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Farmer preferences for bengal gram varietal attributes: A conjoint analysis in Kurnool district of Andhra Pradesh

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Abstract

Bengalgram is the single largest category of pulses, contributing 44.5 per cent to the basket of total pulses, followed by pigeon pea and urad bean. This research aims to analyze the attributes of bengalgram varieties preferred by farmers using Conjoint Analysis. Multistage purposive random sampling technique was used for the selection of respondents. The present study was conducted in the Kurnool district of Andhra Pradesh during Rabi 2023-24. From the Kurnool district, four mandals, from each mandal two villages and each village constituting 10 farmers growing NBeG 857 variety released by the regional agricultural research station and 10 farmers growing JG 11 variety, which is a desi variety, were randomly selected. Thus, a total of 160 farmers who were actively involved in bengalgram cultivation were randomly selected for the current study. The findings revealed that the most preferred trait of bengalgram farmers in Kurnool district are seed source (23.83%), followed by yield (23.13%), grain size (17.94%) and price of seed (12.53%). Maturity time (3.49%) and plant height (1.71%) were identified as the least preferred attributes. Conjoint analysis reveals key factors influencing variety selection and market dynamics. These findings can help researchers, policymakers, and extension agencies design targeted agricultural interventions and support systems that align with farmer preferences and enhance the crop productivity of bengalgram.

Keywords: Conjoint analysis, attributes, utility estimates, NBeG 857, JG 11, traits

Introduction

India is the largest producer (25% of global production), consumer (27% of world consumption), and importer (14%) of pulses in the world (dpd.gov.in 2023). Major pulses grown in India are gram (chickpea), red gram (tur), lentil (masoor), green gram (mung), and black gram (urad). Bengalgram is the single largest category of pulses contributing 44.5 per cent to the basket of total pulses followed by pigeon pea and urad bean (arccjournals.com).

Bengalgram is a rabi season crop and is majorly produced in the states of India *viz*., Madhya Pradesh, Uttar Pradesh, Rajasthan, Maharashtra, Gujarat, Karnataka and Andhra Pradesh which share over 95 per cent of the total area under bengalgram (Gautam and Maurya, 2023). Bengalgram is emerging as a cash crop in black cotton soils of Andhra Pradesh replacing different crops like cotton, sorghum, bajra, sugarcane, groundnut, and tobacco with an area of 3.02 lakh hectares, the yield of 994 Kg/ha and production of 3.00 lakh tonnes (DES, 2023-24).

The bengalgram crop is predominantly grown in Kurnool, Anantapuramu, YSR, Nandyal, Prakasam and Bapatla districts, which accounted for 86.09 per cent of the total area under the crop in Andhra Pradesh state during 2023-24 and Kurnool district alone accounts for 19.21 percent of the total area under the crop. Among the major bengalgram growing districts Kurnool is at second place with a production of 46522 tonnes during 2023-24. In 2021-22, Kurnool district ranked the highest in area, production, and productivity of Bengalgram in Andhra Pradesh. After, the bifurcation of districts in 2022 Kurnool district is the second largest producer of bengalgram after YSR Kadapa district due to the reduction of land area (Directorate of Economics and Statistics, Andhra Pradesh, 2023-2024).

The two major types of bengalgram cultivated in India are: Desi, which is traditionally grown in South Asia and East Africa, and Kabuli, a larger-seeded variety. India has remained a major importer of Desi Bengalgram but has emerged as a leading exporter of Kabuli chickpea over the past decade. More than 250 chickpea varieties have been developed in India to date. The share of new varieties that are less than 10 years old has increased to more than 81 per cent of production. Improving new varieties shows impressive growth in area, production, and productivity of bengalgram in India, which has helped marginal and small landholders during the past decade.

In Andhra Pradesh, 90 per cent of the bengalgram area is

now occupied by improved varieties. Since initiating chickpea breeding programs in 2004, A.N.G.R.A.U has released ten improved NBeG varieties, including the first machine-harvestable variety. Over the past decade, 23 varieties have been released in India through collaboration with the Indian Council of Agricultural Research (ICAR) and ICRISAT (icrisat.org).

The preferences of farmers for Bengalgram varieties in the Kurnool district are deeply influenced by key attributes, including seed source, Grain Size, seed price, Maturity time, Plant height, Pest and disease resistance, Yield and Market Price. Such preferences are crucial for optimizing market viability and ensuring farmers' efficiency. Farmers' preferences have been greatly influenced by market demand, market facilities, drought conditions, and production. This helps select the right varieties and raises awareness of market-oriented variety selection strategies.

