

ASSESSMENT OF KNOWLEDGE OF FARMERS REGARDING BANANA WASTE MANAGEMENT PRACTICES

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ABSTRACT

Banana (Musa spp.) cultivation generates a substantial quantity of biomass waste, creating significant environmental and management challenges, particularly in India, the world's largest banana-producing country. The present study assessed the knowledge level of banana farmers regarding scientifically recommended banana waste management practices in Vadodara district of Gujarat. An ex-post facto research design was employed, and 120 banana growers were selected through simple random sampling from three talukas and twelve villages. The findings revealed that two-thirds (63%) of the respondents possessed medium to low level of knowledge regarding banana waste management practices. It is indicated that economic motivation, annual income, innovativeness, education, and material possession were positively and significantly associated with the knowledge level of the respondents. The study further highlighted major gaps in extension support and capacity-building initiatives, as none of the respondents had received formal training on banana waste management and 97.50 per cent reported negligible participation in extension activities related to banana waste management. Furthermore, knowledge regarding advanced waste utilization technologies, such as fibre extraction, biochar production, and preparation of organic inputs, was found to be inadequate among the respondents. The findings emphasize the need for targeted extension programmes, training interventions, and awareness campaigns to enhance farmers' knowledge and promote sustainable banana waste management practices.

Keywords: banana waste management, extension participation, economic motivation, sustainable development

INTRODUCTION

Agriculture generates enormous quantities of crop residues and biomass waste every year, making agricultural waste management a critical issue for environmental sustainability and agricultural development. According to FAO (2019), food and agricultural systems generate approximately 1.3 billion tons of food loss and waste annually worldwide. Improper disposal of agricultural residues often results in environmental pollution, greenhouse gas emissions, nutrient losses, and wastage of valuable biological resources. Consequently, sustainable management and utilization of agricultural waste have become important components of climate-smart and circular agricultural systems. Banana (*Musa spp.*) is one of the most important fruit crops in the world and occupies a prominent position in global food security and agricultural economies. Global banana production is estimated at about 135 million metric tons annually, cultivated in more than 130 countries (FAO, 2023). However, banana cultivation generates a substantial quantity of biomass waste because the plant bears fruit only once during its life cycle. Alzate *et al.* (2025) estimated that

banana cultivation generates approximately 114.08 million metric tons of biomass waste annually worldwide. For every ton of banana fruit harvested, nearly four tons of biomass residues are produced in the form of pseudostems, leaves, peels, and stalks.

Several studies have highlighted the immense potential of banana waste for value addition and sustainable utilization. Banana residues can be used for fibre extraction, paper production, composting, vermicomposting, biochar production, biogas generation, animal feed preparation, wastewater treatment, and the manufacture of various eco-friendly products (Comath and George, 2025; Mallappa *et al.*, 2023; Vegad *et al.*, 2021; Pratik and Vinaya, 2022). Majumdar and Jagadale (2023) reported that banana pseudostem is rich in cellulose, hemicellulose, and lignin, making it a valuable source of natural fibre for industrial applications. Effective utilization of banana waste can contribute to environmental conservation, resource recycling, additional farm income, and sustainable rural development. India is the largest producer of bananas in the world, contributing nearly 27.8 per cent of global production, with an annual output of about

37.47 million metric tons from approximately 0.96 million hectares (Kumari, 2022). Gujarat is one of the leading banana-producing states and records among the highest productivity levels in the country. The large-scale cultivation of banana in Gujarat results in the generation of substantial quantities of biomass waste every year. Despite the availability of technologies and institutional initiatives promoting banana waste utilization, the adoption of scientific waste management practices remains limited at the farm level.

Knowledge is a fundamental prerequisite for the adoption of improved agricultural practices. Farmers with adequate knowledge are more likely to understand the benefits, economic viability, and environmental significance of recommended technologies. Studies have shown that education, information access, and awareness significantly influence farmers' adoption behaviour and willingness to engage in sustainable waste management practices (Atinkut *et al.*, 2020; Li *et al.*, 2024). However, inadequate knowledge and limited awareness often act as major constraints in the adoption of innovative agricultural practices. Although several technological advancements and policy initiatives have been introduced for agricultural waste management, empirical information regarding farmers' knowledge of banana waste management practices remains limited. Assessing farmers' knowledge is essential to identify areas where they require further information, training, and technical support regarding recommended banana waste management practices. Such an assessment can facilitate the development of need-based extension programmes, capacity-building initiatives, and policy interventions aimed at promoting the sustainable utilization of banana waste. Furthermore, understanding the existing level of knowledge among farmers can help identify knowledge gaps and provide valuable inputs for designing effective educational and extension strategies. In view of the above considerations, there is a need to systematically assess the knowledge of banana farmers regarding banana waste management practices. Therefore, the present study entitled "Assessment of Knowledge of Banana Farmers Regarding Banana Waste Management Practices" was undertaken to evaluate the existing knowledge level of banana growers and provide a basis for future extension, research, and developmental efforts in the field of sustainable banana waste management.

