J. Farm Sci., 38(1): (72-78) 2025

RESEARCH PAPER

Constraints and suggestions of sugarcane growers in crop residue management

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(Received: November, 2023 ; Accepted: March, 2025)

DOI: doi.org/10.61475/JFS.2025.v38i1.15

Abstract: Crop residues are the materials that are left in the agriculture field after the crop has been harvested. A hectare of sugarcane typically produces ten tonnes of residue. Traditionally, the residue is burnt *in-situ*, this practice results in nutrient loss, organic carbon depletion, and greenhouse gas emissions. Experts have recommended various methods of sugarcane residue management such as bedding materials for animals, livestock feed, soil mulch, bio manure and compost production *etc*. The present study was conducted in Belagavi and Bagalkot districts of Karnataka during 2022-23 by employing *Ex-post facto* research design and simple random sampling technique constituting a total sample size of 120 farmers. The sugarcane growers indicated more of non-technical constraints than technical constraints. Majority (65.83%) of them expressed pest management hurdle because biomass provides media to insects-pest, followed by, slow decomposition process of crop residue at field (64.16%) and high cost of machinery used in management practices (62.50%) were the major non-technical constraints. Majority (62.50%) of them suggested that providing training and education to farmers on effective pest management strategies specific to biomass, followed by creating awareness among sugarcane growers about quick residue decomposition methods (60.83%) were the major suggestions. Sugar factories can also play very significant role by helping the farmers in residue management by providing them with facilities for the proper disposal and utilization of sugarcane residues. Further, research trials can be designed to investigate the potential ex-situ residue management practices such as bioenergy production, livestock feed, biochar production techniques that offer a range of opportunities to maximize the utilization of crop residues, reduce environmental impacts, and contribute to sustainable agricultural practices.

Key words: Crop residue management, Non-technical constraints, Sugarcane, Suggestions, Technical

Introduction

Agriculture contributes around 17-18% to India's overall economy. A wide variety of crops are grown on a large portion of the land in India's many agroecological regions. Sugarcane (*Saccharum officinarum* L.) is the country's most important commercial crop. It is one of the most valuable cash crops. It is extensively planted along the river and canals where irrigation facilities are easily available. India is first in terms of area and second in terms of sugarcane production worldwide with the total area of 51.75 lakh ha and production of 439.89 million tonnes (Anon,2022). Sugarcane is one of the important commercial crops of Karnataka occupying around 6.37 lakh ha of area and production of 61.15 million tonnes. A sizable amount of agricultural residue is left in the field after harvest. The materials that are left in the agriculture field after the harvest of the crop are known as crop residues. The residue includes stalks, leaves, stems, seedpods, *etc*. Every year, 500-550 million tonnes (Mt) of crop residue is produced in India (National Policy on Management of Crop Residue, 2014). It is estimated that Uttar Pradesh stands first in crop residue production with 60 Mt followed by Punjab (51 Mt), and Maharashtra (46 Mt). In Karnataka around 33.94 million tonnes crop residue is generated every year (Anon, 2014).

Around 12 Mt of sugarcane residue is generated annually in India. In order to prepare the field for the next crop, the residue is burnt *in-situ* because it is useless as cattle feed and doesn't decompose easily. The problem of on-farm burning of crop residue is escalating in recent years due to the lack of human labour, removal of crop residue from the field is expensive and mechanised crop harvesting. The environmental consequences of improper residue disposal, the economic barriers to residue utilization, the lack of awareness and technology, and the need for sustainable farming practices have all led to the need for a structured approach. Keeping this in view the present study was taken up with the objective of studying the constraints faced by farmers and seeking their suggestions in crop residue management of sugarcane

Material and methods

The present study was conducted in Belagavi and Bagalkot districts of Karnataka during 2022-23. These districts were purposively selected keeping in view that these districts cover maximum area under sugarcane cultivation in North Karnataka by employing *Ex-post facto* research design and simple random sampling technique constituting a total sample size of 120 farmers. The data was collected by personal interview using the pre-tested schedule.