Methodology

Sampling Procedure and Selection of the Districts

A multistage purposive sampling technique was used for the selection of the state, district, mandals and villages. Farmers were selected randomly. Andhra Pradesh state was purposively selected as it stands seventh in the country with an Area of 3.02 lakh hectares, production of 3.00 lakh tonnes and productivity of 994 Kg/ha for 2023-24. Kurnool district was purposively selected for the study as it stands at the fourth place with highest area coverage (0.33 lakh hectares) and the productivity (790 kg/ha) of Bengalgram in Andhra Pradesh. Kurnool district alone accounts for 19.21 percent of the total area under the crop. (Directorate of Economics and Statistics, Andhra Pradesh, 2023-2024).

Four mandals were selected *viz*., Alur, Chippagiri, Maddikera East and Aspari based on the highest area coverage in Bengalgram. Alur was the leading area coverage of Bengalgram in Kurnool district with 12586 acres, followed by Aspari with 7468 acres, Chippagiri with 7411 acres and Maddikera East with 6741 acres. (https://karshak.ap.gov.in). From Alur mandal, Molagavalle and Hatibelagal villages, from Aspari mandal, Joharapuram and Chinna Hothur villages, from Chippagiri mandal, Chippagiri and Nemakalu villages and from Maddikera East mandal, Maddikera North and Maddikera East villages were purposively selected based on the highest area coverage of Bengalgram. (https://karshak.ap.gov.in).

From each village, 20 farmers were selected, from each village which 10 farmers cultivating the NBeG variety and 10 farmers cultivating the JG 11 variety, making a total sample of 160 farmers.

Conjoint Analysis

Conjoint analysis is an analytical technique that can be used to determine relative importance level and utility value appeared from related attributes/traits based on respondent perception. This approach suggests that respondents derive utility not from goods themselves, but rather from the attributes or characteristics that the goods possess. The conjoint analysis operates on the basic principle that a product is composed of attributes *viz*., Plant height and that each attribute may have two or more levels *viz*., tall and short. Furthermore, conjoint analysis serves as a valuable technique for assessing the value judgments made by respondents. Therefore, in the current study, this technique was employed to assess the Bengalgram traits preferred by farmers.

Conjoint analysis is used to determine the best possible combination of the attributes in availing different traits of Bengalgram by identifying the utility values for different levels of the selected key attributes and the relative importance that these attributes preferred by the farmers. If the farmers were asked to give their preference one by one for each attribute, then they may select attributes which may not be feasible. In this case, combination of different levels of each attribute has been generated to administer to farmers and rate their preference. The number of combinations that could be created for two levels each of eight attributes selected for the study (Table 1.) was (2^8 = 256 profiles) which was complex for farmers to rank. Hence, out of these 256 combinations, by employing the orthogonal procedure, 12 combinations (profiles) of attributes and levels were obtained. By employing the orthogonal design, farmers' fatigue can be reduced to a minimum; thereby, 256 combi-nations are reduced to 12. The rule of thumb is the minimum number of choice sets should be equal to [(1 + Total number of attribute levels) Number of attributes] = [(1+16)-8] = 9 (Kumar and Babu, 2021) [4]. With the orthogonal design, generated the 12 combinations of attributes and attribute levels is simplified to make it easier for the farmers to describe their preferences.

Utility is a conceptual basis for measuring value in a conjoint analysis, which is an assessment of subjective preferences that are unique for each respondent. The conjoint analysis's main output is a series of utility values for each level of the attributes considered above. Each attribute that enjoys higher utility value will have a higher preference and a higher chance of being selected and vice versa. The predicted preference for each level of selected attributes of farmers preferences in availing different traits in Bengalgram would be obtained from the merging of these utilities across the respondents. This is given by:

$$Y = X_1 + X_2 + X_3 + ...+ X_n + \text{Constant}$$

where the independent variables on the RHS are the attributes of availing different traits in Bengalgram. These independent variables are non-metric (ranked) data for different profiles of farmers' preferences in availing different traits in Bengalgram, considering different levels across the selected attributes. While the dependent variable, Y is the overall or total utility preference of the respondent to different levels across different attributes. This dependent variable also includes farmer ratings of the importance of levels across the attributes of availing different traits in Bengalgram. Thus, in this study,

Total utility = Utility X_1 (attribute level 1 to i) + Utility X_2 (attribute level 2 to i) + Utility X_3 (attribute level 3 to i) + Utility X_4 (attribute level 4 to i) + Utility X_5 (attribute level 5 to i) + Utility X_6 (attribute level 6 to i) + Utility X_7 (attribute level 7 to i) + Utility X_8 (attribute level 8 to i) + Constant

where, Y = total utility, X_1 to X_8 = Predicted utility values of (eight) selected attributes and Constant = the constant value in the analysis. The mean utility values across all the

selected profiles serve as the analysis summary. They are used to derive the importance and relative importance of an attribute. Attribute importance is the difference between the highest and lowest utility levels of the attribute. The relative importance of an attribute is essentially its share of importance. If the distance between the utility levels of an attribute is large (i.e., the difference between the highest and lowest utility levels of the attribute), then that attribute will have a larger bearing on the farmers' choice of preference than another attribute, where the distance is not as large. The distance, therefore, reflects the importance of the attribute in determining farmer preferences.

