

International Journal of Agriculture Extension and Social Development

Volume 9; Issue 9; September 2026; Page No. 561-564

Received: 02-06-2026
Accepted: 08-07-2026

Indexed Journal
Peer Reviewed Journal

A study on farmer's perception of biopesticides in Karimnagar district of Telangana using 4A framework

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DOI: <https://www.doi.org/10.33545/26180723.2026.v9.i9h.4235>

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Abstract

Biopesticides are gaining importance as an environmentally sustainable component of crop protection and integrated pest management. However, their adoption depends on farmers' awareness, acceptability, accessibility and affordability. The present study evaluated farmers' perceptions of biopesticides available in Karimnagar district of Telangana using the 4A Framework. General awareness and sources of information were assessed among 96 farmers, while the four 4A dimensions were assessed among 48 farmers using a five-point Likert scale. The findings showed that 42.7 per cent of farmers had moderate awareness, followed by 39.6 per cent with high awareness, indicating that 82.3 per cent had moderate to high awareness. Agricultural input dealers were the major source of information (71.9%), followed by fellow farmers (46.9%). Among the four dimensions, Awareness ranked first with a mean score of 3.45 and was classified as high, followed by Acceptability (3.32) and Accessibility (3.11), both at moderate levels. Affordability recorded the lowest mean score of 2.58 and was classified as low. The findings indicate that although farmers were relatively familiar with biopesticides, affordability, local availability and satisfaction with product performance remained important concerns. Strengthening dealer networks, field demonstrations, technical guidance and farmer-oriented pricing strategies could improve the adoption potential of biopesticides in the study area.

Keywords: Biopesticides, 4A framework, awareness, acceptability, accessibility, affordability, farmers, Karimnagar, Telangana

Introduction

Agricultural production has traditionally relied heavily on chemical pesticides for controlling pests and diseases. However, excessive and indiscriminate pesticide use has raised concerns related to environmental contamination, resistance development and effects on non-target organisms. Biopesticides have therefore gained importance as environmentally compatible components of integrated pest management. They include microbial and biochemical agents derived from natural sources and can contribute to reducing dependence on synthetic pesticides.

Despite their potential, the adoption and commercialization of biopesticides continue to face challenges such as inconsistent field performance, limited awareness and difficulties in market penetration. Farmer perceptions regarding product performance, availability, cost and technical knowledge can consequently influence their willingness to use biopesticides.

The 4A Framework, comprising Awareness, Acceptability, Accessibility and Affordability, provides a customer-oriented approach to understand how farmers perceive agricultural products. Awareness represents knowledge of the product and its uses; Acceptability reflects perceived quality, performance and suitability; Accessibility refers to the ease

of obtaining the product; and Affordability represents the perceived reasonableness of price and value for money.

In this context, the present study was undertaken to evaluate farmers perception using the 4A Framework with regard to biopesticides available in the study area.

The study was conducted in Karimnagar district of Telangana using a purposive sampling approach. Primary data were collected through a structured interview schedule from 96 farmers, comprising 48 biopesticide users and 48 non-users. General awareness and sources of information were assessed among all 96 farmers, while detailed perceptions under the four dimensions of the 4A Framework were evaluated among 48 farmers using a five-point Likert scale. Mean scores and standard deviations were calculated for each dimension, and the dimensions were ranked according to their overall mean scores. The mean scores were interpreted as Very High (4.21–5.00), High (3.41–4.20), Moderate (2.61–3.40), Low (1.81–2.60), and Very Low (1.00–1.80).

Sources of Information on Biopesticides

Information sources play an important role in developing farmers' awareness and shaping their perceptions of biopesticides. Farmers may obtain information through agricultural input dealers, fellow farmers, extension

personnel, company representatives and various media channels. Since farmers could report more than one source,

the information was analysed using a multiple-response approach.

Table 1: Sources of Information on Biopesticides (Multiple Response, n = 96)

S. No.	Source of Information	No. of responses	Percentage of Farmers (%)
1.	Agricultural input dealers	69	71.9
2.	Fellow farmers/peer network	45	46.9
3.	Agricultural Extension Officers/KVK	27	28.1
4.	Company representatives/demonstrations	15	15.6
5.	Television/radio/print media	11	11.5
6.	Social media/digital platforms	20	20.8

Source: Field survey.

