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Assessment of perceived constraints and suggestions of farmers towards biofertilizers and biopesticides adoption using the garret ranking approach

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Abstract

Biofertilizer and biopesticide, which are crucial components of organic farming, play an important role in ensuring long-term soil fertility and sustainability. The present study was conducted in 2023-2024 in the Bundelkhand region of Uttar Pradesh to assess farmers' perceived constraints and recommendations regarding the adoption of biofertilizers and biopesticides. A descriptive research design was used in the present study. The present study was conducted in one district, namely Hamirpur, in the Bundelkhand region of Uttar Pradesh. Hamirpur district comprises seven blocks, in which one block, namely Gohand, was randomly selected. Six villages were selected randomly from this block, and a total of 150 farmers were selected randomly. The study revealed that the lack of availability of biofertilizers and biopesticides at nearby locations ranked first among constraints with a high Garrett's score (131.20). The important suggestion stated by the farmers that biofertilizers and biopesticides should be available free of cost or at a subsidised rate ranked first among suggestions with a high Garrett's score (124.80). This study also strongly suggests that policy interventions are required to strengthen the supply chain of biofertilizers and biopesticides at the village and block levels. The government should prioritize the establishment of local production units, certified input outlets, and cooperative-based distribution systems to ensure timely and easy access for farmers. Providing biofertilizers and biopesticides at subsidized rates or through free distribution during the initial adoption phases would further encourage their use, particularly among small and marginal farmers.

Keywords: Biofertilizers, biopesticides, constraints, suggestions, Bundelkhand

1. Introduction

The green revolution, which began with high-yielding seedlings that respond primarily to increased levels of chemical fertilizer, laid the groundwork for modern agriculture. Although pesticides are now an essential component of modern agriculture, their overuse and careless application have not only contaminated the environment but also resulted in the emergence of pest resistance, pest resurgence, and negative effects on beneficial organisms such as pollinators and honeybees (Gupta *et al.*, 2010) [3]. Continuous use of chemical fertilizers contaminates soil and water supplies, polluting the environment (Kappala and Bolla, 2022) [8]. Numerous studies and publications have found that excessive and indiscriminate pesticide use in many countries harms people, other living organisms, non-living organisms, and the environment (Gupta *et al.*, 2020) [4]. Some of the environmental consequences of increased fertilizer use and highly productive systems include air pollution, biodiversity loss, and impaired ecosystem functioning. Other difficulties include soil degradation, surface water, and groundwater contamination. It is obvious

that sustainable farming practices are needed globally (Kawalekar, 2013) [9]. A part of sustainable agriculture, organic farming aims to produce healthful goods while simultaneously safeguarding the environment, land, and water (Singh *et al.*, 2019) [13]. It also promotes agro-ecosystem health, including biodiversity, biological cycle, and soil biological activities (Ahmed *et al.*, 2019; Sharma *et al.*, 2016) [1, 12]. Henceforth, Biofertilizers and biopesticides are one of the possible solutions for sustainable agriculture through organic farming under the current climate change, as they are less expensive, have no negative effects on the soil or environment, and do not disrupt ecological equilibrium (Sahoo *et al.*, 2021) [11]. Biofertilizer is referred to as "a substance containing living microorganisms that, when applied to seed, plant surfaces, or soil, colonize the rhizosphere or the interior of the plant and increase the supply or availability of primary nutrients to the host plant" (Malusa and Vassilev, 2014) [10]. Through natural processes, including phosphorus solubilization, nitrogen fixation, and the synthesis of compounds that promote growth, biofertilizers supply nutrients to plants. The microorganisms

in biofertilizers help to build organic matter in the soil and maintain the natural nutrient cycle. They not only promote healthy plants, but also help to improve soil sustainability and health.

Pesticides derived from natural sources, including bacteria, plants, animals, and some minerals, are known as biopesticides. A microorganism, such as a bacterium, fungus, virus, or protozoan, is the active component in microbial pesticides. Although each active ingredient in microbial pesticides is specific to the pests and diseases they are intended to treat, they can manage a variety of pests (Vanpariya *et al.*, 2020) [15]. The most significant advantage of biopesticides is that their hazardous residues are not detectable, and usually sprayed similarly to chemical pesticides. In order to maintain soil fertility and sustainability over time, organic farming relies heavily on biofertilizers and biopesticides.

