RESEARCH ARTICLE

Exploring the market viability of hybrid maize seeds in Coimbatore and Tiruppur districts of Tamil Nadu

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Abstract

Maize is the third most important grain crop in India, following rice and wheat. It accounts for around 10% of total food grain production in the country. Maize consumption is mainly for animal feed, the food sector and industry. The main aim of the study was to assess the market potential for maize hybrid seeds in Coimbatore and Tiruppur districts of Tamil Nadu state. Two blocks and 3 villages from each block with 15 farmers in each village selected by random sampling method comprised the study sample of 180 farmers. The data was collected of the year 2022-23 and 2023-24. Results of the study revealed that the overall market potential for hybrid maize seeds was predicted to reach 1770 tonnes in 2023-2024 and 1903 tonnes in 2024-2025 which shows maize cultivation is going to increase in the future in these regions. The major sources of information about maize hybrid seeds to farmers are friends and relatives. The brand most preferred by farmers was NK7720 and they faced high seed prices as a major constraint. More promotional activities and schemes targeting maize production would improve the area and production in the study area leading to an increase in farmers. Friends and relatives were identified as the primary sources of information regarding maize hybrid seeds for farmers.

Keywords

hybrids; maize; market potential; seeds; yield

Introduction

Maize, often known as corn, is a cereal grain that was first cultivated by ancient Central Americans (1). It is presently the third-most important cereal crop in the world capable of adapting to a wide range of agro-climatic environments. It is cultivated over 193.7 million ha in approximately 170 countries with a greater diversity of soil, temperature and biodiversity (2). Maize consumption is distributed as follows: feed (61%), food (17%) and industry (22%) of total production. The United States of America is the world's greatest producer of maize accounting for 387.7 million tonnes (3) for almost 31% of global production in 2020. Global maize production for the 2023-24 is expected to reach 1.23 billion tonnes (4). Maize is the third most important grain crop in India, following rice and wheat which account for around 10% of total food grain production. India is the fifth largest producer of maize in 2022, accounting for 2.59% of global production (2). Maize production in India faces significant challenges due to the harsh ecological conditions, particularly during the *kharif* season. This is reflected in the lower yield of *kharif* maize (2706 kg/ha) compared to rabi maize (4436 kg/ha). The more stable and predictable ecosystem during the *rabi* season contributes to the higher yield. Karnataka stands

out as the top maize producer in India, accounting for 16.45% of the national production. Madhya Pradesh, Maharashtra and Bihar follow closely, contributing 11.37%, 10.91% and 8.9% respectively. Uttar Pradesh, Gujarat, Himachal Pradesh and Tamil Nadu also contribute significantly to the national maize production.

The area under maize in Tamil Nadu in 2023 was 0.41 million ha. It is mostly grown in the Salem, Dindigul, Erode and Coimbatore districts accounting for roughly 75% of the entire area under this crop in the state (5). Tamil Nadu's maize production meets less than half of the poultry industry's demand. In this context, the market potential for maize hybrid seeds is estimated and the level of satisfaction of farmers with maize hybrid seeds was analysed.

Materials and Methods

The data was collected using an interview schedule gathered from farmers for the years 2022-23 and 2023-24. Secondary data were also sourced from government publications, academic journals and annual reports to supplement the primary data. The data collection period was 2023-24.

Coimbatore and Tiruppur districts of Tamil Nadu were chosen for the study as maize cultivation and marketing centres have been predominant in these regions in recent years. By employing purposive sampling technique 2 blocks recorded with high maize area were chosen from each district in the first stage and three villages were chosen from each block in the second stage on the same basis. In the third stage, fifteen farmers were randomly chosen from each village comprising a total sample size of 180 farmers for these primary and secondary sources.

Tools of Analysis

Conventional Analysis

Percentage analysis was used to study the demographic characteristics of the farmers and their farm and cropping details.

