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Assessing Farmers' Buying Behavior and Challenges in Adopting Organic Fertilizers: A Case Study from Banaskantha District, Gujarat, India

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Authors' contributions

This work was carried out in collaboration between both authors. Author JJ designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Author DBP managed the analyses of the study. Both authors read and approved the final manuscript.

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ABSTRACT

The adoption of organic fertilizers in India has seen significant growth, driven by increasing consumer awareness of the environmental impact of chemical fertilizers and government policies promoting sustainable agriculture. This study explores the buying behaviour and challenges faced by farmers in Deesa and Palanpur talukas, Banaskantha district, Gujarat regarding their use of organic fertilizers. Through interviews with 200 farmers, findings reveal that although a majority

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express strong interest in organic fertilizers, they face significant challenges, including poor efficiency, delayed effects, and limited knowledge of proper use. Understanding these obstacles is crucial for developing policies that promote sustainable agriculture in India. A descriptive research design was employed, utilizing both primary and secondary data. Primary data were collected using a semi-structured schedule, while secondary data were obtained from literature, government publications, and online sources. The sampling method involved purposive selection of farmers with knowledge of organic farming practices from ten randomly selected villages in the two talukas. Data were analyzed using descriptive statistics and the Weighted Average Mean method. The results showed that the majority of farmers (53.5%) were in the age range of 36-50 years. Most farmers (48%) had an annual income between Rs. 100,000 and Rs. 500,000, with 44.5 per cent having an education level below SSC. The primary occupation was a combination of agriculture and animal husbandry (54.5%). Land holdings are mostly below 5 acres (49 %), and the main crops are wheat (35.5 %) and potato (27 %). Organic fertilizer is primarily purchased from retail outlets (69 %), with past experience being the most important factor influencing purchases (WAM score 4.800), followed by dealer recommendations (WAM score 4.500). A significant 94.5 per cent of farmers express a strong interest in purchasing organic fertilizers. Challenges include poor efficiency and delay effects of organic fertilizers, along with a notable lack of knowledge on their effective use. Understanding the socio-economic characteristics, buying behaviour, and challenges faced by farmers in these regions is crucial for developing strategies to promote the adoption of organic fertilizers and contribute to sustainable agriculture in India. The study suggests targeted education and support initiatives to enhance adoption rates and improve the efficacy of organic farming practices.

Keywords: Organic fertilizers; purchasing behaviour; sustainable farming; organic farming adoption; farmer perceptions.

1. INTRODUCTION

As per the Economic Survey 2021-22, agriculture plays a vital role in the Indian economy, serving as a key sector that contributes 20.2% to the GDP and provides employment to approximately 50-60% of the population (Sahoo and Dudhagara, 2023). Following the Green Revolution, farmers began adopting crop cultivation practices that relied on chemical fertilizers to increase the production as well as productivity of the land (Patil and Gaikwad, 2022; Komarudin et al., 2021). The growing use of chemical fertilizers has significantly impacted the ecological environment, contributing to agricultural non-point source pollution, food safety concerns, and various other issues (Lin and Ming, 2020). Organic farming has evolved from a grassroots movement opposing the industrialization of agriculture into a global industry, now playing a crucial role in tackling modern challenges related to environmental health, sustainability, and food safety (Panday et al., 2024). Organic farming is practised in 179 countries across all continents, with a growing awareness among consumers of the environmental harm caused by chemical fertilizers. This awareness has led to a preference for organic fertilizers, supported by health concerns and policies that promote soil health and rural economic development. The global organic agriculture area has seen consistent growth, reaching 50.9 million hectares in 2014 and increasing by 6.5 million hectares from the previous year (Yadav & Pandey, 2020).