2. Methodology

The investigation applied a descriptive research design. The study was conducted in seven districts of Uttar Pradesh and six districts of Madhya Pradesh in the Bundelkhand region of Central India. The Bundelkhand region includes the districts of Chitrakoot, Banda, Jhansi, Jalaun, Hamirpur, Mahoba, and Lalitpur in Uttar Pradesh. The U.P. government's agriculture department has chosen Hamirpur and Banda as two of these districts to support organic farming. Hamirpur district was selected purposively. The district comprises seven blocks, namely Gohand, Kurara, Maudaha, Muskara, Rath, Sarila, and Sumerpur. Out of them, one block, namely Gohand, was selected through simple random sampling. A list of villages from the selected block was compiled, and six villages were selected randomly through applying a lottery system of selection. From the selected village, 25 farmers were selected through simple random sampling; thus, a total of 150 farmers constituted the sample size for the study. The main focus of the investigation is to assess the constraints and suggestions perceived by the farmers for the adoption of biofertilizers and biopesticides. The study made use of primary data. Primary data for this study were gathered using a pre-tested, structured and semi-structured interview scheduled procedure of extended farm visits and personal interviews. The information was gathered in 2023 and 2024. The constraints and suggestions perceived by the farmers for the adoption of biofertilizers and biopesticides were analyzed using the Garrett ranking technique.

2.1 Garrett's Ranking Technique

Garrett's Ranking Technique provides a numerical representation of limitations and recommendations for ordering. The main benefit of this approach over a simple frequency distribution is that the limits and recommendations are ranked according to severity from the respondents' perspective. As a result, the same number of interviewers may have received different rankings based on two or more limits and suggestions. Garrett's score method was applied to ascertain the most supreme constraints and suggestions among the groups as perceived by farmers (Gupta *et al.*, 2025) [5]. The following is the percentage position formula proposed by Garret (1980):

$$\text{Per cent position} = 100 \times \frac{(R_{ij} - 0.5)}{N_j}$$

Were,

R_{ij} = Rank given for the i^{th} variable by j^{th} respondent

N_j = Number of variables ranked by j^{th} respondent

To convert the per cent position to scores, Garrett and Woodworth's table is used. The mean score and total score are calculated once the individual factor scores are added together. The mean scores for each factor are then organized in descending order to make it easier to identify the most important components based on the allocated ranks. The element with the highest mean value is the most significant one in the study.

3. Results and Discussion

According to the severity of a consequence, respondents assign ratings to different constraints using the Garrett Ranking Technique, as Table 1 shows. The data shows that the ranks of various barriers to the adoption of biofertilizers and biopesticides according to their GMS are found. The major impediments are a Lack of availability of biofertilizers and biopesticides at nearby locations (Rank 1), as the case may be for farmers who may face challenges in accessing the inputs. This becomes an inhibitive factor against the effective use and integration into agricultural practices, as the products are ecologically friendly. Followed by a Lack of knowledge about the uses of biofertilizers and biopesticides (Rank II). This is partially because the majority of farmers are unaware of the proper way to administer these inputs. Lack of knowledge has led to ineffective use, a lack of confidence in these inputs, and ultimately, the application of chemical pesticides and fertilizers. High price of the products (Rank III). Most of all, it is in the case of small and marginal growers. With increased production and distribution costs, the affordability of these kinds of products will be very low. This counterbalances the long-term environmental and agronomic benefits by limiting their wider adoption. Lack of proper skill and technical guidance (Rank IV), because proper handling, application, and storage methods may be difficult for farmers. Low adoption rates and less-than-ideal outcomes result from inadequate extension support, which further erodes faith in these inputs. Don't show the immediate result (Rank V), which sometimes hinders their adoption by farmers. The slow response time also requires requirement a drawback in the absence of proper awareness. Lack of availability of good quality products (Rank VI), as poor or substandard products reduce effectiveness in the field. This inconsistency in quality lowers farmer trust and negatively impacts the adoption of these sustainable agricultural inputs. No increase in production (Rank VII). This has especially been the case during the early stages of use. This short-run yield response has contributed to farmers underestimating the long-run benefits associated with these inputs. Not available at the time of application (Rank VIII), A lack of timely supplies forces the farmer to move towards chemical substitutes; otherwise, biological inputs will not be adopted. Lack of awareness about the benefits of biofertilizers and biopesticides (Rank IX), because many

farmers are not aware of their long-term benefits for soil quality, safety, and sustainable crop production practices. This can be attributed to a lack of knowledge, thus reducing their confidence in using such inputs in crop production practices accessed through conventional farming systems. Overall, the constraint highlights the multiple barriers that

must be addressed to increase the broad use and efficacy of biofertilizers and biopesticides in agricultural practices. Jangid *et al.* (2012) ^[6], Slathia *et al.* (2013) ^[14], Diptesh and Chauhan (2016) ^[2], and Joshi *et al.* (2019) ^[7] also reported the same.