Factor analysis

A statistical method known as factor analysis is employed to find underlying latent variables, or factors, that account for the patterns of correlations between variables that are observed. It seeks to distill a vast array of variables into a more manageable set of unseen entities. The basic factor analysis model can be expressed mathematically as

$$X = \Lambda F + \varepsilon$$

Where X represents the observed variables, Λ (lambda) is the factor loading matrix, F represents the common factors and ε (epsilon) denotes the unique factors or error terms. Factor analysis is a technique that involves the analysis of the covariance structure of observed variables in order to estimate the factor loadings, thus indicating how every observed variable is related to the underlying factors.

Factor analysis in this study was used to investigate the factors influencing farmers' brand preferences. Pest and disease resistance, seed germination, seed quality, credit availability, better market price, peer group influence, high yield, availability and access, high grain weight, dealer recommendation, brand image, advertisement, quantity of packages available and seed price were among the many factors considered for the study.

Friedman test

A non-parametric statistical test technique is called the Friedman test. When examining ranking data from 3 or more matched groups, is especially helpful. To ascertain whether the differences between these rankings are statistically significant, the mean ranks are compared. The test statistic for the Friedman test is calculated as

$$\chi^2 r = [12 / (nk(k+1))] * [\sum R^2 j - 3n(k+1)]$$

Where n is the number of blocks (or subjects), k is the number of treatments, and Rj is the sum of ranks for the jth treatment. This statistic has k-1 degrees of freedom and roughly follows a chi-square distribution. We reject the null hypothesis, which states that there are no differences between the treatments if the computed $\chi^2 r$ is greater than the critical chi-square value and this test is used to analyse the level of satisfaction of farmers cultivating maize hybrid seeds. Results would be interpreted as the lower mean score denotes higher satisfaction and a higher mean score denotes lower satisfaction.

Garret's Ranking Technique

Garret's ranking technique was used to rank the constraints faced by farmers and brand preferences of maize hybrid seeds.

$$\text{Percent position} = \frac{100 \times \sum (Rij - 0.5)}{Nj}$$

Where, R_{ij} = Ranking given for the ith factor by the jth respondents, N_j = Number of variables ranked by j^{th} respondents. With the help of Garrett's table. The constraints and brands preferred having the highest means value was considered to be the most important constraint.

Results and Discussion

Socio-economic characteristics of the sample respondents

The socio-economic characteristics concerning hybrid maize farmers of Coimbatore and Tiruppur districts are given among the sample farmers in the 2 districts majority of age distribution are

- 38.89% were aged between 41 and 50 years
- 35.56% were aged between 31 and 40 years
- 17.78% were above 50 years old.

Gender distribution is 86% of the farmers were men. Most of the sample farmers were (32%) illiterate, followed by those with primary education (22%) and secondary education (20%) and 94% of the farmers were married. Of the sample farmers, 88% belong to nuclear families. The majority of the farmers choose farming as their primary occupation. 43% of the farmers were earning 1-3 lakhs. The percentage share of those farmers who had more than 3 lakh rupees as their yearly income was 27.78%, while the percentage share of those who had Rs. 50000 to 1 lakh as their yearly income was 20% and only 8.89% had an annual income less than Rs. 50000. Cropping details of hybrid maize farmers of Coimbatore and Tiruppur districts are given in the following Table 1.

Table 1. Farm holding and maize hybrid seed cultivation of sample farmers

Farm details	No. of farmers		Total	Percentage (%)
	Coimbatore	Tiruppur		
Size of land holding (acres)				
Marginal (<2.5)	9	6	15	8.33
Small (2.5-5)	25	26	51	28.33
Medium (5-10)	44	30	74	41.11
Large (>10)	12	28	40	22.2
	90	**90**	**180**	**100**
Source of Irrigation				
Well	5	15	20	11.11
Canal	28	22	50	27.77
Bore well	48	40	88	48.88
Rain fed	9	13	22	12.22
Area under Maize Cultivation (acres)				
Less than 2.5	15	12	27	15
2.5 to 5	23	25	48	26.66
5 to 10	42	28	70	38.88
More than 10	10	25	35	19.44
	90	**90**	**180**	**100**
Yield of Hybrid maize (Tonnes/ha)				
Below 2.5	10	6	16	8.89
2.5 to 5	22	20	42	23.33
5 to 7.5	24	22	46	25.56
Above 7.5	34	42	76	42.22
	90	**90**	**180**	**100**
Farming Experience in Maize cultivation (years)				
Below 5	7	5	12	6.67
5 to 15	24	18	42	23.33
16 to 30	38	42	80	44.44
More than 30	21	25	46	25.56
	90	**90**	**180**	**100**

