CURRENT STATUS OF GRAIN QUALITY ASSESSMENT IN APMCs FOR MAJOR CITIES OF GUJARAT

Abstract: Agriculture is a key pillar of India's economy, supporting over half the population and supplying essential raw materials to industries. Agricultural marketing, involving collection, storage, processing, and distribution, plays a crucial role in ensuring the efficient movement of produce from farms to markets. A study was conducted to find out the current status of grain quality assessment in APMCs for major cities of Gujarat. It investigated the existing systems, challenges, and opportunities in grain quality testing across APMCs. It focused on modern tools, including AI-based machines, for enhancing transparency and efficiency. A case study was conducted on a digital agri-tech firm offering AI-powered grain assessment tools, showing how such technology benefits APMCs and farmers. A survey of 30 APMC Secretaries revealed insights into infrastructure, testing methods, and the extent of digital adoption. Most Secretaries were experienced, educated males with limited access to modern tools and training. Visual inspection remains dominant, but there's growing awareness of advanced methods. Key challenges include inadequate equipment and technical skills. Respondents emphasized the need for investments in digital systems, training, and partnerships to improve grain quality assessment across Gujarat's APMCs.

Key Words: Grain Quality Assessment, APMCs (Agricultural Produce Market Committees), AI-based Technology, Digital Agri-tech, Infrastructure and Training Gaps.

1. Introduction

Agriculture, derived from the Latin words *'ager'* (field) and *'cultura'* (cultivation), is the science and art of cultivating plants and livestock. It covers a wide range of activities like crop production, animal husbandry, forestry, and fisheries, all aimed at producing food, fiber, and other essential products. In India, agriculture is a backbone of the economy, supporting more than half of the population. It not only provides food to the growing population but also supplies raw materials to key industries like textiles, sugar, and oilseeds. Despite industrial development, agriculture remains a major source of employment and income for millions. It also contributes to trade through exports of tea, coffee, rice, and spices, helping earn foreign exchange and boost the national economy. Agriculture contributes about 16% to India's GDP and provides livelihood to around 46.1% of the population, showing its significance in both economic and social contexts (Indiabudget.gov, 2025).

Agricultural marketing plays a critical role in connecting farmers with markets. It includes a series of activities such as collection, storage, processing, transportation, and distribution of farm produce. These processes help ensure that agricultural inputs and outputs efficiently reach

consumers, processors, and exporters. India’s marketing system is made up of various channels like direct sales, village haats, mandis, and cooperative marketing (agristudoc, 2025). Among these, mandis—regulated under the APMC Acts—serve as structured marketplaces where farmers sell their produce through an auction system, often facilitated by traders and commission agents. These systems aim to reduce exploitation by middlemen and ensure fair prices. However, many traditional market systems still lack modern infrastructure and efficiency, particularly in areas like grain quality assessment, where manual evaluation is the norm (dmi, 2025).

Grain quality assessment is a crucial part of agricultural marketing, as it determines pricing, storage, and export potential. In APMCs, food grains are evaluated mainly through visual inspection, considering parameters like grain size, moisture, color, and impurities. However, manual methods are prone to human error and inconsistency. To overcome this, modern technologies like Artificial Intelligence (AI), Machine Learning (ML), and Near-Infrared Spectroscopy (NIR) are being adopted. These technologies allow objective, fast, and reliable testing of grain quality, improving transparency and market trust. By modernizing grain quality assessment systems, mandis can evolve into agri-tech hubs, providing better incomes to farmers and strengthening India's agricultural value chain (nationalagriinstruments, 2025).

1.1 Objectives

1. To study the socio-economic profile of APMC officers
2. To study the current practices and methods of grain quality assessment in APMCs
3. To identify the problems in grain quality assessment within APMCs
4. To study opportunities for improvement in grain quality assessment in APMCs

2. Review of Literature

Hans and Govindaswamy (2024) studied the problems and changes in agricultural marketing in India. They found that small land size, lack of water, and poor market access make it hard for farmers to earn well. Farmers also face problems like weak storage, bad roads, and too many middlemen. Climate change and lack of modern tools make things worse. Government is trying to help, but more work is needed to improve roads, storage, and farmer training.