Table 1: The constraints perceived by the farmers towards the adoption of biofertilizers and biopesticides

Sr. No.	Statements	Total Score	GMS	Rank
1	Lack of availability of biofertilizers and biopesticides in the nearby location.	19680	131.2	I
2	Lack of knowledge about the uses of biofertilizers and biopesticides.	15594	103.96	II
3	Don't show the immediate result.	10675	71.17	V
4	Lack of proper skill and technical guidance.	10890	72.60	IV
5	High price of the products.	11450	73.33	III
6	Lack of availability of a good quality product.	9548	63.65	VI
7	No increase in production.	8132	54.21	VII
8	Not available at the time of application.	5790	38.60	VIII
9	Lack of awareness about the benefits of biofertilizers and biopesticides.	3382	22.55	IX

Note: GMS = Garret Mean Score

Table 2: The suggestions given by the farmers towards the adoption of biofertilizers and biopesticides

Sr. No.	Statements	Total Score	GMS	Rank
1.	The product should be available free of cost or at subsidized rates.	18720	124.8	I
2.	A sound marketing network for biofertilizers and biopesticides is required.	14300	95.33	II
3.	Training should be given at the farmers' fields about the use of biofertilizers and biopesticides.	13281	88.54	III
4.	Availability of quality products.	9000	60.00	IV
5.	Ensure the market and price of products	8862	59.08	V
6.	Extension activities, i.e. kisan mela, demonstration, exhibition, training and scientists' visit at the village level	6698	44.65	VI
7.	More activities are required	4053	27.02	VII

Note: GMS = Garret Mean Score

The data in Table 2 shows that the GMS ranks strategies aimed at promoting the adoption of biofertilizers and biopesticides in agriculture. The most effective strategy Product should be available free of cost or at subsidies rates (Rank I). This financial assistance may lower costs as well as speed up the adoption of these environmentally friendly agricultural resources. Followed by Sound marketing network for biofertilizers and biopesticides is required (Rank II) to ensure their timely availability and wider reach among farmers. A more efficient distribution and promotion system would provide for better product awareness, confidence-building for farmers, and improved adoption of these sustainable agriculture inputs. Training should be given at farmers' fields about the use of biofertilizers and biopesticides (Rank III), to enhance their practical understanding and application capabilities. Demonstration as well as on-farm practical assistance can help build confidence, establish proper usage, and foster proper adoption of these biological inputs. Availability of quality products (Rank IV). These will help improve effectiveness and build the farmer's confidence to adopt sustainable agricultural inputs. Ensure the market and price of products (Rank V). Effective regulation of the market and price controls can improve availability and restore confidence and sustained use of such green farm inputs. Extension activities, i.e. kisan mela, demonstration, exhibition, training and scientists' visit at village level (Rank VI). These activities enhance farmer awareness, provide hands-on experience, and facilitate direct interaction with experts, thereby improving adoption and proper utilization. More

activities are required (Rank VII). There is a need for further extension and promotional work to disseminate information on the benefits and use of biofertilizers and biopesticides. Increased field demonstrations and training activities, and interactions between farmers and scientists, would increase awareness and confidence among the farming community. Overall, the report emphasises key strategies that could significantly enhance the uptake and utilization of biofertilizers and biopesticides in agricultural practices. Diptesh and Chauhan (2016) ^[2] also reported the same.

4. Conclusion

A critical analysis of constraints and suggestions perceived by farmers for the adoption of biofertilizers and biopesticides revealed the following major constraints: limited availability of these products in many locations, limited knowledge of their uses, and high product prices. The suggestion given by the farmers, i.e., that the product should be available free of cost or at subsidized rates, a Sound marketing network for biofertilizers and biopesticides is required, and Training should be provided at farmers' fields on the use of biofertilizers and biopesticides. This paper examines the key constraints and recommendations that facilitate the adoption of biofertilizers and biopesticides by farmers. To make progress in this area, there is a need for more long-term, multi-location field trials, formulation enhancements, improved shelf life, and enhanced extension and training. Overcoming these constraints will improve the integration of biofertilizers and biopesticides into sustainable agricultural practice.

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