From Table 1, the operational land holdings of the overall sample maize farmers, it was found that 41% of the sample farmers were classified as medium farmers and 28% as small farmers. The majority of the farmers were using bore wells (48%). The majority of farmers (38%) grow maize on 5 to 10 acres and the majority of sample farmers (42%) obtain yields in the range of above 7.5 tonnes/ha. The 44% of farmers have 16 to 30 years of experience in maize crop cultivation.

Buying behavior of the sample farmers

Sources of information about Maize Hybrids

From Table 2, the majority of sample farmers (43.33%) who use different sources to learn about maize seed brands rely on friends and family, followed by dealers or input shops (25.56%). Farmers depend on a variety of media, including newspapers and journals, radio and television and demonstrations (15.56%, 8.89% and 6.66%). In similar research on the attitude of farmers towards maize hybrids conducted (6), agricultural department officials were reported to be the major source of information about maize hybrid seeds followed by friends and relatives.

Table 2. Source of Information about maize hybrids

Sl. No.	Source of Information	No. of farmers		Total	Percentage (%)
		Coimbatore	Tiruppur		
1	Dealers/Retailers	28	18	46	25.56
2	Television/Radio	15	13	28	15.56
3	Journals/ Newspapers	10	6	16	8.89
4	Demonstration/ Field trails	5	7	12	6.6
5	Friends/Family Relatives	32	40	78	43.44
		90	**90**	**180**	**100**

Mode of Purchase

From Table 3, the majority of farmers (49%) made cash purchases of maize hybrid seeds, followed by credit purchases (31%) and dealers (20%) with cash and credit purchases.

Table 3. Mode of purchase

Sl. No.	Mode of purchase	Frequency		Total	Percentage (%)
		Coimbatore	Tiruppur		
1	Cash	40	48	88	48.89
2	Credit	30	26	56	31.1
3	Cash and Credit	20	16	36	20
		90	**90**	**180**	**100**

Brand Preference of sample farmers for specific hybrid maize brand

In comparison to other types, branded hybrid seeds have a higher potential yield and are more resistant to pests and illnesses. These factors influence farmers' selection for a given hybrid maize brand. The Garrett ranking technique was used to analyse and the results given in Table 4 revealed that among all brands, NK 7720 was highly preferred with a mean score of 26.50 followed by P1844 while Sakthi hybrid seeds were the least preferred brand. Farmers considered the hybrid yield potential, quality, germination, tolerance to pests and disease, seed price, availability and duration while selecting these brands. The most preferred brand of maize among the farmers in Andhra Pradesh was P3396 maize hybrid (7).

Table 4. Farmers' preference for hybrid maize brands

Sl. No.	Brand name	Mean score	Rank
1	NK 7720	26.50	I
2	P 1844	26.33	II
3	KMH 25K45	24.94	III
4	NK 30	24.44	IV
5	KMH 2589	22.54	V
6	MRM 4066	18.83	VI
7	DK 8148	16.83	VII
8	Sakthi	14.59	VIII

Comparison of Maize Hybrid and Variety Seeds

The cost of seed, duration and yield of both hybrid and varieties of maize seeds were collected and presented in Table 5. It was found that respondents from the study region preferred to buy 4 kg maize hybrid seed packs.