Kumar et al. (2023) studied new ways to check grain quality and stop adulteration. They said old methods take time and can have mistakes. New technologies like image processing and machine learning give faster and more accurate results. Using mobile apps and cloud systems can help in checking quality quickly. These methods can help APMCs reduce grain loss and keep food safe for people.

Saravanan et al. (2022) studied the problems in making farming sustainable in India. They said farmers need more income, jobs, and better use of modern farming methods. Big problems are poor credit, weak support groups, less farming land, and water issues. The study also warned about soil damage and loss of biodiversity. It said small farmers need help through better markets, insurance, and support, and youth should find farming attractive again.

Balkrishna et al. (2021) studied the current situation of Indian agriculture. They found that farming has helped in food production and jobs, but farmers still face many problems. These

include poor roads, lack of water, high costs, and low income. The use of too many chemicals has harmed soil and water. New methods like organic and smart farming can help, but they are still not used everywhere.

Joseph and Thomas (2020) studied the food processing industry in India. They said the industry has good raw materials, skilled workers, and modern machines, but it is still not fully developed. There are many chances to grow, but problems like poor infrastructure and rules slow it down. More people now want ready-to-eat food, so this industry can grow fast. To improve, India needs better policies, more investment, and stronger supply systems.

Jagani (2016) studied the lives of 400 farmers in Gujarat's APMC markets. Most farmers were men, while women mostly worked as helpers. Many farmers were aged 30–45 and had finished school. Most lived in joint families and did farming as their main work, but also needed other jobs due to low income. Small farmers earned less and faced problems in reaching markets, so they need better support and nearby market access.

Sidnal et al. (2013) studied better ways to check grain quality, especially for APMCs. They found that current manual checking is slow and not always correct due to human mistakes. So, they suggested using computers with image processing and neural networks to check grain shape and color. This method gave very good results and can help farmers get fair grading. Though it can’t check inside quality like protein, it still makes the process faster and more accurate.

3. Materials and Methods

The research followed a descriptive design, utilizing both primary and secondary data. Primary data was collected through a semi-structured schedule from 30 selected APMC officers across Gujarat using non-probability purposive sampling. Secondary data was sourced from relevant literature, government reports, and web sources. The survey was conducted over a period of 60 days, focusing on grain quality assessment practices. Data analysis was performed using descriptive statistics, weighted average mean, and Garrett’s ranking technique to interpret the findings effectively.

4. Result and Discussion

4.1 To study the socio-economic profile of APMC officers

Table 1. socio-economic profile of APMC officers

Sr. No.	Particulars	Respondents	Percentage
1	**Gender**		
	Female	1	3.00
	Male	29	97.00

	Total	30	100.00
2	**Age (years)**		
	Below 30	1	3.00
	31-40	9	30.00
	41-50	7	23.00
	Above 50	13	44.00
	Total	30	100.00
3	**Education Qualification**		
	10th to 12th Grade	4	13.00
	Undergraduate	18	60.00
	Postgraduate	8	27.00
	Total	30	100.00
4	Annual income		
	Above ₹60,000	30	100.00
	Total	30	100.00
5	**Location of APMCs**		
	Semi-Urban	22	73.00
	Urban	8	27.00
	Total	30	100.00
6	**Current position in APMCs**		
	Secretary	30	100.00
	Total	30	100.00
7	**Years of experience in APMCs**		
	Less than 5 years	3	10.00
	5-10 years	2	7.00

	11-20 years	12	40.0
	More than 20 years	13	43.00
	Total	30	100.00

The study revealed that the respondent group was predominantly male and mostly above 50 years of age, indicating that APMC Secretaries are largely experienced individuals with long-term involvement in the system. Female representation was very low, showing a gender imbalance in leadership roles within APMCs.

In terms of education, most respondents were undergraduates, followed by postgraduates, highlighting a moderate academic background among the sample. All respondents had a uniform income level above ₹60,000, reflecting a similar economic category across the group.