The fertilizer industry in India has undergone substantial development since the inception of the first plant in 1906, according to the Ministry of Chemicals and Fertilizers (2024). Today, India produces a diverse array of fertilizers, encompassing both organic and inorganic varieties, each serving a specific purpose in enhancing soil fertility and crop yields. Organic fertilizers, derived from natural resources such as manure and plant residues, contribute to improving soil structure and microbial activity while fostering sustainable farming practices. On the other hand, inorganic fertilizers, which are synthesized from chemical compounds, offer stable and efficient nutrient delivery, a critical component for achieving high-yield agriculture (Saichand, 2011).

Organic fertilizers are categorized based on their source. These sources primarily include crop residues and horticultural byproducts, as well as livestock husbandry and slaughterhouse waste. Additionally, naturally occurring minerals are utilized. Consequently, three distinct types of organic fertilizers have emerged: plant-based,

animal-based, and mineral-based fertilizers (Eos Data Analytics, 2024).

India has witnessed substantial growth in organic farming, evidenced by the increase in cultivated land from 528,171 hectares in 2007-2008 to 1.18 million hectares in 2014-2015. According to projections, the annual nutrient contribution (NPK) from organic sources is expected to reach approximately 5 million tons, with a further increase to 7.75 million tonnes anticipated by 2025 (Yadav & Pandey, 2020).

The world market for organic fertilizers was valued at 8.3 billion U.S. dollars in 2020, representing a growth of approximately three billion dollars since 2015. Projections indicate that the global market for organic fertilizers will reach 15.8 billion U.S. dollars by 2026 (Fertilizer industry, 2024). The Indian organic fertilizer market is projected to reach USD 694.41 million by 2029, with a compound annual growth rate (CAGR) of 8.80% during the forecast period of 2024-2029 (Mordor intelligence, 2024).

Price and experience in biofertilizer purchase in Maharashtra, advocating for government quality standards and support (Paliwal & Nistala, 2021). Prayagraj farmers had significant experience, medium to large families, and media engagement (Singh, 2019). Understanding the buying behaviour and challenges faced by farmers in Deesa and Palanpur talukas is crucial for developing effective strategies for promoting the adoption of organic fertilizers. These regions, with their reliance on agriculture, present a unique opportunity to study how farmers perceive organic fertilizers, the factors influencing their purchasing decisions, and the problems they face with their use of organic fertilizers. Applying organic fertilizers (manures) aids in retaining inorganic fertilizer nitrogen and reducing losses, primarily by gradually enhancing soil structure and improving nitrogen storage for slow release from soil organic matter (Krupnik et al., 2004; Ladha et al., 2005, 2020), understanding farmers' practices regarding organic and inorganic fertilizer use is essential for formulating policies that address climate change and related environmental challenges in agriculture (Aryal et al., 2021).

By focusing on local farmers' buying behaviour and socio-economic factors, the study sheds light on the barriers to and motivators for organic fertilizer adoption, which is crucial for formulating supportive agricultural policies. The research is particularly important for promoting sustainable farming practices in India and supports global environmental goals by reducing reliance on chemical fertilizers. Addressing these issues can help formulate policies and provide support to enhance the adoption of organic fertilizers, thereby contributing to sustainable agriculture.

2. MATERIALS AND METHODS

The research used both primary and secondary data to meet its objectives. Primary data were gathered through interviews with farmers who use organic fertilizers, using a semi-structured schedule based on the study's aims. Secondary data came from literature, government publications, and online sources to support the primary data. The sampling method was non-probability sampling, specifically using purposive sampling to select farmers with knowledge of organic farming practices. This descriptive research focused on 200 farmers from the Deesa and Palanpur talukas of Banaskantha district over 90 days. Villages within these talukas were selected randomly, with five villages chosen from each taluka, making a total of ten villages. From each village, 20 farmers were purposively selected to ensure that the sample included individuals with relevant experience and insights. The data were analyzed using descriptive statistics, such as frequencies, percentages, and tabular analysis, to provide a clear overview of the findings. Additionally, the Weighted Average Mean method was used to analyze responses to Likert scale questions, allowing for a detailed interpretation of the data. This involved calculating a weighted mean for each question by multiplying each response by its corresponding weight, summing these products, and then dividing by the total weight, thus providing a comprehensive analysis of the farmers' responses regarding their use of organic fertilizers (Parasuraman et al., 1988).

