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Farmers' knowledge on soil health management practices: A case of sugarcane growers in Kolhapur District, Maharashtra

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Abstract

The study assessed the knowledge of sugarcane growers regarding Soil Health Management (SHM) practices in Kolhapur district of Maharashtra. A sample of 150 farmers was randomly selected from Karveer, Hatkanangle, and Shirol tehsils using an ex-post facto design. Results revealed that 51.33% of respondents had a medium level of knowledge, 38.67% had low knowledge, and only 10% had high knowledge of SHM. Farmers lacked awareness in key technical areas such as soil testing, interpretation of soil health cards, use of bio-fertilizers, and balanced nutrient application. The study recommends strengthening extension services, providing practical training, and improving access to soil testing facilities to bridge the knowledge gap. Enhancing scientific understanding of SHM is essential for sustainable sugarcane production and long-term soil fertility.

Keywords: Soil health management, sugarcane growers, knowledge level, sustainable agriculture, farmer training

Introduction

Soil health forms the foundation of sustainable agriculture, influencing crop productivity, nutrient cycling, and environmental resilience (FAO, 2017; Verma & Singh, 2023) [4, 9]. Sugarcane, being a long-duration and nutrient-intensive crop, requires careful soil management. However, continuous monocropping, excessive chemical fertilizer use, and poor conservation practices have degraded soils in many regions (Kumbhar & Chavan, 2024) [6].

Agriculture faces considerable challenges from increasing soil health issues such as multi-nutrient deficits, inadequate and imbalanced nutrient utilization and production stagnation. Other challenges include the availability of essential inputs at acceptable rates, farmer's reluctance to prepare and apply organic inputs, soil nutrient depletion and soil physical and biological deterioration. Moreover, cereal-based mono-cropping systems (such as rice-wheat in the north and rice-rice in the south and east), poor water management resulting in secondary salinization in canal command areas, groundwater depletion due to over-exploitation and insufficient recharge in tube well-irrigated areas and the effects of climate change on agriculture are significant constraints. Poor extension services compound these issues, affecting agriculture sustainability.

Farmer awareness of SHM practices such as soil testing, organic manure application, bio-fertilizer use, integrated nutrient management (INM), and soil conservation is crucial for adoption. Yet, inadequate knowledge has restricted sustainable practices, resulting in nutrient imbalances, low organic matter, and declining productivity (Dhivya *et al*., 2021) [3]. This study therefore aimed to assess sugarcane growers' knowledge of SHM practices and analyze the relationship between their profiles and knowledge levels.

Objectives

1. To study sugarcane growers' knowledge of SHM practices.
2. To examine the relationship between farmers' profiles and their knowledge level.

Methodology

The study was carried out in Kolhapur district, Maharashtra, a leading sugarcane-growing region. Three tehsils—Karveer, Hatkanangle, and Shirol—were purposively selected. A sample of 150 sugarcane growers was chosen using random sampling (10 farmers from each selected village).

A structured schedule with 43 knowledge statements, validated by subject matter experts, was used to assess farmers' knowledge. Knowledge was measured in three categories: complete, partial, and no knowledge. Seven thematic areas were assessed: soil testing, soil properties, organic manures and green manuring, bio-fertilizers, integrated nutrient management, soil conservation and

moisture management, and causes of soil degradation.

Results and Discussion

1. Overall Knowledge of SHM Practices

Knowledge of Soil Health Management (SHM) practices enables farmers to make informed decisions regarding the adoption of appropriate methods for soil conservation, fertility enhancement, and sustainable nutrient use.

Table 1: Classification of respondents according to their overall knowledge of Soil Health Management practices.

Sr. No.	Category	Knowledge score	Frequency (N=150)	Percentage (%)
1.	Low	Up to 30	58	38.67
2.	Medium	31 to 41	77	51.33
3.	High	42 and above	15	10.00
Total			150	100.00
Range= 19 Min = 11 Max = 68				

It is revealed that, the (51.33%) of respondents belonged to the medium knowledge category, about 38.67 per cent were in the low knowledge category, suggesting that a substantial proportion of farmers lacked adequate understanding of soil health principles. This indicates that most farmers had only a moderate understanding of SHM, while very few had advanced knowledge. The findings highlight the need for capacity-building and targeted training.

2. Specific Knowledge of SHM Practices

The practice wise knowledge of sugarcane growers regarding Soil Health Management (SHM) practices is presented in Table No. 2.