The majority of APMCs were located in semi-urban areas, and all participants held the designation of Secretary, ensuring consistency in the responses. The findings suggest that experienced and similarly positioned individuals are responsible for grain quality decisions in these markets.

4.2 To study the current practices and methods of grain quality assessment in APMCs.

Table 2. Current practices and methods of grain quality assessment in APMCs

Sr. No.	Particulars	Respondents	Percentage
1	**Awareness regarding grain quality assessment practices**		
	Yes	30	100.0
	Total	30	100.00
2	**Use of Machinery**		
	No	27	90.00
	Yes	3	10.00
3	**Assessment of grain quality**		
	Manually	29	3.30
	Through Machine	1	96.70
	Total	30	100.00

Table 3. Grain Quality Assessment Parameters, Methods, and Responsible Persons in APMCs

Sr. No.	Particulars	Respondents	Percentage of cases
1.	**Parameters for grain quality assessment**		
	Size	30	100.00
	Color	30	100.00
	Moisture content	22	73.30
	Purity	30	100.00
	Insect damage	13	43.30
	Potiya	13	43.30
	Mud ball	18	60.00
	Total	156	--
2.	**Methods of grain quality assessment**		
	Visual Inspection	29	96.70
	Moisture Meter	13	43.30
	NIR (Near-Infrared) spectrometers	1	3.30
	Total	43	--
3.	**Conducting quality assessments**		
	Traders	30	100.00
	Dedicated APMC Staff	30	100.00
	Total	60	--

The study shows that all 30 respondents (100%) were aware of grain quality assessment practices in APMCs. Parameters like size, color, and purity were considered important by all (100%), while 22 respondents (73.3%) mentioned moisture content, and 18 (60%) included mud ball as a factor. This reflects a strong understanding of key quality indicators.

Visual inspection was the most used method, reported by 29 respondents (96.7%), while 13 respondents (43.3%) used moisture meters. Only 1 respondent (3.3%) reported using NIR spectrometers. This indicates that traditional methods are dominant, and modern technologies are still rarely used.

While 3 respondents (10%) said machines were used, the majority—27 respondents (90%)—relied only on manual methods. Only 1–2 APMCs were found using analyzer spectrometers

linked with the e-NAM platform. This shows the potential of technology to increase transparency and improve price discovery for farmers, though adoption is still limited.

4.3 To identify the problems in grain quality assessment within APMCs.

Table 4. Problems faced in grain quality assessment

Sr. No.	Problems	WAM	Rank
1	Lack of Adequate Equipment	78.66667	1
2	Limited Awareness of Advanced Tools	76.76667	2
3	Insufficient Training of Staff	59.9	3
4	Inconsistent Standards	59.1	4
5	Technological Barriers	57.13333	5
6	Weather and Storage Impact	53.26667	6
7	Maintenance Issues	47.26667	7
8	Communication Gaps	41.1	8
9	Insufficient Funding	37.16667	9
10	Lack of Transparency	36.96667	10
11	Disputes Between Buyers and Sellers	36.66667	11
12	Time-Consuming Processes	17	12

The analysis of problems faced in grain quality assessment reveals that the most critical issue is the lack of adequate equipment, with the highest mean score of 78.67, followed by limited awareness of advanced tools (76.77). Other significant challenges include insufficient training of staff, inconsistent standards, and technological barriers. Factors such as weather and storage impact, maintenance issues, and communication gaps also affect the quality assessment process. Issues like insufficient funding, lack of transparency, and disputes between buyers and sellers were ranked lower but still present challenges. The least problematic area identified was the time-consuming nature of the processes, with the lowest mean score of 17.

4.4 To study opportunities for improvement in grain quality assessment in APMCs.

Table 5. Opportunities for improvement in grain quality assessment in APMCs.