To know the constraints faced and suggestions regarding sugarcane residue management from the farmer's point of view, a list of constraints and suggestions was prepared after extensive review of literature, consulting scientists and based on experience gained during pre-testing in non-sample area. These constraints are categorized on the basis of operational challenges such as labour shortage, machinery availability and technological limitations that pertains to technical constraints

Table 1. Constraints faced by the sugarcane growers in adoption of sugarcane residue management (n=120)

I	Technical Constraints	F	%	Rank
	Risks associated with new technologies (insurability, performance and rate of return)	48	40.00	I
	Lack of marketable usage of residue persuade farmers to burn the residue	48	40.00	I
	Lack of knowledge about conversion process of residue into usable form	43	35.83	II
	Poor accessibility of crop residue management technologies	42	35.00	III
II	Non-technical constraints			
	Pest management hurdle because biomass provides media to insects-pest	79	65.83	I
	Slow decomposition process of crop residue at field	82	64.16	II
	High cost of machinery used in management practices	75	62.50	III
	Incorporation or collection of field residue is costly	69	57.50	IV
	Transportation of crop residue is laborious and cost intensive	65	54.16	V
	High wages of labour during harvesting season	64	53.33	VI

and non-technical constraints are based on socio-economic, cultural

and policy-related factors influence residue management practices. Further, the sugarcane growers were asked to give their opinion by answer 'Yes' or 'No'. These constraints and suggestions were analysed using frequency and percentage. Based on the previous studies and discussion with experts the profile characteristics *viz*., age, education, family size, annual income, area under sugarcane, experience in sugarcane cultivation, mass media exposure, extension contact, irrigation facility, farm resource base, method of planting, use of organic inputs and environmental awareness were employed in the study. The procedure was developed for measuring planting method, the procedure followed by Nidhi (2021) and Mondol (2020) was used for measuring use of organic inputs and environmental awareness, respectively.

Results and discussion

Constraints faced by sugarcane growers in adoption of sugarcane residue management

The overall analysis of constraints in adoption of sugarcane residue management in Table 1 concluded that less than 40 per cent of the sugarcane growers expressed the problem of risks associated with new technologies (insurability, performance and rate of return), lack of marketable usage of residue persuade farmers to burn the residue, lack of knowledge about conversion process of residue into usable form and poor accessibility of crop residue management technologies were the technical constraints faced by the sugarcane growers

With respect to non-technical constraints majority (65.83%) of sugarcane growers expressed the constraints of pest management hurdle because biomass provides media to insects-pest, followed by, slow decomposition process of crop residue at field (64.16%), high cost of machinery used in management practices (62.50%), incorporation or collection of field residue is costly (57.50%), transportation of crop residue is laborious and cost intensive (54.16%) and high wages of labour during harvesting season (53.33%). As sugarcane is a commercial crop and the farmers are progressive in nature, they were faced with more of non-technical constraints than technical constraint.

The incidence of similar constraints was also reported in the earlier research studies conducted by Kaur (2017), Mondol *et al*. (2020) and Nidhi (2021).

Suggestions expressed by sugarcane growers to enhance the adoption of sugarcane residue management

The delineation of suggestions by sugarcane growers to enhance the adoption of sugarcane residue management shown in Table 2 pointed out that majority (62.50%) of the sugarcane growers suggested that providing training and education to farmers on effective pest management strategies specific to biomass, followed by creating awareness among sugarcane growers about quick residue decomposition methods (60.83%), adequate availability of tractor drawn implements on a custom hire basis at village level (58.33%), 54.17 per cent of the sugarcane growers suggested that advocacy for government initiatives that provide subsidies or financial assistance for transportation of crop residue, farmers should be introduced to the knowledge of enhanced crop residue management through practical demonstration (43.33%) and sugar factories can assist farmers in adopting effective residue management practices (37.50%). These suggestions were given by majority of the sugarcane growers to overcome the problems.