- **Soil Testing:** Weak awareness. 68% had partial knowledge of its importance, but 74% did not know how to use Soil Health Card (SHC) reports. Only 12% realized soil testing could reduce cultivation costs.
- **Soil Properties:** Mixed knowledge. While 64% knew about soil-crop suitability, only 16% understood organic carbon levels and 58% lacked awareness of micronutrient needs.
- **Organic Manures and Green Manuring:** Better knowledge. 64% knew about press-mud and vermicompost; 56.67% recognized green manuring's role in nitrogen fixation. However, only 25% understood correct incorporation timing.
- **Bio-fertilizers:** Poor awareness. Only 9.33% had full knowledge of bio-fertilizers, while 82% were unfamiliar with potash-mobilizing bacteria.
- **Integrated Nutrient Management (INM):** Moderate awareness. 40.67% knew about integrated use of inputs, but only 6% had knowledge of balanced fertilization.
- **Soil Conservation & Moisture Management:** Relatively better awareness. About 63% recognized contour bunding, and 51% understood trash mulching. However, knowledge about drip irrigation and pest resistance remained low.
- **Soil Degradation Causes:** About 50% acknowledged chemical fertilizers as harmful, and 52.67% recognized deforestation as a cause. However, awareness about straw burning (18% complete knowledge) and poor drainage (20%) was limited.

Overall**,** farmers had relatively better knowledge of organic manures, green manuring and soil conservation, but their understanding of soil testing, bio-fertilizers and INM remained poor. The predominance of partial and no knowledge responses across key technical aspects reflects significant gaps that could limit adoption of sustainable SHM practices. Focused training, field demonstrations and extension support are therefore essential to strengthen farmer knowledge and ensure long-term soil health and productivity.

Table 2: Classification of respondents according to their specific knowledge of soil health management practices.

Sr. No.	Knowledge Statement	Complete	Partial	No
A) Knowledge regarding Soil Testing				
1	Soil testing helps to determine soil nutrient status before sugarcane planting.	27 (18.00)	102(68.00)	21 (14.00)
2	Soil testing should ideally be done once every 2-3 years.	18 (12.00)	48 (32.00)	84 (56.00)
3	Suitable time for soil testing is before Cultivation.	12 (08.00)	54 (36.00)	84 (56.00)
4	For soil sampling knowledge regarding Proper depth, weight and moisture condition are important.	12 (08.00)	06 (04.00)	132(88.00)
5	Recognising pH and EC as essential indicators of soil health and fertility.	09 (06.00)	06 (04.00)	135(90.00)
6	Soil Health Card (SHC) reports helps to decide fertilizer doses.	21 (14.00)	18 (12.00)	111(74.00)
7	Awareness about the availability of local soil testing laboratories or mobile testing units.	18 (12.00)	57 (38.00)	75 (50.00)
8	Soil testing helps to reduce expenditure on crop production.	18 (12.00)	15 (10.00)	117(78.00)
9	Soil testing helps to decide crop selections as per soil suitability.	15 (10.00)	06 (04.00)	129(86.00)
B) Knowledge regarding Soil Properties				
10	Knowledge of the soil's pH status and salinity/sodicity levels.	70 (46.67)	62 (41.33)	18 (12.00)
11	Knowledge of the organic carbon content required for healthy soil (>0.5%).	24 (16.00)	48 (32.00)	78 (52.00)
12	Awareness about the fertility status of the field soil.	84 (56.00)	54 (36.00)	12 (08.00)
13	Major and micronutrients required for sugarcane.	18 (12.00)	45 (30.00)	87 (58.00)
14	The moisture retention capacity of soil.	24 (16.00)	12 (08.00)	114(76.00)
15	Crops suitable for soil type.	96 (64.00)	36 (24.00)	18 (12.00)
C) Knowledge regarding Organic Manures and Green Manuring				
16	FYM and compost improve soil fertility and structure.	81 (54.00)	36 (24.00)	33 (22.00)
17	Press-mud and vermin-compost are good organic nutrient sources.	96 (64.00)	48 (32.00)	06 (04.00)
18	Green manuring crops like *dhaincha* or sun hemp are beneficial to improve soil fertility and structure.	63 (42.00)	54 (36.00)	33 (22.00)