OBJECTIVES

- (1) To study the profile of farmers
- (2) To find out the knowledge level of farmers towards banana waste management practices
- (3) To ascertain the relationship between profile of the

farmers and their knowledge level about banana waste management practices

METHODOLOGY

The study was conducted in Vadodara district of Gujarat, which was selected purposively. Three talukas, namely Vadodara, Shinor, and Savli, were selected for the study. From each taluka, four villages were selected randomly, resulting in a total of twelve villages. Further, ten banana farmers were selected randomly from each selected village, constituting a total sample of 120 respondents. The required data were collected through personal interviews using a pre-tested and structured interview schedule. The collected data were coded, tabulated, analyzed, and interpreted using appropriate statistical tools such as frequency, percentage, mean score, and rank.

RESULTS AND DISCUSSION

Profile of banana farmers

Table 1 presents the socio-economic and psychological profile of the respondents. The findings indicate that a majority of the respondents (53.33%) belonged to the middle age group (36–50 years), followed by 27.50 per cent in the old age group and 19.17 per cent in the young age group. Regarding education, 43.33 per cent had completed higher secondary education, while 26.67 per cent were graduates and above. Most respondents (60.83%) belonged to medium-sized families comprising 5–8 members (Warshini *et al.*, 2023). More than half of the respondents (51.67%) maintained up to three animals. In terms of landholding, 38.33 per cent possessed medium landholdings (4.01–10.00 ha), followed by 24.17 per cent with large landholdings.

The annual income distribution revealed that 35.84 per cent of respondents earned more than ₹4,00,000 annually, indicating a relatively sound economic status. With respect to irrigation, tube well/borewell was the predominant source (43.33%), followed by open wells (31.67%). A substantial majority (68.33%) adopted drip irrigation, reflecting the increasing use of efficient irrigation technologies (Nagar and Kumar, 2024; Deshmukh *et al.*, 2022).

The results further showed that 81.67 per cent of respondents had very low extension participation, while 39.17 per cent and 35.83 per cent exhibited very low and low digital media exposure, respectively (Barme *et al.*, 2022; Gamit and Vinaya, 2022). Concerning psychological characteristics, the majority of respondents belonged to the medium category of economic motivation (56.67%), innovativeness (60.00%), and scientific orientation (45.84%). Additionally, 32.50 per cent had a high level of scientific orientation. Overall,

Table 1 indicates that the respondents were predominantly middle-aged, educated, economically stable, and progressive in irrigation practices, although their extension participation and digital media exposure remained comparatively low. Their medium levels of economic motivation, innovativeness, and scientific orientation suggest a favorable potential for

the adoption of improved agricultural technologies and practices. These findings point to a deep structural deficit in information and learning infrastructure in the study area, a pattern consistent with global evidence that weak extension services are among the most persistent barriers to sustainable practice adoption in developing country agriculture.

Table 1: Classification of farmers according to their profile

(n=120)

Sr. No.	Particulars	Categories	Frequency	Per cent
1	Age	Young group (up to 35 years)	23	19.17
		Middle group (between 36 to 50 years)	64	53.33
		Old group (above 50 years)	33	27.50
2	Education	Illiterate	04	03.33
		Primary education (1 st to 8 th std)	03	02.50
		Secondary education (9 th and 10 th std)	29	24.17
		Higher secondary education (11 th and 12 th std)	52	43.33
		Graduation and above	32	26.67
3	Family size	Up to 4 members	26	21.67
		5 to 8 members	73	60.83
		More than 8 members	21	17.50
4	Herd size	Up to 3 animals	62	51.67
		4 to 6 animals	32	26.66
		Above 6 animals	26	21.67
5	Land holding	Marginal (up to 1.00 ha)	05	04.17
		Small (1.01 to 2.00 ha)	15	12.50
		Semi medium (2.01 to 4.00 ha)	25	20.83
		Medium (4.01 to 10.00 ha)	46	38.33
		Large (above 10.00 ha)	29	24.17
6	Annual income	Up to ₹ 1,00,000/-	7	05.84
		₹ 1,00,001/- to ₹ 2,00,000/-	13	10.83
		₹ 2,00,001/- to ₹ 3,00,000/-	25	20.83
		₹ 3,00,001/- to ₹ 4,00,000/-	32	26.67
		Above ₹ 4,00,000/-	43	35.84
7	Source of irrigation	Tube well / Borewell	52	43.33
		Open well	38	31.67
		Canal irrigation	11	09.17
		Lake / Pond	10	08.33
		River	9	07.50
8	Method of irrigation	Surface irrigation	18	15.00
		Sprinkler irrigation	20	16.67
		Drip irrigation	82	68.33
9	Extension participation	Very low (Up to 04.80)	98	81.67
		Low (04.81 to 09.60)	19	15.83
		Medium (09.61 to 14.40)	03	02.50
		High (14.41 to 19.20)	00	00.00
		Very high (Above 19.20)	00	00.00
10	Digital media exposure	Very low (up to 03.00 score)	47	39.17
		Low (03.01 to 06.00 score)	43	35.83
		Medium (06.01 to 09.00 score)	21	17.50
		High (09.01 to 12.00 score)	09	07.50
		Very high (above 12.00 score)	00	00.00