Table 2. Suggestions expressed by sugarcane growers to enhance the adoption of crop residue management (n=120)

Suggestions	F	%	Rank
Provide training and education to farmers on effective pest management strategies specific to biomass	75	62.50	I
Creating awareness among sugarcane growers about quick residue decomposition methods.	73	60.83	II
Adequate availability of tractor drawn implements on a custom hire basis at village level	70	58.33	III
Advocacy for government initiatives that provide subsidies or financial assistance for transportation of crop residue	65	54.17	IV
Farmers should be introduced to the knowledge of enhanced crop residue management through practical demonstration	52	43.33	V
Sugar factories can assist farmers in adopting effective residue management practices.	45	37.50	VI

Table 3. Socio-economic characteristics of sugarcane growers

(n=120)

Category	F	%
Age		
Young (18-35 years)	12	10.00
Middle (36-55 years)	64	53.33
Old (above 55 years)	44	36.67
Mean = 48		
Education		
Illiterate	10	8.33
Primary school (1st to 4th std)	14	11.67
Middle school (5th to 7th std)	26	21.67
High school (8th to 10th std)	34	28.33
PUC (11th to 12th std)	23	19.17
Graduation (degree)	11	9.17
Post-graduation	1.67	
Family size		
Small family (<5 members)	31	25.83
Medium family (5-8 members)	77	64.17
Large family (>8 members)	12	10.00
Mean =6		
Annual income		
Low (< ₹ 6,20,797)	48	40.00
Medium (₹ 6,20,797- ₹ 16,06,952)	53	44.17
High (> ₹ 16,06,952)	19	15.83
Mean = 1113875.00	SD = 1160181.77	
Area under sugarcane cultivation		
< 2.5 acres	38	31.67
2.51 to 5.0 acres	30	25.00
5.01 to 10 acres	22	18.33
10.01to 25 acres	14	11.67
Above 25 acres	16	13.33
Mean = 11.20		
Experience in sugarcane cultivation		
Low (< 17)	43	35.83
Medium (17–26)	50	41.67
High (> 26)	27	22.50
Mean = 21.03	SD =10.30	

The similar suggestions were also reported in past research studies conducted by Patel and Vyas (2014) and Memon *et al*. (2021)

Socio-economic characteristics of sugarcane growers

Age

It was evident from the Table 3 that, 53.33 per cent of the sugarcane growers belonged to middle age category, followed by old (36.6%), while only 10.00 per cent of them belonged to young age category.

Typically, farmers in the middle age category exhibit greater enthusiasm and higher levels of work efficiency compared to older and younger ones. Given that agriculture serves as the primary source of income in the designated research area, it is conceivable that middle-aged family members might adopt the parental occupation, especially since the younger generation shows a lack of interest in agricultural activities. Furthermore, individuals between the age group of 36 to 55 tend to shoulder a greater share of familial responsibilities compared to their younger ones. Hence, majority of the sugarcane growers fall under middle age category. This indicate that middle-aged farmers are more receptive to adopting innovative agricultural practices.

The past research studies conducted by Chouhan *et al.* (2013), Shanthy *et al* (2020) and Jagatpal *et al.* (2017) also reported the more distribution of farmers in middle age category.

Education

It was observed from the results that, more than half (58.34%) of the sugarcane growers completed their formal education because high percentage of the sugarcane growers belonged to middle age category and there was gradual progress in the education system, hence the result. The positive correlation between education and the adoption of sustainable agricultural practices suggests that the formal education of sugarcane growers in the region likely contributes to the implementation of effective residue management strategies.

The results are in conformity with findings of Patidar and Patidar (2015).

Family size

The results revealed that majority (64.17%) of the sugarcane growers belonged to medium family size (5-8 members). Division of joint family system in the society was observed in recent years is the reason behind this result. Labor-intensive residue management techniques, such as manual mulching, composting, or shredding, may become burden some for families with fewer members. This can lead to reliance on traditional, less sustainable practices such as burning residues, which are easier but more harmful to the environment.

The past research studies conducted by Jagatpal *et al.* (2017), Tukaram (2019) and Mondal *et al.* (2020) also reported similar results.

