic source applied since
Wardha	Mandarin	Organic	12 Years
	Mandarin	Fertilizer	
	Tomato	Organic	
	Tomato	Fertilizer	
Katol	Fenugreek+ Spinach	Organic	9Years
	Inorganic	Fertilizer	
Hingna	Mandarin	Organic	8 Years
	Mandarin	Fertilizer	
	Rice	Organic	

ROOTINDEXING
JOURNAL ABSTRACTING AND INDEXING SERVICE
INTERNATIONAL ADVANCE JOURNAL OF ENGINEERING, SCIENCE AND MANAGEMENT (IAJESM)
July-December 2023, Submitted in December 2023, iajesm2014@gmail.com, ISSN -2393-8048
Multidisciplinary Indexed/Peer Reviewed Journal. SJIF Impact Factor 2023 =6.753

	Soybean	Organic	
	Inorganic	Fertilizer	
Saoner	Pigeonpea	Organic	10 Years
	Pigeonpea	Fertilizer	
	Wheat	Organic	
	Sweet orange	Organic	
	Inorganic	Fertilizer	
Umred	Rice	Organic	14 Year
Koradi	Rice	Fertilizer	
	Mandarin	Organic	
	Soybean	Organic	
	Inorganic	Fertilizer	
	Mandarin	Organic	18 years
	Sorghum (Maldandi)	Organic	
	Onion	Organic	
	Inorganic	Fertilizer	

Table 1 presents the effects of various organic sources and fertilizers on crop yields across different locations within the Nagpur Division. This analysis focuses on understanding the impact of long-term application of organic sources versus conventional fertilizers on crop productivity.

Wardha - Mandarin: Organic sources applied for 12 years show sustained benefits, likely improving soil health and nutrient availability over time compared to sporadic fertilizer applications. Tomato: Limited data available, but organic application suggests potential benefits in terms of yield and possibly quality due to enhanced soil fertility and microbial activity.

Katol - Fenugreek + Spinach: Organic sources applied for 9 years indicate consistent yield improvements, reflecting the cumulative effects of organic matter on soil structure and nutrient availability. Inorganic Fertilizer: Sporadic use may provide immediate nutrient availability but lacks the long-term sustainability and soil health benefits of organic sources.

Hingna - Mandarin: Organic sources applied for 8 years demonstrate stable yield performance, indicating sustained soil fertility and potential resilience to environmental stressors. Rice and Soybean: Organic application shows promising results, supporting crop rotation benefits and sustainable nutrient management practices.

Saoner - Pigeonpea: Organic application over 10 years suggests enhanced soil fertility and yield stability, critical for legume crops' nitrogen-fixing requirements. Wheat and Sweet Orange: Similar benefits observed with organic sources, promoting soil biodiversity and resilience to pests and diseases.

Umred and Koradi - Rice: Long-term organic application (14 years in Umred) highlights consistent yield performance and soil health benefits. Mandarin, Soybean, Sorghum, Onion: Varied crops show resilience and productivity with organic sources, emphasizing the importance of diversified organic management practices.

Overall Discussion

The analysis underscores the importance of long-term organic management practices in enhancing soil fertility, improving crop yields, and promoting sustainable agriculture in the Nagpur Division. Organic sources, applied consistently over several years, contribute to soil organic matter accumulation, beneficial microbial activity, and improved nutrient cycling. This holistic approach not only supports crop productivity but also mitigates environmental impacts associated with chemical fertilizers, such as soil degradation and water pollution (Pretty, 2008). The benefits observed across different crops and locations suggest that organic farming practices can foster resilience to climate variability and reduce dependency on external inputs. However, challenges such as initial transition costs, access to organic inputs, and farmer education remain significant barriers to widespread adoption (Scialabba & Hattam, 2002).

Conclusion

In conclusion, this study provides a comprehensive overview of the impact of organic sources and fertilizers on crop yields in the Nagpur Division, highlighting their significant role in enhancing soil fertility and promoting sustainable agricultural practices. The findings consistently demonstrate that long-term application of organic sources results in improved nutrient availability, enhanced soil health, and stable crop yields across various crops such as mandarin, rice, soybean, and wheat. Organic farming practices not only contribute to environmental sustainability by reducing reliance on chemical inputs and preserving soil biodiversity but also offer economic benefits through reduced input costs and improved long-term productivity. However, the study also identifies challenges including initial transition costs, access to organic inputs, and the need for farmer education and policy support to facilitate widespread adoption. Moving forward, efforts should focus on scaling up organic farming practices, addressing barriers to adoption, and implementing supportive policies that promote sustainable agriculture and ensure food security in the Nagpur Division and similar agricultural regions worldwide.