From Table 5, the study reveals that Hybrid P 1844, because of its qualities, such as good kernel set, resistance to pests and diseases and high yield potential. In varieties Prabhat gives a high yield of 5.5 tonnes/ha, when compared with Co1. So, the study reveals that hybrid have high yield potential and is mostly preferred by sample farmers. A similar result of farmers' inclination to adopt maize hybrid seeds due to higher yields from hybrids was reported (8) in their study on assessing farmers' adoption of maize hybrid seeds for higher productivity in Ghana.

Table 5. Comparison of maize seeds for different brands

Sl. No.	Brand	Cost of the seed	Duration	Yield
Hybrid (in Rs / 4 Kg packet)				
1	KMH 25K45	1750	95–100 days	7.0–7.6 tonnes/ha
2	DK 8148	1400	100–105 days	7.5 tonnes/ha
3	P 1844	1600	90–100 days	9.42 tonnes/ha
4	NK 7720	1850	100–120 days	8.81 tonnes/ha
5	NK 30	1800	80-90 days	8.2 tonnes/ha
6	Sakthi	1250	95-100 days	6.61 tonnes/ha
7	KMH 2589	1700	100-110 days	7.0 tonnes/ha
8	MRM 4066	1700	135-140 Days	6.5-7.0 tonnes/ha
Varieties (per Kg price)				
1	Co.1	28	100 days	4 tonnes/ha
2	Prabhat	35	95 days	5.5 tonnes/ha

Market Potential for Hybrid Maize Seeds in Coimbatore and Tiruppur Districts

The compound growth rate using the chain ratio approach was employed to assess the market potential of maize seeds. For this study, the trend in an area under maize was estimated for the nine years from 2012-13 to 2021-22. From Table 6, the study found that the compound growth rate for the area under maize (CGR) varied for the 2 sample districts. In the Coimbatore district, it was 0.73%, whereas in the Tiruppur district, it was 0.68%. For 2023-2024 and 2024-2025, the area planted under maize was estimated using the growth rates mentioned above. The recommended seed rate for planting maize hybrid seeds was 18.75 kg/ha on average.

In both districts, the predicted total market potential for hybrid maize seeds was 1770 tonnes in 2023-2024 and 1903 tonnes in 2024-2025. The estimated market potential of hybrid maize seeds in both districts reflected a higher scope for an increase in utilization of maize hybrids by farmers. It was mainly due to maize hybrid seed performance like higher yield, remunerative price and less incidence of pests and diseases. Hence, in the future, there would be higher demand for hybrid maize seeds due to increasing demand in the poultry feed sector. The existence of a higher market potential for hybrid rice VSPL seeds in the Koraput district of Odissa was reported (9).

Level of satisfaction of farmers with maize hybrid seeds

Farmers' responses towards the satisfaction level of performance of hybrid maize seeds were assessed using the Friedman test.

Related-Samples Friedman's Two-Way Analysis of Variance

The total disparities in the ranks given to the various factors are measured by Friedman's test statistic (146.096). There are seven degrees of freedom, and a higher test statistic denotes greater variations between the components. The P-value (0.001) suggests that there is statistical significance in the ranks among the components. Higher mean ranks are indicative of lower levels of satisfaction, whereas lower mean ranks are generally indicative of higher levels of satisfaction in variables. It indicated most satisfied factors are seed quality and resilience to pests and diseases, while the least satisfied factors are yield performance, marketability and cost effectiveness of hybrid maize seeds as revealed by the sample respondents in both districts. Similarly, erode farmers had higher satisfaction levels with hybrid seeds in their study, mostly due to higher yields (10).

Constraints faced by the sample farmers

Using the Garrett Ranking Technique, the major constraints faced by the maize hybrid farmers in the cultivation of maize hybrid seeds in the study area were examined. Out of all the issues the farmers had when cultivating hybrid maize (Table 7).

