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Constraints faced by Sugarcane growers in adoption of integrated nutrient management practices and suggestions to overcome them: A study of Ahilyanagar district of Maharashtra

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Abstract
The study was conducted in Ahilyanagar district of Maharashtra, to identify the constraints faced by sugarcane growers in adopting Integrated Nutrient Management (INM) practices and to document their suggestions. A total of 120 sugarcane growers were selected randomly from six villages across two talukas, Sangamner and Rahuri. Data were collected through personal interviews and analyzed using Garrett's ranking technique and frequency percentages. The most severe constraint was the perception that organic manures yield lower net returns than chemical fertilizers (mean Garrett score 69.70), followed by unawareness about optimal nutrient combinations (68.46), irregular availability of organic inputs (60.70), residue management difficulties (52.72), and outdated training of extension personnel (49.03). Major suggestions included subsidies on organic manures (62.50%), short-duration training programmes (55.83%), timely input availability (49.16%), subsidized residue management equipment (55.00%), and stronger extension support (36.67%). The study concludes that economic and knowledge-related constraints dominate over technical ones, and promoting INM adoption requires financial incentives, capacity building, and stronger institutional linkages.

Keywords: Integrated Nutrient Management, constraints, suggestions, sugarcane growers, Garrett's ranking technique

Introduction
Sugarcane (*Saccharum officinarum* Linn.), a member of the Poaceae family, is a globally recognized crop that has garnered significant attention as a source of food, biofuel, biomaterials, and alternative energy, particularly in rural economies (Singh *et al*., 2015; Aguilar-Rivera *et al*., 2012) [5, 1]. India ranks as the world's second-largest producer of sugarcane, with cultivation spanning approximately 5.1 million hectares and an annual production exceeding 430 million tonnes. The crop plays a vital role in the nation's agricultural economy, contributing nearly 7.5 per cent to the agricultural gross domestic product (GDP) and supporting the livelihoods of over 50 million farmers and agricultural workers. Furthermore, sugarcane farming engages around 7.5 per cent of India's rural population (Solomon, 2016) [6]. In terms of regional distribution, tropical states—including Maharashtra, Karnataka, Tamil Nadu, and Andhra Pradesh—account for about 51 per cent of India's total sugarcane production. The remaining 49 per cent is contributed by sub-tropical regions such as Uttar Pradesh, Bihar, Uttarakhand, Punjab, and Haryana (GOI, 2016). As the second-largest agro-based sector after textiles, India’s sugar industry is heavily dependent on sugarcane as a primary raw material. To meet increasing demand and sustain growth, it is crucial to increase sugarcane productivity to around 110 tons per hectare by 2030 within the existing cultivation area (Vision, 2030, Sugarcane Breeding Institute, Coimbatore, India) [8]. The sugarcane sector's contribution to agricultural GDP has shown a consistent upward trend over the past two decades. Both sugarcane cultivation and the sugar industry serve as major sources of employment and livelihood, engaging more than 50 million farmers in cultivation and processing activities. Enhancing sugarcane yield has a direct positive impact on the economic well-being of these farmers (Powar *et al*., 2020) [3].

Objective

Constraints faced by sugarcane growers in adoption of Integrated Nutrient Management Practices and suggestions to overcome these constraints.

Review of Literature

Sugarcane cultivation is associated with a wide range of constraints that hinder optimal productivity and profitability for growers. Several studies have investigated these challenges and offered suggestions to address them. Gurav *et al.* (2015) [2] reported that a substantial proportion of respondents encountered several challenges in sugarcane cultivation. The most prominent constraint was the high cost of production coupled with low market rates for sugarcane, reported by 38.88 per cent of the farmers. Additionally, 36.66 per cent of respondents noted that sugar factories showed a preference for other sugarcane varieties over CoM-0265. Labour scarcity was identified as a constraint by 30.00 per cent of the growers, while 24.44 per cent reported difficulty in accessing farmyard manure (FYM). Furthermore, 20.00 per cent of the respondents indicated that available micronutrients were expensive. Similarly, Shaikh *et al.* (2004) [4] found that sugarcane cultivators faced multiple challenges, with the non-availability of predators being the most prevalent constraint (82.26 per cent). Other significant problems included the non-utilization of sugarcane as fodder (77.42 per cent), expensive insecticides (73.39 per cent), difficulty in inter-culturing older crops (64.52 per cent), and inadequate technical knowledge about insecticide application (62.90 per cent). In terms of suggestions, Thorat *et al.* (2004) [7] concluded that the majority of respondents (89.44 per cent) recommended that farmers should be provided with technical information regarding the latest technologies. This was followed by the suggestion that demonstrations of improved varieties should be conducted on farmers' fields (57.22 per cent). Additionally, 85.55 per cent of the respondents suggested that planting material of improved varieties should be made available, while 53.89 per cent recommended that the University should develop low-cost technology for sugarcane cultivation. Furthermore, 37.22 per cent emphasized the need for close linkages between scientists and farmers. These studies collectively highlight that sugarcane growers face significant economic, technical, and institutional constraints. The findings underscore the need for strengthened extension services, timely availability of inputs, and enhanced farmer-scientist linkages to promote sustainable sugarcane cultivation.