Annual income

It was found that 44.17 per cent of the sugarcane growers belonged to medium annual income category because sugarcane is a profitable commercial crop and majority of the sugarcane growers were progressive, hence the result. In general, farmers who possessed large land holdings and engaged in subsidiary occupation were able to generate higher earnings compared to others. The limited access to affordable technology can thus hinder the adoption of efficient residue management practices, even for those with moderate income. This is particularly relevant for those in the medium income group, where while the income is sufficient for daily operations, significant capital expenditure might still be challenging without external support.

The results are in conformity with the findings of Chouhan *et al*. (2013) and Jagatpal *et al.* (2017).

Area under sugarcane cultivation

It was depicted that 31.67 per cent of the sugarcane growers had less than 2.5 acre of area under sugarcane cultivation because of the fragmentation of joint families the land holdings were also divided. Marginal and small land holding might be the reason for their lesser area under sugarcane cultivation.

Table 4. Mass media exposure of sugarcane growers (n=120)

Mass Media	Subscribed/ Possessed f(%)	Programmes/ Articles	Extent of Participation			Index	Rank
			Regularly	Occasionally f (%)	Never		
Radio	13(10.83)	Agriculture	1(0.83)	13(10.83)	106(88.33)	8.75	V
		News	11(9.17)	14(11.67)	95(79.17)		
		Entertainment	1(0.83)	10(8.33)	109(90.83)		
Television	119(99.17)	Agriculture	18(15.00)	75(62.50)	27(22.5)	66.81	I
		News	68(56.70)	50(41.67)	2(1.67)		
		Entertainment	66(55.00)	52(43.33)	2(1.67)		
Newspaper	49(40.83)	Agriculture	9(7.50)	63(52.50)	48(40.00)	31.25	IV
		News	43(35.83)	36(30.00)	41(34.17)		
		Entertainment	2(1.67)	18(15.00)	100(83.33)		
Farm magazine	10(8.33)	Agriculture	9(7.50)	17(14.17)	94978.33)	6.39	VI
		News	0(0.00)	9(7.50)	111(92.50)		
		Entertainment	0(0.00)	2(1.67)	118(98.33)		
Social media	89(74.17)	Agriculture	11(9.17)	56(46.67)	53(44.17)	38.61	II
		News	11(9.17)	71(59.17)	38(31.67)		
		Entertainment	29(24.17)	49(40.83)	42(35.00)		
Internet	88(73.33)	Agriculture	9(7.50)	47(39.17)	64(53.33)	34.17	III
		News	11(9.17)	56(46.67)	53(44.17)		
		Entertainment	29(15.83)	65(54.17)	36(30.00)		

Small and marginal farmers often have limited financial and physical resources, which hinders their ability to invest in residue management technologies such as shredders, balers, or machines for converting residues into bioenergy or compost.

The past research study reported by Thatchinamoorthy and Selvin (2014) also observed that majority (62.80%) of the sugarcane growers had less than 2.5 acre of area under sugarcane cultivation.

Experience in sugarcane cultivation

An observation of the results indicated that 41.67 per cent of the sugarcane growers had medium experience in sugarcane cultivation. Their substantial experience could potentially be attributed to their age and level of education. Majority of the sugarcane growers belonged to middle age category hence, the experience was medium. While medium-experienced farmers often have substantial knowledge and expertise in sugarcane cultivation, they may still adhere to traditional practices when it comes to residue management. If they have been using burning or other outdated methods for years, their medium level of experience might make them more resistant to adopting newer, more sustainable practices, even if these methods are more beneficial for soil health and the environment.

The similar results were also reported by Durairaj (2023).

Mass media exposure

An investigation of the results presented in the Table 4 indicated that majority (99.17%) of the sugarcane growers possessed television The rising prevalence and appeal of audio-visual aids have contributed to the supremacy of television over other mass media forms.

Majority (74.17%) of the sugarcane growers possessed social media and 73.33 per cent of them were internet subscribers, the prevalence of social media and internet usage was due to the possession of mobiles at affordable price by majority of the sugarcane growers and easy access of internet in the recent years has influenced the use of social media by them.

About 40.83 per cent of the sugarcane growers are subscribers of newspaper. This trend could be attributed to factors such as the affordability of subscriptions, a moderate educational background and varying levels of interest.