- High seed costs ranked highest, with a Garrett's score of 68.2
- Poor seed quality (62.7)
- lack of timely credit availability (59.1)
- low yield (55.8)
- lack of marketing (51.3)
- poor germination (48.6)
- price fluctuations (43.9)
- lack of brand knowledge (40.4)

Consequently, high seed prices were the main constraint encountered by the sample farmers. Study based on the problems in hybrid maize production stated that the highest seed price was the major constraint faced by farmers (11).

Table 7. Constraints faced by the sample farmers in hybrid maize cultivation

Sl. No.	Constraints	Mean score	Ranks
1	High seed cost	68.2	I
2	Poor quality of seeds	62.7	II
3	Lack of timely credit availability	59.1	III
4	Low yield	55.8	IV
5	Lack of Marketing	51.3	V
6	Poor germination	48.6	VI
7	Price Fluctuations	43.9	VII
8	Lack of knowledge about the brand	40.4	VIII

Table 6. Market potential for hybrid maize seeds

| District | CGR % | 2023-2024 | | | 2024-2025 | | |
| | | Projected Area (Ha) | Estimated Potential | | Projected Area (Ha) | Estimated Potential | |
			Tonnes	%		Tonnes	%
Coimbatore	0.725	48513.69	909.63	53.22	52537.11	985.07	51.52
Tiruppur	0.680	45892.24	860.47	46.77	48987.32	918.51	48.47
Total Market Potential		94405.93	1770	100	101524.43	1903.58	100

Conclusion

Among sample farmers, 41.11% of landholders had medium-sized farms. Large farmers made up 22.2% of the total, while small and marginal farmers made up 28.33% and 8.3% respectively. Consequently, medium-sized and large- farms are owned by the majority of sample farmers. Friends and family (43.44%) and dealers (25.56%) were the main sources of information among the different sources to farmers for buying different brands of hybrid maize. The majority of the sample farmers (93.33%) purchased hybrid maize from private dealers, with cash purchases accounting for 48.89% of total purchases and credit purchases accounting for 31.11%. Eight brands of maize hybrid seeds that were popularly used by the farmers in the study area were KMH 25K45, DK 8148, P 1844, NK 7720, NK 30, Sakthi, KMH 2589 and MRM 4066. Among these, the majority of the farmers preferred to buy NK 7720 followed by P 1844. The total market potential estimated for maize hybrid seeds would be 1770 tonnes in 2023-24 and 1903 tonnes in 2024-25 reflecting its future growth in the study area. The major constraint in hybrid maize cultivation was the highest cost of the seeds, followed by inferior quality and lack of timely credit availability.

Suggestions

Farmers have a preference for quality and reasonably priced maize hybrid seeds. Consequently, companies are functioning to increase their product range and awareness by running promotional campaigns in the field and on other marketing platforms. The company should provide farmers with need-based technical help and high-quality seeds at a fair cost. The training programs for farmers on various cultivation aspects of high-quality seed, knowledge of appropriate practices for their area, proficiency with mobile applications for consulting on crop management, purchase of inputs, etc., should be given higher priority by the companies, NGOs and government. In seed marketing, dealers play a critical role in creating demand for hybrid seeds. To manage this aspect the companies should use their sales personnel for direct purchase and tie-up for their crop management also. High-quality and more productive seeds should be provided to attract both farmers and dealers and boost customer loyalty. To boost sales field demonstrations, trade shows and awareness campaigns have to be imparted in the regions. The extent of hybrid maize seed usage by farmers is going to increase in the future as demand for maize as animal feed is in the rising trend. Hence, the companies, extension agents, government and NGOs should promote the adoption of best practices and provide subsidy schemes that would improve the farmers' well-being.

Authors' contributions

DPS carried out the research and analysed the data. RA guided the research by formulating the research concept and approved the final manuscript. BP contributed by developing the ideas and reviewed the manuscript. AV contributed by summarizing and revising the manuscript. KGG helped in summarizing and revising the manuscript.

Compliance with ethical standards

Conflict of interest: Authors do not have any conflict of interests to declare.

Ethical issues: None

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