Sr. No.	Particulars	Categories	Frequency	Per cent
11	Economic motivation	Very low (06.00 to 10.80 score)	00	00.00
		Low (10.81 to 15.60 score)	27	22.50
		Medium (15.61 to 20.40 score)	68	56.67
		High (20.41 to 25.20 score)	22	18.33
		Very High (25.21 to 30.00 score)	03	02.50
12	Innovativeness	Very low (06.00 to 10.80 score)	03	02.50
		Low (10.81 to 15.60 score)	14	11.67
		Medium (15.61 to 20.40 score)	72	60.00
		High (20.41 to 25.20 score)	20	16.67
		Very high (25.21 to 30.00 score)	11	09.17
13	Scientific orientation	Very low (14.00 to 25.20 score)	07	05.83
		Low (25.21 to 36.40 score)	13	10.83
		Medium (36.41 to 47.60 score)	55	45.84
		High (47.61 to 58.80 score)	39	32.50
		Very High (58.81 to 70.00 score)	06	05.00

Knowledge of farmers regarding banana waste management practices

The data revealed in Table 2 that the largest proportion of respondents (36.67%) possessed a low level of knowledge regarding banana waste management practices, followed by 26.67 per cent with a medium level of knowledge. Further, 18.33 per cent of the respondents were categorized under the very low knowledge group, whereas only 11.67 per cent and 6.67 per cent exhibited high and very high levels of knowledge, respectively. Thus, a majority of the respondents (55.00%) belonged to the low and very low knowledge categories, indicating inadequate awareness and understanding of recommended banana waste management practices. The observed low level of knowledge among the respondents may be attributed to their limited exposure to extension and information sources. The profile characteristics showed that a majority of the respondents had very low extension participation (81.67%) and low to very low digital media exposure (75.00%), which might have restricted their access to information related to improved waste management technologies. In addition, the lack of organized training programmes and technical guidance on banana waste utilization could have further contributed to the knowledge gap. Consequently, farmers may not be fully aware of the economic and environmental benefits associated with scientific banana waste management practices.

The findings emphasize the need for strengthening extension services, conducting regular training programmes, demonstrations, and awareness campaigns to enhance farmers' knowledge and adoption of sustainable banana waste management technologies. The present findings are in conformity with those reported by Okonta et al. (2023); Bansal and Parmar (2025); Parvadiya et al. (2025); Mallappa et al. (2023); Vegad et al. (2021); Pratik and Vinaya (2022).

Table 2: Distribution of the farmers according to their knowledge level regarding banana waste management practices (n=120)

Sr. No.	Categories	Frequency	Per cent
1	Very low (0.00 to 20.00 per cent score)	22	18.32
2	Low (21.00 to 40.00 per cent score)	44	36.67
3	Medium (41.00 to 60.00 per cent score)	32	26.67
4	High (61.00 to 80.00 per cent score)	14	11.67
5	Very high (81.00 to 100.00 per cent score)	08	06.67

Association between farmers' profile characteristics and knowledge level

The correlation analysis revealed that education ($r = 0.328^{**}$), digital media exposure ($r = 0.248^{**}$), economic motivation ($r = 0.261^{**}$), and innovativeness ($r = 0.274^{**}$) had positive and highly significant relationships with the knowledge level of banana farmers regarding banana waste management practices. The positive influence of education may be attributed to the ability of educated farmers to understand, interpret, and utilize technical information obtained from various sources. This finding agrees with the results reported by Nagar and Kumar, 2024.