Radio was possessed by only 10.83 per cent sugarcane growers because television has taken over the radio due to its visual impact, hence the result and farm magazines were subscribed by only 8.33 per cent of the sugarcane growers because limited awareness and interest and challenging in accessing these magazines within their local community.

Further, Table 5. concluded that 43.33 per cent of the sugarcane growers had medium level of mass media exposure, followed by 32.50 per cent and 24.17 per cent of the sugarcane growers had high and low-level mass media exposure, respectively.

The results are in conformity with the findings of Memon *et al.* (2021), Nidhi (2021) and Pawar and Devendrappa (2022).

Extension contact

The extension contact made by the sugarcane growers as presented in Table 6. indicated that 97.50 per cent of them contacted extension workers of sugar industry, followed by

Table 5. Distribution of Sugarcane growers according to mass media exposure (n=120)

Category	Frequency	Percentage
Low (<12)	29	24.17
Medium (12-17)	52	43.33
High (>17)	39	32.50
Mean=14.63	SD=6.06	

Table 6. Extension contact of sugarcane growers (n=120)

Extension workers	Extent of Contact					Index	Rank
	Once in a week	Once in two weeks	Once in a month	Whenever needed f (%)	Never		
Assistant Horticulture officer	0(0.00)	0(0.00)	0(0.00)	2(1.67)	118(98.33)	0.42	VIII
Assistant Director of Horticulture	0(0.00)	0(0.00)	0(0.00)	4(3.33)	116(96.67)	0.83	VII
Assistant Director of Agriculture	0(0.00)	0(0.00)	0(0.00)	26(21.67)	94(78.33)	5.42	VI
Agriculture officer	0(0.00)	0(0.00)	3(2.50)	34(28.33)	83(69.17)	8.33	V
Assistant Agriculture officer	0(0.00)	0(0.00)	6(5.00)	54(45.00)	60(50.00)	13.75	IV
Input Dealers	0(0.00)	0(0.00)	11(9.17)	106(88.33)	3(2.50)	26.67	I
KVK (Subject matter specialist)	0(0.00)	0(0.00)	19(15.83)	40(33.33)	61(50.83)	16.25	III
Extension workers of sugar industry	0(0.00)	0(0.00)	3(2.50)	117(97.50)	0(0.00)	25.63	II

input dealers (88.33%), Assistant Agricultural Officer (45.00%), subject matter specialist of KVK (33.33%), Agriculture Officer (28.33%), Assistant Director of Agriculture (21.67%) in the situation of 'whenever needed'. Likewise, 3.33 per cent and 1.67 per cent of sugarcane growers contacted Assistant Director of Horticulture and Assistant Horticulture officer to the lesser extent in the situation of 'whenever needed'.

The results in the Table 7. showed that 39.17 per cent of the sugarcane growers had medium level extension contact, followed by 33.33 per cent and 27.50 per cent of the sugarcane growers had low and high extension contact, respectively.

The prevalence of sugarcane growers in the medium and high category of extension activities can likely be attributed to their keen interest in seeking agricultural guidance. This inclination enables them to access valuable information about contemporary advancements and technological updates, often obtained through interactions with Input dealers, Assistant Agricultural Officers, Agricultural Officers and extension workers of sugar industries.

The results are in conformity with the findings of Nidhi (2021) and Pawar and Devendrappa (2022).

Irrigation facility used by sugarcane growers

It was depicted from the Table 8 that majority (77.50%) of the sugarcane growers had tube well as source of irrigation. Even though canal and river irrigation were available to 37.50 per cent of the sugarcane growers, they cannot rely completely on it, as sugarcane crop demands regular irrigation. Hence, most of the sugarcane growers used tube well as their source of irrigation.

The above findings were in accordance with the findings of Nidhi (2021).

Farm resource base of sugarcane growers

The data on farm resource base of sugarcane growers as shown in Table 9 revealed that cent per cent of the sugarcane growers had land under irrigation because sugarcane crop demands consistent and adequate water supply throughout its growth cycle, hence the result. Majority (72.50%) of the sugarcane growers had low (up to 2) family labours because majority of them belonged medium and small family size.