Table 1: Attributes and attribute levels of bengalgram considered for conjoint analysis

S. No	Attributes	Attribute Levels
1.	Seed source	Government
		Private source
2.	Grain size	Round
		Oval
3.	Price of seed (Rs/Kg)	Rs.70
		Rs. 110
4.	Maturity time (days)	85 days
		95 days
5.	Plant height	Short
		Tall
6.	Pest and disease resistance	Less
		More
7.	Yield (Quintal)	9 Quintals
		12 Quintals
8.	Market Price (Rs/Qtl)	Rs. 6500
		Rs. 7000

Results and Discussion

The preferential traits of farmers in the selection of Bengalgram varieties

Conjoint analysis was employed to quantify the important traits of Bengalgram that are determining the farmers' preferences in the selection of Bengalgram varieties in the Kurnool district of Andhra Pradesh. Out of 160 sample farmers, 80 farmers were cultivating JG 11 and the remaining 80 farmers were cultivating NBeG 857. The attributes and levels were selected to analyse the preferences of Bengalgram varieties using Conjoint Analysis. Eight attributes were selected for the study, with three levels each. The selected attributes were 1. Seed source 2. Grain size 3. Price of seed (Rs/Kg) 4. Maturity time (days) 5. Plant height 6. Pest and disease resistance 7. Yield (Quintal/ha) 8. Market Price (Rs/Qtl).

Mean utility values of each attribute level

The utility estimates with the highest positive values represent the most preferred attribute levels among farmers, while the lowest negative values indicate the least preferred levels. Additionally, the overall utility value with the highest positive score reflects the most preferred combination of attributes.

From Table 2 and Fig.1, it was observed that the farmers' most preferred attribute level was 'Government' (1.514) under the 'Seed Source' attribute. This preference is largely due to the subsidies provided by the government, which lower input costs and reduce the burden of transportation for farmers. In contrast, the least preferred level was 'Private source' (-1.514), also under the 'Seed Source' attribute, as these private sources are typically located far from villages, resulting in higher transportation costs. Most respondents opined that the seeds supplied by the public sector were reasonably priced. (Patil, 2006) [6].

For the 'Yield' attribute, the '12 quintals' level has the highest positive utility value, with 1.469 indicating it was the most preferred yield level among farmers. In contrast, the '9 Quintal' level has a negative utility value of -1.469. This suggests that farmers prefer varieties that offer higher yields, as they are likely to generate better returns in the market (Ajayakumar *et al*., 2024) [1].

For the 'Grain size' attribute, the 'round' level was mostly preferred with the highest positive utility value of 1.140 as consumers prefer round-shaped seeds over oval seeds because round-shaped seeds perform better in post-harvest processing, which fetches a better price for farmers. The least preferred level was 'oval', which has the lowest negative utility value of -1.140, as consumers don't prefer and are not up to market standards (Ajayakumar *et al*., 2024) [1].

For the 'Price of seed' attribute, the 'Rs. 70/Kg level was mostly preferred with the highest utility value of 0.796, as farmers get a subsidy from the government. The least preferred level was 'Rs. 110/Kg' has the lowest negative utility value of -0.796, as farmers do not prefer to spend a larger amount of money on the agri inputs themselves, as they still have to spend their money on further agricultural operations (Kehinde *et al*., 2022).

For the 'Market Price' attribute, the 'Rs. 7000' level was preferred with the highest positive utility value of 0.761 for the farmers when the price for the produce was high in the open market so that every farmer could get profits over their investment without a distressed sale. whereas the least preferred was 'Rs. 6500', which in contrast has the negative utility value of -0.761, as farmers want to sell all of their produce in the open market when the prices are higher than MSP.

For the 'Pest and disease resistance' attribute, the 'more resistance' level was preferred with the highest positive utility value of 0.340, as farmers get to reduce the purchasing of more inputs like fertilizers if the crop is disease-resistant. whereas the least preferred was 'less resistance', which in contrast has the highest negative utility value of -0.340, as farmers need to purchase more inputs and produce may be reduced, which leads to distress sales (Ajayakumar *et al*., 2024 and Chinni *et al*., 2023) [1, 3]

For the 'Maturity time' attribute, the '85 days' was mostly preferred with the highest positive utility value of 0.222 because the closer the maturity, as shorter the duration of the crop fetches higher returns to the farmers. The least preferred level was '95 days', which has the lowest and negative utility value of -0.222. This might be due to the requirement of additional chemical spray and decline in the quality of the produce due to a high incidence of pests for long-duration varieties. (Ajayakumar *et al*., 2024) [1].