Agricultural input dealers were the dominant source of information, reported by 71.9 per cent of farmers, followed by fellow farmers at 46.9 per cent. Extension Officers/KVKs accounted for 28.1 per cent, while social media and digital platforms accounted for 20.8 per cent. Company representatives and demonstrations were reported by 15.6 per cent, whereas television, radio and print media were the least-used sources.

The findings highlight the important role of agricultural dealers in the biopesticide market. Dealers act not only as points of purchase but also as important sources of product information. Thus, Awareness and Accessibility are closely connected in the rural agricultural input market. The role of fellow farmers further indicates the importance of peer experience in shaping farmers' perceptions.

Evaluation of the 4A Framework

The 4A Framework was used to assess the major factors influencing farmers' perceptions and potential adoption of biopesticides. The framework comprises four dimensions: Awareness, Acceptability, Accessibility and Affordability.

Awareness measures farmers' knowledge and understanding of biopesticides; Acceptability reflects their perceptions of product effectiveness, suitability and satisfaction; Accessibility assesses the ease and convenience of obtaining the products; and Affordability examines whether farmers consider the products reasonably priced and capable of providing value for money. Together, these dimensions provide a comprehensive understanding of the strengths and limitations of the biopesticide market from the farmers' perspective.

Awareness

The Awareness dimension measures the extent to which farmers possess knowledge about the availability, brands, benefits and proper application of biopesticides. It also considers whether farmers have received reliable information or demonstrations about these products. Assessing awareness is important because adequate knowledge is a basic requirement for the correct use and wider adoption of biopesticides.

Table 2: Farmers' Perception on the Awareness Dimension (n = 48)

S. No.	Statement	Mean	S.D.	Level
1.	I am aware that biopesticides are available for use on my crops.	3.54	0.99	High
2.	I know the names of at least one biopesticide brand/product.	3.36	1.13	Moderate
3.	I understand the benefits of biopesticides over chemical pesticides.	3.33	1.09	Moderate
4.	I am aware of the correct dosage and method of applying biopesticides.	3.47	1.10	High
5.	I have received information/demonstration about biopesticides from a reliable source.	3.54	1.17	High
6.	Overall Awareness Mean Score	3.45	–	High

The Awareness dimension recorded an overall mean score of 3.45, indicating a high level of awareness. Farmers were particularly aware of the availability of biopesticides and had received information or demonstrations from reliable sources. However, knowledge of specific brands and understanding of the benefits of biopesticides compared with chemical pesticides were moderate. This indicates that general awareness has developed, but product-specific and technical knowledge remains a gap. Hence, future awareness programmes should focus on product-specific information, correct dosage, application methods and demonstrated field

benefits rather than general awareness alone.

Accessibility

The Accessibility dimension measures the ease with which farmers can obtain biopesticides when required. It considers the availability of products through local dealers, the availability of suitable pack sizes, timely supply during the cropping season and the presence of alternative outlets. Accessibility is important because even farmers who are aware of and willing to use biopesticides may not adopt them regularly if the products are difficult to obtain.

Table 3: Farmers' Perception on the Accessibility Dimension (n = 48)

S. No.	Statement	Mean	S.D.	Level
1	Biopesticides are readily available with dealers in/near my village.	2.50	0.90	low
2	Biopesticides are available in the pack sizes I require.	3.08	1.20	Moderate
3	Biopesticides are available when I need them during the cropping season.	3.19	0.95	Moderate
4	There is more than one dealer/outlet from whom I can buy biopesticides.	3.02	1.14	Moderate
5	Overall Accessibility Mean Score	3.11	-	Moderate

Source: Field survey.

Accessibility recorded an overall mean score of 3.11, indicating a moderate level. The lowest score was observed for availability with dealers in or near the village (2.50). Availability during the cropping season recorded the highest score (3.19). The findings indicate that local availability is the major accessibility concern. Strengthening dealer-level stocks and ensuring timely replenishment during peak crop-protection periods could improve accessibility.

Affordability

The Affordability dimension measures whether farmers consider biopesticides financially accessible for regular use. It includes perceptions of price compared with chemical pesticides, ability to use the products regularly, value for money, availability of credit or instalment facilities, and the extent to which cost discourages use. This dimension is important because price and recurring application costs can directly influence farmers' willingness to adopt biopesticides.