Majority (71.67%) of the sugarcane growers had buffaloes and 67.50 per cent of them had cow, because many of them had one or the other livestock for their household purpose and can also provide multiple benefits, such as additional income streams, organic matter for soil improvement. Majority

Table 7.Distribution of sugarcane growers according to extension contact (n=120)

Category	Frequency	Percentage
Low (<3.46)	40	33.33
Medium (3.46 - 4.33)	47	39.17
High (>4.33)	33	27.50
Mean=3.89	SD=1.03	

Table 8. Irrigation facility of sugarcane growers (n=120)

Irrigation sources	f	%
River	15	12.50
Well	29	24.17
Farm pond	2	1.67
Canal	30	25.00
Tube well	93	77.50

Table 9. Farm resource base of sugarcane growers (n=120)

Resources	f	%
Land (acre)		
a. Irrigation	120	100
b. Rain fed	0	0.00
c. Plantation area	0	0.00
d. Uncultivable area	0	0.00
Family labour (numbers)		
High (More than 5)	1	0.83
Medium (3-5)	32	26.67
Low (up to 2)	87	72.50
Livestock (numbers)		
a. Cow	81	67.50
b. Buffaloes	86	71.67
c. Goat	46	38.33
d. Bullocks	25	20.83
e. Poultry	19	15.83
f. Sheep	2	1.67
Farm machinery		
a. Sprayer	114	95.00
b. Tractor	59	49.17
c. Tiller	30	25.00
d. Others (Rotovator)	10	8.33

Table 10. Distribution of sugarcane growers according to farm resource base (n=120)

Category	Frequency	Percentage
Low (<4)	18	15.00
Medium (4-8)	74	61.67
High (>8)	28	23.33
Mean=6.23	SD=2.25	

(95.00%) of them had sprayer and nearly half (50.00%) of them had tractor because sugarcane is commercial crop and it requires high mechanization for harvesting and also for many other activities, hence the result.

The results on overall distribution of farm resource base as shown in Table 10. revealed that medium level of resource base was witnessed among 61.67 per cent of the sugarcane growers. Whereas, high and low was noticed respectively with 23.33 per cent and 15.00 per cent sugarcane growers.

The findings were also reported by Jagatpal *et al.* (2017).

Planting method followed by sugarcane growers

The results in the Table 11. indicated that majority (73.3%) of the sugarcane growers followed ridge and furrow planting method. The choice of planting method was influenced by regional climate, soil types and type of irrigation. The prevalence of the ridge and furrow approach might be a result of traditional practices passed down through generations and also this method ensured a consistent spacing between plants, promoting uniform growth and facilitated easier crop management tasks such as fertilization and pest control.

Use of organic inputs by sugarcane growers

The results presented in Table 12. revealed that use of organic inputs index of sugarcane growers was highest with regard to FYM (96.39), followed by green manures/press mud (56.11), compost/vermicompost (56.11), bio fertilizes (35.00), bio fungicides (19.72), bio pesticides (16.94) and (15.83) for other inputs like jeevamrutha, beejamrutha *etc.* Use of organic input index was highest for FYM because it is can be prepared by farmer himself or it also locally available, while index for bio-fertilizers, bio-fungicides and bio pesticides was comparatively low because of lack of awareness and accessibility.

Table 11. Planting method followed by sugarcane growers (n=120)

Method of planting	f	%
Ridge and furrow	88	73.33
Paired row planting	0	0.00
Wider row spacing	39	32.50
Mean= 1.06		

*Multiple responses are possible

Table 12. Use of organic inputs by sugarcane growers (n=120)

Organic Inputs	Awareness	Available f (%)	Used	Index	Rank
FYM	120(100.00)	120(100.00)	107(89.17)	96.39	I
Green manures /press mud	117(97.50)	81(67.50)	78(65.00)	76.67	II
Compost/ Vermicompost	118(99.17)	42(35.00)	42(35.00)	56.11	III
Bio-fertilizers	79(65.83)	32(26.67)	15(12.50)	35.00	IV
Bio fungicides	43(35.00)	25(20.83)	4(3.33)	19.72	V
Bio pesticides	40(33.33)	15(12.50)	3(2.50)	16.94	VI
Others	29(24.17)	14(11.67)	14(11.67)	15.83	VII

It was observed from the Table 13. that 46.67 per cent of the sugarcane growers had medium use of organic inputs, followed by 28.33 per cent and 25.00 per cent of the sugarcane growers belonged to low and high category, respectively.