Sr. No.	Particulars	Respondents	Percentage of cases
1.	**Awareness of machines used in grain quality assessment**		
	AI-powered grading machines	8	27.60
	Digital moisture meters	24	82.80
	Grain Quality Testing Machines	16	55.20
	No idea	4	13.80
	Total	52	--
2	**Particulars**	**Respondents**	**Percentage**
	Collaboration Opportunities		
	No	11	37.00
	Yes	19	63.00
	Total	30	100.00
3	**Particulars**	**Respondents**	**Percentage of cases**
	Leading stakeholders in collaboration		
	Government	13	68.00
	Government and APMCs	2	11.00
	Government and Private sector	1	5.00
	Government, APMC and Private sector	3	16.00
	Total	19	100

The analysis shows that digital moisture meters are the most well-known machines, with 82.8% of respondents aware of them. Grain quality testing machines were known by 55.2%, while only 27.6% were aware of AI-powered grading machines. Additionally, 13.8% of respondents had no knowledge of any of these machines, indicating limited awareness of modern tools.

Participants saw a strong opportunity to invest in AI-powered machines, digital grading systems, and IoT-based sensors. They believed such tools would help reduce human errors and improve fairness in the bidding process. Many also stressed the importance of training APMC staff and traders to use new technologies properly.

Around 63% of respondents felt that collaboration between private companies, APMCs, and the government could help improve grain quality assessment. On the other hand, 37% did not agree with this idea. This shows a positive attitude toward working together for better solutions.

Finally, 68% of respondents said the government should take the lead in introducing advanced technologies. 16% supported a joint effort by government, APMCs, and private firms, while smaller groups preferred partnerships like government-private (5%) or

government-APMC (11%). This highlights the trust in government leadership, along with interest in collective action.

Table 6. Perception on the potential of advanced technologies to replace manual methods in grain quality assessment

Sr. No.	Sentences	WAM	Result
1	Advanced technologies are capable of fully replacing manual methods in grain quality assessment.	2.866667	Neutral
2	Advanced technologies can improve accuracy and efficiency better than manual methods	2.066667	Agree
3	The use of advanced technologies ensures consistency in grain quality assessment that manual methods cannot achieve	1.966667	Agree

The results indicate that respondents generally agree that advanced technologies can improve the accuracy and efficiency of grain quality assessment, with a mean score of 2.06. Similarly, there is agreement that such technologies ensure consistency in assessment that manual methods may lack, reflected by a mean score of 1.96. However, when it comes to the complete replacement of manual methods by advanced technologies, the responses are neutral, with a mean score of 2.86. This suggests that while there is a positive perception of the benefits offered by technology, there remains some hesitation about fully replacing traditional manual practices in the current APMC setup.

Perceived areas where ai can improve grain quality assessment

Out of the total 30 respondents, 19 individuals (63%) believed that the introduction of AI-based systems would improve the process of grain quality assessment. These respondents were further asked to identify the areas where they see the greatest potential for AI to make a difference. Based on their opinions, several key areas emerged.

Most respondents highlighted that AI can enhance accuracy in detecting grain quality parameters like moisture content, insect damage, and impurities. Others mentioned that AI can reduce human bias and ensure standardized grading, which is often lacking in manual inspection. Some respondents also noted the time efficiency and real-time report generation capabilities of AI tools, which can speed up the auction process and help farmers get fair prices quickly. Additionally, AI can support online trading platforms like e-NAM by providing verified digital quality reports, making the process more transparent and trustworthy.

5. Conclusion

The study reveals that while APMCs play a vital role in grain quality assessment, their methods largely rely on manual inspection, focusing on parameters like size, color, and purity. Other commonly assessed factors include moisture content, insect damage, potiya, and mud balls. Despite complete awareness of quality assessment practices among APMC staff, challenges persist—mainly the lack of modern equipment, limited awareness of advanced tools, and inadequate training. In contrast, Upjao, a deep-tech startup, offers AI-powered solutions that assess over ten parameters quickly and accurately, revolutionizing the traditional system. The findings highlight opportunities to improve the process through AI-based systems, automated grading machines, and real-time monitoring tools. There is also strong potential for collaboration between the government, private companies, and APMCs. A significant number of respondents agree that AI can improve accuracy, reduce bias, and ensure consistency in grading. With strategic investment in technology, training, and infrastructure, the grain assessment process in APMCs can become more transparent, efficient, and farmer-friendly.

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