3. RESULTS AND DISCUSSION

3.1 Age of the Farmers

According to the survey, Table 1 provides detailed information on the age-wise distribution of different groups in the population. It indicates that the age range of 36-50 comprises 107 farmers, which is equivalent to 53.50 percent of the total. The age range of 51-65 includes 60 farmers, making up 30.00 percent of the total. Lastly, the age range of 21-35 consists of 33 farmers, representing 16.50 percent of the total. This result corroborates with the research findings by Ladumor et al. (2023).

3.2 Marital Status of the Farmers

Table 2 shows that 100 percent of farmers were married. There are no unmarried farmers in the sample.

3.3 Annual Income of Farmers

Results show that 13.5 percent of the farmers were earning below Rs.100000 as their annual income, 48 percent of the farmers earning Rs.100000 – Rs.500000, 22.5 percent of the farmers earning Rs.500000 – Rs.1000000 as their annual income and 16 percent of the farmers earning More than Rs.1000000. It was found from the analysis that the majority (48 %) of the farmers earning Rs.1,00,000 – Rs.5,00,000 as their annual income.

3.4 Education of the Farmers

Table 4 shows the education level of farmers and reveals that 44.50 percent of farmers have an education level below SSC, 27 percent of farmers have completed SSC, around 16.50 percent of farmers have completed HSC and 12 percent of farmers were graduates. It was found that the majority of farmers have an education level below SSC implying that education does not have an impact towards the use of organic fertilizer.

3.5 Occupation of the Farmers

According to the study, 54.5 percent, of farmers are engaged in agriculture and animal husbandry, which constitutes the largest occupation in this area, while 24 percent of farmers are solely involved in agriculture and 21.5 percent combine agriculture with business as their occupation. This implies that farmers keeping animal as their source of income are more likely to use organic fertilizer as their direct availability of animal-based fertilizer.

Table 1. Age of the farmers

Age (Years)	Frequency	Percentage
21-35	33	16.5
36-50	**107**	**53.5**
51-65	60	30
Total	**200**	**100**

Source -Field survey

Table 2. Marital Status of the farmers

Marital Status	Frequency	Percentage
Married	200	100
Unmarried	0	0
Total	**100**	**100.00**

Source -Field survey

Table 3. Annual income of farmers

Income (Rs.)	Frequency	Percentage
<1 Lakh	27	13.5
1 - 5 Lakh	**96**	**48.0**
5-10 Lakh	45	22.5
> 10 Lakh	32	16.0
Total	**200**	**100**

Source -Field survey

Table 4. Education of the farmers

Education Level	Frequency	Percentage
Below SSC	**89**	**44.50**
SSC	54	27.00
HSC	33	16.50
Graduate	24	12.00
Total	**200**	**100**

Source -Field survey

Table 5. Occupation of the farmers

Occupation	Frequency	Percentage
Agriculture	48	24
Agriculture + Animal Husbandry	**109**	**54.5**
Agriculture + Business	43	21.5
Total	**200**	**100**

Source -Field survey

Table 6. Size of the family

Size of the Family	Frequency	Percentage
2 members	8	4.0
3- 5 members	**111**	**55.5**
Above 5 members	81	40.5
Total	**200**	**100**

Source -Field survey

3.6 Family Size of the Farmers

According to the survey, 55.5 percent of farmers' family size were between 3 to 5 members, around 40.5 percent of farmers' family size was above 5 members and only 4 percent of farmers' family size was only 2 members (Table 6). In a similar study, Lin and Ming also found that farmers' gender and the number of family farmers are the important factors influencing farmers' purchase of organic fertilizer (Lin and Ming, 2020).