Methodology

The constraints faced by sugarcane growers in adopting Integrated Nutrient Management (INM) practices were identified through personal interviews conducted with farmers in Ahilyanagar district. Two talukas — Sangamner and Rahuri — were selected, and from each, three villages were chosen based on sugarcane area and production. Twenty sugarcane growers were randomly selected from each of the six villages, yielding a total sample of 120 respondents. Each respondent was asked to share how severe every constraint was in their own farming situation. They were then requested to rank these constraints from most to least severe based on their personal experience. The ranks given by the farmers were converted into Garrett scores using the standard Garrett conversion table. After this, the Garrett score for each constraint was calculated and the average (mean) Garrett score was worked out. The constraints were then arranged in descending order of their mean Garrett scores. The constraint with the highest mean score was placed at Rank I, showing it was the most serious problem faced by the growers. Suggestions to overcome these constraints were elicited separately and expressed as frequencies and percentages.

Results and Discussion

Table 1: Constraints faced by sugarcane growers

Constraints	Garrett's score	Garretts mean	Rank
Net return is less by using organic manures as compared to inorganic fertilizers.	8365	69.708333	I
Unawareness about optimal combination of organic, inorganic, and biofertilizer inputs.	8215	68.458333	II
Organic fertilizers and biofertilizers are unavailable at times.	7284	60.7	III
Residues of green manure and previous crops interfere with tillage operations.	6326	52.716667	IV
Extension personnel lack updated training on dynamic INM protocol.	5883	49.025	V
Misleading guidance from agro service centres.	4952	41.266667	VI
Weak institutional linkages among farmers, research institutions, and input suppliers.	3782	31.516667	VII
Late decomposition of organic manure.	3033	25.275	VIII

Table 1 presents the constraints faced by sugarcane growers in adopting Integrated Nutrient Management (INM) practices, ranked using Garrett's scoring technique. A higher mean Garrett score indicates a more severe constraint as perceived by the respondents. The challenges encountered by sugarcane growers in Ahilyanagar district while adopting Integrated Nutrient Management practices reflect a mix of financial, informational, and systemic hurdles. The most pressing issue, ranked first, was the widespread belief that organic manures bring lower profits than chemical fertilizers, showing how strongly economic considerations shape farmers' choices. Close behind was the lack of clarity about how to blend organic, inorganic, and biofertilizer sources in the right proportions, revealing a substantial knowledge gap that holds back even those willing to try INM. The third ranked constraint was the inconsistent supply of organic fertilizers and biofertilizers, exposing weaknesses in the distribution system that make INM difficult to practice during peak planting windows. Problems with managing crop residues during land preparation ranked fourth, pointing to the practical difficulties farmers face when trying to incorporate green manure or leftover residues into the soil. The fifth constraint was the outdated training of extension personnel, which creates a bottleneck in passing on current INM recommendations to farmers. Misleading advice from agro service centres ranked sixth,

illustrating how commercial pressures can compromise technical guidance and weaken farmer confidence. Poor coordination among farmers, research bodies, and input suppliers ranked seventh, reflecting systemic gaps that slow down the movement of knowledge and inputs to the village level. The least severe constraint was the slow decomposition of organic manure, ranked eighth, indicating that while this is a real technical concern, farmers view other issues as more urgent. Taken together, these findings show that financial and knowledge-related barriers outweigh purely technical ones, highlighting the need for subsidies, practical training, and stronger institutional linkages to encourage INM adoption among sugarcane growers in the district.

Table 2: Suggestions made by the sugarcane growers to overcome the constraints

Suggestions	Frequency	Percentage
Provide subsidy on organic manures (FYM, vermicompost, pressmud) as per with chemical fertilizers to reduce the cost burden	75	62.5
Organize short duration training programmes on INM technology	67	55.83
Ensure timely availability of organic fertilizers and biofertilizers through cooperative societies and agri-input centres before the planting season begins.	59	49.16
Provide subsidized residue management equipment like mulcher, and rotavator to incorporate crop residues without affecting tillage.	66	55.00
Strengthen extension support through Krishi Vigyan Kendras (KVKs) and Agricultural Universities.	44	36.67

Table 2 highlights the recommendations put forward by sugarcane growers to address the challenges they face in adopting Integrated Nutrient Management practices. The suggestion receiving the highest response, from 62.50 per cent of the farmers, was to offer subsidies on organic manures such as FYM, vermicompost, and pressmud, similar to the support provided for chemical fertilizers. This clearly points to the financial strain farmers experience when buying organic inputs. The next most common suggestion, made by 55.83 per cent of respondents, was to conduct short-duration training programmes focused on INM technology. This indicates that farmers are eager to learn but prefer programmes that do not take them away from their fields for long periods. Ensuring timely availability of organic fertilizers and biofertilizers through cooperative societies and agri-input centres was recommended by 49.16 per cent of growers, reflecting gaps in the supply system. Providing subsidized residue management equipment such as mulchers and rotavators was suggested by 55.00 per cent of respondents, addressing the practical difficulty of incorporating crop residues into the soil. Finally, 36.67 per cent of farmers recommended strengthening extension support through Krishi Vigyan Kendras and Agricultural Universities to bridge the gap between research and actual field adoption.

Conclusion and Implication

Given the focus on INM adoption, these constraint-and-suggestion patterns strongly support a case for developing farmer-led institutional mechanisms in Ahilyanagar district — since collective bargaining for subsidized organic inputs, shared residue management equipment, and organized training programmes directly address the top ranked constraints (low net returns from organic manures, unawareness about optimal nutrient combinations, and irregular input availability) identified by the growers themselves. Such institutional arrangements can make INM economically viable, technically accessible, and practically feasible for sugarcane growers in the region.

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