The prevalence of medium usage suggested that substantial group of farmers who strike a balance between conventional and organic practices. The awareness about harmful effects of inorganic fertilizers were increased among the sugarcane growers. The diverse application of organic inputs among sugarcane growers fosters sustainable residue management by enhancing soil health, promoting efficient nutrient cycling, and reducing reliance on chemical inputs.

The results are in conformity with the findings of Nidhi (2021).

Environmental awareness among sugarcane growers

The environmental awareness among sugarcane growers was presented in Table 14. It was depicted that cent per cent of them were aware about burning causes severe pollution and smoke emitted affects human health, followed by burning degrades the soil (96.67%), loss of bio diversity (95.00%). Further, 94.17 per cent of the sugarcane growers were aware

Table 13. Distribution of sugarcane growers according to use of organic inputs (n=120)

Category	Frequency	Percentage
Low (<8.20)	34	28.33
Medium (8.20– 11.02)	56	46.67
High (>11.02)	30	25.00
Mean=9.61	SD=3.32	

Table 14. Environmental awareness among sugarcane growers (n=120)

Statements	f (%)	Rank
Burning causes severe pollution	120(100.00)	I
Smoke emitted affects human health	120(100.00)	I
Burning degrades the soil	116 (96.67)	II
Loss of bio-diversity	114 (95.00)	III
Burning kills micro flora and fauna beneficial to the soil.	113 (94.17)	IV
Nutrients present in residue are lost	110 (91.67)	V
Burning adversely affects trees in near vicinity	110 (91.67)	V
Green house gas emission leads to global warming	38 (31.67)	VI
Climate change due to global warming.	38 (31.67)	VI

Table 15. Distribution of sugarcane growers according to their environmental awareness (n=120)

Category	Frequency	Percentage
Low (<6.90)	18	15.00
Medium (6.90-7.68)	59	49.17
High (>7.68)	43	35.83
Mean=7.29	SD=0.91	

about burning kills micro flora and fauna beneficial to the soil. While, equal per cent (91.67%) of the sugarcane growers were aware about nutrients present in residue are lost and burning adversely affects trees in near vicinity and equal per cent (31.67%) of them were aware about greenhouse gas emission leads to global warming and climate change due to global warming.

The results on overall distribution of sugarcane growers according to their environmental awareness as shown in Table 15 revealed that 49.17 per cent of the sugarcane growers had medium environmental awareness, followed by high (35.83%) and low (15.00%), respectively.

The prevalence of medium awareness is due to significant portion of growers were attentive to environmental concerns associated with sugarcane cultivation. This group were likely to possess a baseline understanding of sustainable practices and their impact on ecosystems.

The results are in conformity with findings of Grover *et al.* (2015) and Anuradha *et al.* (2021).

Conclusion

The management of sugarcane residues presents both significant challenges and opportunities. The primary constraints identified include the wide spread practice of residue burning, lack of awareness among farmers, limited access to affordable technologies, insufficient infrastructure, and economic barriers that prevent effective utilization of residues. These issues not only harm the environment by contributing to air pollution and soil degradation but also hinder the full potential of sugarcane residues as valuable resources for sustainable farming and bioenergy production. Sugar factories can also play very significant role by helping the farmers in residue management by providing them with facilities for the proper disposal and utilization of sugarcane residues. Further, research trials can be designed to investigate the potential ex-situ residue management practices such as bioenergy production, livestock feed, biochar production techniques that offer a range of opportunities to maximize the utilization of crop residues, reduce environmental impacts, and contribute to sustainable agricultural practices.

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