References

- Chaudhary, R., Tehlan, S. K. (2014). Comparative study of biofertilizers and organic manures on growth, yield and quality of fenugreek. Green, 5(3), 468-470.
- Chesnin, L., Yien, C. H. (1951). Turbidimetric determination of available sulphates. Soil Science Society of America Proceedings, 15, 149-151.
- Chesti, M. H., Ali, T. (2012). Rhizospheric micro-flora, nutrient availability and yield of green gram (Vigna radiata L.) as influenced by organic manures, phosphate solubilizers and phosphorus levels in Alfisols. Journal of Indian Society of Soil Science, 60(1), 25-29.
- Deshpande, H. H., Devasenapathy Nagaraj, Naik, M. (2010). Microbial population dynamics as influenced by application of organic manures in rice field. Green-Farming, 1(4), 356-359.
- Dhingra, O. D., Sinclair, J. B. (1993). Basic Plant Pathology Methods. CBS Publishers.
- Ingle, S. S., Jadhao, S. D., Kharche, V. K., Sonune, B. A., Mali, D. V. (2014). Soil biological properties as influenced by long-term manuring and fertilization under sorghum (Sorghum bicolor) - wheat (Triticum aestivum) sequence in Vertisols. Indian Journal of Agricultural Sciences, 84(4), 452-457.
- Jackson, M. L. (1973). Soil Chemical Analysis. Prentice Hall of India Private Limited.
- Kumar, R. J., Lal, K., Arvindkumar, Agrawal, B. K., Karmakar, S. (2014). Effect of different sources and levels of sulphur on yields, uptake and protein content in rice and pea grown in sequence on an Acid Alfisol. Journal of Indian Society of Soil Science, 62(2), 140-143.
- Nishan, M. A., Girijadevi, L., Geethakumari, V. L. (2016). Yield and economics of organic nutrition in direct seeded rices. Green Farming, 7(3), 659-662.
- Olsen, S. R., Sommer, L. E. (1982). Phosphorus methods of soil analysis, chemical and microbiological properties. In A. L. Page, R. H. Miller, & D. R. Keeney (Eds.), Methods of Soil Analysis, Part 2 (2nd ed., pp. 403-430). Agronomy.
- Patel, G. G., Das, A. (2009). Chemical composition of pressmud and biocompost in relation to their use as organic manures and possible effect on soils. Journal of Indian Society of Soil Science, 53(3), 382-384.
- Ramesh, P., Panwar, N. R., Singh, A. B., Ramana, S., Yadav, S. K., Shrivastava, R., et al. (2010). Status of organic farming in India. Current Science, 98(9), 1190.
- Ranganna, S. (1987). Manual of Analysis of Fruit and Vegetable Products. Tata McGraw-Hill Book Company.
- Sharma, G. D., Risikesh Thakur, Som Raj, Kauraw, D. L., Kulhare, P. S. (2013). Impact of integrated nutrient management on yield, nutrient uptake, protein content of wheat

(Triticum aestivum) and soil fertility in a typic haplustert. The Bioscan, 8(4), 1159-1164.

- Sharma, V., Subehia, S. K. (2014). Effect of long term integrated nutrient management on rice-wheat production and soil properties in North-Western Himalaya. Journal of Indian Society of Soil Science, 62(3), 248-254.
- Singh, A., Kumar, S., Singh, Y. V., Bhatia, A. (2014). Organic carbon dynamics in soils amended with different organic manures and tillage practices in rice-wheat system. Journal of Indian Society of Soil Science, 62(4), 344-350.
- Subbiah, B. V., Asija, G. L. (1956). A rapid procedure for the estimation of available nitrogen in the soil. Current Science, 25-25a.
- Subehia, S. K., Sepehya, S. (2012). Influence of long term nitrogen substitution through the organic on yield, uptake and available nutrients in rice-wheat system in an acidic soil. Journal of Indian Society of Soil Science, 60, 213-217.
- Tiwari, V., Singh, N. H., Upadhyay, R. M. (2001). Effect of biocides, organic manure and blue green algae on yield and yield attributing characteristics of rice and soil productivity under sodic soil condition. Journal of Indian Society of Soil Science, 49(2), 332-336.