3.7 Land Holding Size of Farmers

The result revealed that the majority, 49.0 percent, of farmers in Banaskantha district have land holdings below 5 acres. Out of the total 200 farmers surveyed, 30 percent farmers possess land holdings ranging from 5 to 10 acres, 16.5 percent of farmers have land holdings between 10 to 20 acres, and 4.5 percent of farmers own land holdings above 20 acres. This result is similar to Prasad et al. (2017).

3.8 Major Growing Crop

Table 8 shows that 35.5 percent of farmers had wheat as the main crop in their fields. 27 percent had potato as their main crop, 13.5 percent had mustard, 10.5 percent had amaranthus crop, 8 percent had cumin as their main crop and 5.5 percent of farmers had other crops in their fields.

3.9 Usage of Packaged Organic Fertilizer by Farmers

From the result, it was found that out of 200 farmers, all farmers were using packaged organic fertilizers. It shows that the majority of farmers use organic fertilizer in their fields.

Table 7. Landholding size of farmers

Land Holding	Frequency	Percentage
Below 5 acre	**98**	**49.0**
5 - 10 acre	60	30.0
10 - 20 acre	33	16.5
Above 20 acre	9	4.5
Total	**200**	**100**

Source -Field survey

Table 8. Major growing crop

Name of crop	Frequency	Percentage
Potato	54	27
Mustard	27	13.5
Amaranthus	21	10.5
Wheat	**71**	**35.5**

Name of crop	Frequency	Percentage
Cumin	16	8
Others	11	5.5
Total	**200**	**100**

Source -Field survey

Table 9. Usage of packaged organic fertilizer by farmers

Usage of packaged organic fertilizer by farmers	Frequency	Percentage
Yes	200	100
No	0	0
Total	**200**	**100**

Source -Field survey

3.10 Source for Purchase of Organic Fertilizer

Table 10 revealed that the majority of farmers, 69 percent buy their organic fertilizer from retail outlets which shows more trust in retailers while 15.5 percent buy from cooperative societies. Only 4.5 percent of farmers buy their organic fertilizer from agricultural universities and 11 percent of farmers buy from others like depo or agri-business centers.

3.11 Most Important Factor that Farmers Consider for Buying of Organic Fertilizer

According to Table 11, it was found that farmers primarily consider experience as the most important factor when buying organic fertilizer, as indicated by the highest WAM score of 4.800. It was followed by the recommendation from dealers or distributors, with a WAM score of 4.500, Which shows more trust in dealers or distributors. Price and quality also play significant roles in farmers' buying behaviour processes, with WAM scores of 3.900 and 3.675 respectively. Availability, ease of application, and promotional activities are considered less important factors, as reflected by their lower WAM scores.

3.12 Person Influencing in Buying Decision

Table 12 shows that the majority of farmers (34 %) make their own decisions when buying organic fertilizers, based on their experience. Dealers or distributors influence 29.5 percent of farmers, while advertisements influence 7 percent. Other farmers' opinions matter to 19.5 percent of farmers. Family members and other factors influence 5.5 percent and 4.5 percent of farmers, respectively.

3.13 Preference Level of Organic Fertilizers in Future

According to Table 13, 94.5 percent of farmers would like to purchase organic fertilizers which indicates a high level of interest while only 5.5 percent of farmers stated they will think about purchasing in the future. Findings highlight a positive outlook towards the use of organic fertilizers among farmers.