Table 3: Correlation analysis of characteristics of the farmers with their knowledge level regarding banana waste management practices

(n=120)

Sr. No.	Characteristics	Correlation coefficient ('r' value)
X ₁	Age	-0.076
X ₂	Education	0.328**
X ₃	Size of family	0.021
X ₄	Herd size	0.126
X ₅	Size of landholding	0.168
X ₆	Annual income	0.198*
X ₇	Irrigation facility	0.152
X ₈	Extension participation	0.187*
X ₉	Digital media exposure	0.248**
X ₁₀	Economic motivation	0.261**
X ₁₁	Innovativeness	0.274**
X ₁₂	Scientific orientation	0.231*
X ₁₃	Risk orientation	0.148

* Significant at 5% level of probability, ** significant at 1% level of probability

Similarly, farmers with greater digital media exposure had better access to agricultural information through smartphones, social media platforms, online videos, and advisory services, which enhanced their knowledge levels. This finding corroborates the observations of Everest (2021) and Abedin and Bose (2023). Economic motivation and innovativeness also exhibited highly significant positive relationships with knowledge. Economically motivated farmers actively seek information that can enhance farm profitability, while innovative farmers are more inclined to explore and adopt new ideas and technologies. These findings are in conformity with Huang and Fu (2023), Okonta *et al.* (2023), Abedin and Bose (2023), and Kumar (2025). Extension participation ($r = 0.187^*$) and scientific orientation ($r = 0.231^*$) were positively and significantly associated with knowledge, indicating that interaction with extension personnel and a scientific outlook facilitate the acquisition of improved information. Annual income ($r = 0.198^*$) also showed a significant positive relationship with knowledge, which is in line with the findings of Poonam and Jhariya (2019), Yadav *et al.* (2022) and Deshmukh *et al.* (2022).

In contrast, age ($r = -0.076$) exhibited a negative and non-significant relationship with knowledge, suggesting that age alone does not determine knowledge acquisition. Similar results were reported by Okonta *et al.* (2023). Family size, herd size, landholding, irrigation facility, material possession, and risk orientation showed positive but non-

significant relationships with knowledge, indicating that these variables have limited direct influence on knowledge levels. The findings are supported by Warshini *et al.* (2023), Deshmukh *et al.* (2022), Ahirel *et al.* (2021) and Kumar (2025). Training received could not be analyzed because none of the respondents had undergone formal training on banana waste management practices. Overall, the results highlight that educational, informational, and psychological characteristics are more important determinants of farmers' knowledge than physical and structural farm characteristics.

CONCLUSION

The present study assessed the profile characteristics, knowledge level, and their association regarding banana waste management practices among farmers. The results revealed that most of the respondents belonged to the middle age group, were moderately educated (higher secondary level), had medium-sized families and possessed medium to large landholdings with relatively higher annual income. A majority of farmers practiced drip irrigation and had low extension participation and low digital media exposure. Psychological traits such as economic motivation, innovativeness and scientific orientation were mostly at a medium level. Regarding knowledge level, majority of farmers possessed low to medium knowledge of banana waste management practices, indicating inadequate awareness of scientific methods for waste utilization. Only few farmers exhibited high to very high levels of knowledge.

The correlation analysis indicated that education, annual income, extension participation, digital media exposure, economic motivation, innovativeness, and scientific orientation had positive and significant to highly significant relationships with knowledge level. In contrast, age, family size, herd size, landholding, irrigation facility, material possession and risk orientation showed non-significant relationships with knowledge. Training exposure was absent among all respondents, reflecting a major gap in institutional support. It may be concluded that farmers' knowledge is mainly influenced by human, informational and psychological factors rather than structural farm assets. Therefore, strengthening extension systems, promoting digital literacy, ensuring regular training programmes and enhancing farmers' scientific orientation and innovativeness are essential to improve knowledge and encourage effective adoption of banana waste management practices for sustainable agricultural development.

RECOMMENDATIONS

The study suggests strengthening extension services through regular field visits, demonstrations, and farmer-

scientist interactions to improve farmers' knowledge on banana waste management. As none of the respondents had received formal training, organized training programmes by KVKs and agricultural institutions are essential. Greater emphasis should be given to digital extension platforms such as mobile apps, WhatsApp groups, and YouTube channels to enhance information access. Efforts should also focus on improving education, innovativeness, scientific orientation, and economic motivation among farmers. The findings imply that knowledge-oriented interventions are more effective than resource-based approaches for promoting sustainable banana waste management practices.

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CONFLICT OF INTEREST

There is no conflict of interest among the authors regarding this study

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