19	Green manure should be incorporated at flowering stage.	58 (38.67)	38 (25.33)	54 (36.00)
20	Green manuring improves nitrogen content and reduces soil erosion.	85 (56.67)	34 (22.67)	31 (20.67)
D) Knowledge regarding Bio-fertilizers				
21	Bio-fertilizers like *Azotobacter, Azospirillum* and PSB are used for better crop growth.	14 (09.33)	57 (38.00)	79 (52.67)
22	Potash-mobilizing bacteria help in potassium availability.	15 (10.00)	12 (08.00)	123(82.00)
23	Bio-fertilizers should be mixed with FYM before field application.	13 (08.67)	48 (32.00)	89 (59.33)
E) Knowledge regarding Integrated Nutrient Management (INM)				
24	Balanced fertilization with N, P, K and micronutrients is essential for Integrated Nutrient Management (INM)	09 (06.00)	65 (43.33)	76 (50.67)
25	Excessive use of urea can make soil acidic.	75 (50.00)	33 (22.00)	42 (28.00)
26	Integrated use of organic, inorganic and bio-inputs is sustainable.	61 (40.67)	54 (36.00)	35 (23.33)
27	Micronutrients like Zinc, Iron, Boron and Sulphur are important for crop growth.	29 (19.33)	58 (38.67)	63 (42.00)
F) Knowledge regarding Soil Conservation and Moisture Management				
28	Trash mulching retains moisture and improves organic matter.	77 (51.33)	55 (36.67)	18 (12.00)
29	*In-situ* trash mulching increases organic carbon content of the soil.	18 (12.00)	39 (26.00)	93 (62.00)
30	Contour farming, *bunding* and cover crops prevent soil erosion.	95 (63.33)	43 (28.67)	12 (08.00)
31	Mulching and proper irrigation reduce leaching and improve soil health.	16 (10.67)	44 (29.33)	90 (60.00)
32	Drip irrigation minimizes nutrient loss and conserves soil moisture.	67 (44.67)	43 (28.67)	40 (26.67)
33	Healthy soil improves pest/disease resistance.	51 (34.00)	63 (42.00)	36 (24.00)
34	Adopting SHM reduces chemical fertilizer dependence.	27 (18.00)	48 (32.00)	75 (50.00)
35	Regular soil health management (SHM) practices reduce cultivation costs in the long- run.	12 (08.00)	54 (36.00)	84 (56.00)
G) Knowledge regarding Soil Degradation Causes				
36	Use of excessive chemical fertilizers degrades the soil.	75 (50.00)	57 (38.00)	18 (12.00)
37	Non-judicious pesticide use affects soil and environment.	45 (30.00)	30 (20.00)	75 (50.00)
38	Poor drainage and faulty irrigation harm soil structure.	30 (20.00)	84 (56.00)	36 (24.00)
39	Straw burning destroys soil organic carbon and microbes.	27 (18.00)	66 (44.00)	57 (38.00)
40	Continuous mono- cropping and lack of legumes affect soil fertility.	60 (40.00)	53 (35.33)	37 (24.67)
41	Improper land levelling and heavy tillage expose soil carbon.	39 (26.00)	84 (56.00)	27 (18.00)
42	Untreated sewage/industrial effluents can degrade soil health.	77 (51.33)	36 (24.00)	37 (24.67)
43	Deforestation and soil erosion reduce soil productivity.	79 (52.67)	56 (37.33)	15 (10.00)

(Parentheses indicates percentage)

Relationship between farmers profile with knowledge level of Soil Health Management Practices

To determine the relationship between independent and dependent variables, the Karl Pearson's correlation coefficient (r), was calculated.

Table 3: Correlation between the knowledge of Soil Health Management (SHM) practices and selected independent variables.

Sr. No	Independent Variables	Correlation Coefficients (r)
1	Age	0.129 NS
2	Education	0.224*
3	Farming Experience	0.192*
4	Occupation	0.139 NS
5	Annual income	0.207*
6	Size of land holding	0.195*
7	Soil type	0.125 NS
8	Cropping pattern	0.249**
9	Cropping intensity	0.168*
10	Mass Media utilization	0.252**
11	Information Seeking behaviour	0.293**
12	Social participation	0.136 NS
13	Innovativeness	0.246**

* = Significant at 0.05 level, ** = Significant at 0.01 level and NS = Non-significant

The findings from the present study indicated that, the independent variables such as education, farming experience, annual income, size of land holding, cropping pattern, cropping intensity, mass media utilization, information seeking behaviour and innovativeness were positively and significantly associated with the adoption of soil health management (SHM) practices. Notably, cropping pattern, mass media utilization, information seeking behaviour and innovativeness demonstrated a highly significant relationship, highlighting their strong impact on the adoption process. Conversely, variables including age, occupation, soil type and social participation showed a positive but statistically non-significant association with SHM adoption.

Conclusion

The study found that sugarcane growers had only a moderate awareness of Soil Health Management (SHM) practices. Farmers showed better understanding of soil conservation, organic manures, green manuring, and soil degradation, but lacked knowledge in crucial areas like soil testing, bio-fertilizers, and integrated nutrient management. This knowledge gap may hinder adoption of sustainable practices, affecting soil fertility, productivity, and environmental sustainability in the long run. To address this, farmer-centric training, practical demonstrations, and stronger extension support are essential. Improving access to soil testing, promoting bio-fertilizers, and educating farmers on balanced fertilization will help bridge the gap. Collaborative efforts by research institutions, extension agencies, and farmer groups are vital to enhance knowledge, ensure sustainable sugarcane production, and maintain soil health for long-term agricultural sustainability.

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