Table 10. Purchase center of organic fertilizer

Purchase center of organic fertilizer	Frequency	Percentage
Retailers	**138**	**69**
Cooperative society	31	15.5
Agricultural University	9	4.5
Others	22	11
Total	**200**	**100**

Source -Field survey

Table 11. Most Important Factor that Farmers Consider for Buying Organic Fertilizers

Factor	WAM Score	Rank
Past experience	4.800	1
Dealer or distributors recommendation	4.500	2
Price	3.900	3

Factor	WAM Score	Rank
Quality	3.675	4
Availability	3.050	5
It should be easy to apply	2.600	6
Promotional activity	2.255	7

(1- Strongly disagree, 2 - Disagree, 3-Neutral, 4-Agree, 5-Strongly agree)

Table 12. Person influencing in buying decision

Person influencing in buying decision	Frequency	Percentage
Self-decision	**68**	**34**
Family Members	11	5.5
Dealer or Distributors	59	29.5
Advertisements	14	7
Other Farmers	39	19.5
Other	9	4.5
Total	**200**	**100**

Table 13. Preference level of organic fertilizers in future

Preference level of organic fertilizers in future	Frequency	Percentage
Would like to purchase	**189**	**94.5**
Will think about it	**11**	**5.5**
Would not like to purchase	**0**	**0**
Total	**200**	**100**

Table 14. Problems faced by farmers while using organic fertilizers

Problem	WAM Score	Rank
Poor efficiency	2.52	1
Delayed effect	2.42	2
Lack of knowledge	2.2	3
Non-availability of credit	1.825	4
Less product range	1.525	5
Transportation issue	1.385	6
Non-availability	1.285	7
Storage problem	1.16	8

3.14 Problems Faced by Farmers While Using Organic Fertilizers

According to Table 14, it was found that poor efficiency was the most significant issue for farmers using organic fertilizer, with the highest WAM score of 2.52. It was followed by the delay effect, with a WAM score of 2.42. Lack of knowledge was also a major problem faced by farmers. Transportation issues, non-availability, and storage problems are not significant problems for farmers, as indicated by lower WAM scores.

4. CONCLUSION

It can be concluded that the majority of respondents are middle-aged (36-50) and 30 percent age between 51-65. Most farmers (48 %) earn between Rs.1,00,000 – Rs.5,00,000 annually, followed by 22.5 percent earns Rs.5,00,000 – Rs.10,00,000. It was found that the majority of farmers having an education level below SSC implies that education is not a factor that influences the use of organic fertilizer. In terms of occupation, 54.5 percent of farmers are engaged in both agriculture and animal husbandry this implies that farmers keeping animals as their source of income are more likely to use organic fertilizer as their direct availability of animal-based fertilizer. Land holdings are mostly below 5 acres (49 %), and the main crops are wheat (35.5 %) and potato (27 %). Organic fertilizer is primarily purchased from retail outlets (69 %), Which shows more trust in dealers or distributors with experience being the most important factor influencing purchases (WAM score 4.800), followed by dealer

recommendations (WAM score 4.500). A significant 94.5 percent of farmers express a strong interest in purchasing organic fertilizers, while 5.5 percent are considering future purchases. Challenges include poor efficiency and delay effects of organic fertilizers, along with a notable lack of knowledge on their effective use. These findings reflect a positive attitude towards organic fertilizers but highlight the need for improved efficiency and education on their usage among farmers.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

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ETHICAL APPROVAL

This study utilized survey methods, involving interviews with farmers to gather information about their socioeconomic and farming activities. As with all socioeconomic surveys or data collection involving family or community representatives, the Institutional Research Ethics Committee (IREC) of the International Maize and Wheat Improvement Center (CIMMYT) classified the study as low-risk and approved it. All research methods were conducted in accordance with the guidelines and regulations established by CIMMYT's Institutional Research Ethics Committee (IREC).

CONSENT

Each questionnaire used in this study included a front-page section requiring informed consent before proceeding with the interview. Participants were informed that they were not obligated to answer any questions, could stop the interview at any time without providing a reason, and could request the removal of any partially recorded data. This approach ensured compliance with CIMMYT-IREC policies and the standard practices typically applied in low-risk social science research.

COMPETING INTERESTS

Authors have declared that they have no known competing financial interests OR non-financial interests OR personal relationships that could have appeared to influence the work reported in this paper.

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