Table 4: Farmers' Perception on the Affordability Dimension (n = 48)

S. No.	Statement	Mean	S.D.	Level
1	The price of biopesticides is reasonable compared to chemical pesticides.	2.50	0.70	low
2	Biopesticides offer value for money considering their benefits.	2.82	1.09	Moderate
3	I can afford to use biopesticides regularly on my crop.	2.45	0.86	low
4	Credit/instalment facility is available for purchase of biopesticides.	2.66	0.92	Moderate
5	The cost of biopesticides does not discourage me from using them.	2.50	0.90	low
6	Overall Affordability Mean Score	2.58	–	low

Source: Field survey.

Affordability emerged as the weakest dimension, with an overall mean score of 2.58, classified as low. Farmers had a low perception regarding the reasonableness of biopesticide prices compared with chemical pesticides and their ability to use them regularly. Although the value-for-money statement recorded a moderate score of 2.82, the overall findings indicate that cost remains a major concern. Affordable pack sizes and clear communication of economic benefits could help improve affordability perceptions.

Acceptability

The Acceptability dimension measures farmers' willingness to accept and use biopesticides based on their perceived effectiveness, suitability and overall performance. It also considers farmers' satisfaction, willingness to recommend the products to others and preference for biopesticides over chemical pesticides wherever feasible. Assessing acceptability is important because positive perceptions of product performance can encourage repeated use and influence other farmers through peer recommendations.

Table 5: Farmers' Perception on the Acceptability Dimension (n = 48)

S. No.	Statement	Mean	S.D.	Level
1	Biopesticides are effective in controlling pests on my crop.	3.41	1.07	Moderate
2	Biopesticides are suitable for my cropping pattern and practices.	3.41	1.06	Moderate
3	I am satisfied with the performance of biopesticides I have used/seen.	2.54	0.78	low
4	I would recommend biopesticides to fellow farmers.	3.17	0.99	Moderate
5	I prefer biopesticides over chemical pesticides wherever feasible.	3.10	1.00	Moderate
6	Overall Acceptability Mean Score	3.32	-	Moderate

Source: Field survey.

The Acceptability dimension recorded a mean score of 3.32, indicating moderate acceptability. Farmers considered biopesticides moderately effective and suitable for their cropping practices. However, satisfaction with product performance recorded a low mean score of 2.54. This indicates that improving confidence in product performance is important for increasing acceptability. Field demonstrations and farmer trials can provide practical evidence of effectiveness and help strengthen farmer confidence. Previous research has similarly identified inconsistent field performance and limited grower awareness as challenges to wider biopesticide adoption.

Conclusion

The study was undertaken to understand farmers' perceptions of biopesticides and to identify the major factors that support or constrain their adoption using the 4A Framework. The findings indicate that awareness was the strongest dimension, while acceptability and accessibility were moderate and affordability emerged as the major concern. The results

therefore show that increasing awareness alone may not be sufficient to achieve wider adoption; improvements are also required in product availability, affordability and confidence in product performance.

From the perspective of the firm, the study provides practical inputs for strengthening the biopesticide market in the study area. The findings suggest that the firm should focus on product-specific technical communication, field demonstrations and farmer trials to improve acceptability. Expansion of the dealer network, adequate stock maintenance and timely replenishment can improve accessibility. Suitable pack sizes, competitive pricing and farmer-oriented promotional or credit strategies can help address affordability concerns. Strengthening dealer training is also important because dealers are the major source of information for farmers. Thus, the 4A assessment provides a practical basis for the firm to design market-entry and expansion strategies according to the actual needs and constraints of farmers in Karimnagar district.

Table 6: Overall Mean Score and Ranking of the 4A Dimensions

Dimension	Overall Mean Score	Level	Rank
Awareness	3.45	High	I
Acceptability	3.32	Moderate	II
Accessibility	3.11	Moderate	III
Affordability	2.58	low	IV

Source: Field survey.

The comparative assessment showed that Awareness ranked first, followed by Acceptability, Accessibility and Affordability. The high Awareness score indicates that farmers were relatively familiar with biopesticides. However, moderate scores for Acceptability and Accessibility indicate that awareness had not fully translated into strong product confidence and convenient availability.

Affordability recorded the lowest score, indicating that economic considerations represented the major weakness in the 4A Framework. The findings therefore suggest that the biopesticide market in the study area has a favourable awareness base but requires improvement in affordability, accessibility and farmer confidence in product performance.

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