For the 'Plant Height' attribute, the 'Tall' level was the most preferred, with the highest positive utility value of 0.109. Taller plants are more suitable for machine harvesting, which helps reduce labour costs. In contrast, the 'Short' level was the least preferred, with a negative utility value of –0.109, as it typically requires manual harvesting, increasing dependence on labour (Parth *et al*., 2018) [5].

Table 2: The utility estimate values of bengal gram attribute levels

S. No	Attributes	Attribute Levels	Utility estimates
1.	Seed source	Government	**1.514****
		Private source	-1.514*
2.	Grain size	Round	1.140**
		Oval	-1.140*
3.	Price of seed (Rs/Kg)	70	0.796**
		110	-0.796*
4.	Maturity time (days)	85	0.222**
		95	-0.222*
5.	Plant height	short	-0.109*
		tall	0.109**
6.	Pest and disease resistance	less	-0.340*
		more	0.340**
7.	Yield (Quintal)	9	-1.469*
		12	1.469**
8.	Market Price (Rs/Quintal)	6500	-0.761*
		7000	0.761**

** The highest utility values represent more value from the farmers' perspective.
* The lowest utility values represent more value from the farmers' perspective

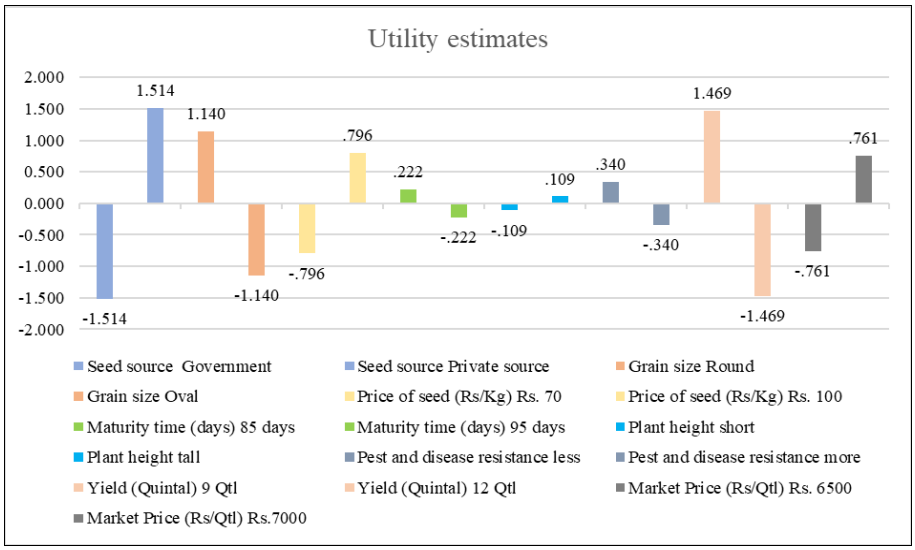

Fig 1: Mean utility values of each attribute level

Relative Importance among selected attributes

The choice of attribute levels has a critical bearing on perceived attribute importance, and this highlights why both the highest and the lowest prevalent levels should preferably be included in the research design to get unbiased estimates of the importance of attributes. If the range of levels within an attribute is stretched beyond the farmers' prevailing levels, its importance will be inflated. Since it may not always be desirable or feasible to cover a realistic range of levels within attributes, the correct interpretation should be in terms of the relative importance of the selected attributes. The findings are shown in Table 3.

It was observed that, for farmers, given the attribute properties tested in terms of relative importance, 'Seed Source' has the strongest influence with 23.83 per cent on the decision-making, followed by farmers considered 'Yield' (23.13 per cent) as the next important attribute which shows that they prefer improved varieties which are high yielding in nature. The other attributes like 'Grain size' (17.94 per cent), the farmer preferred round shape of grains. Followed by 'Price of seed' (12.53 per cent), 'Market price' (11.98 per cent), 'Pest and disease resistance' (5.35 per cent), 'Maturity time' (3.49 per cent), it shows that farmers are preferring to grow tall duration bengalgram varieties and 'Plant height' (1.71 per cent) were followed in the order of preference. Contrary to expectations, the 'Plant Height' attribute was given lower priority by farmers, as they believed that regardless of whether the crop is harvested manually or with the help of machinery, both methods would still incur labour costs. The relative importance of these attributes as perceived by the farmers in the study area will be useful to the state government in planning further development and promoting improved varieties.

Table 3: Relative importance values of bengalgram traits

S. No	Attributes	Relative Importance (%)
1.	Seed source	23.83
2.	Grain size	17.94
3.	Price of seed (Rs/Kg)	12.53
4.	Maturity time (days)	3.49
5.	Plant height	1.71
6.	Pest and disease resistance	5.35
7.	Yield (Quintal)	23.13
8.	Market Price (Rs/Qtl)	11.98
Total		100

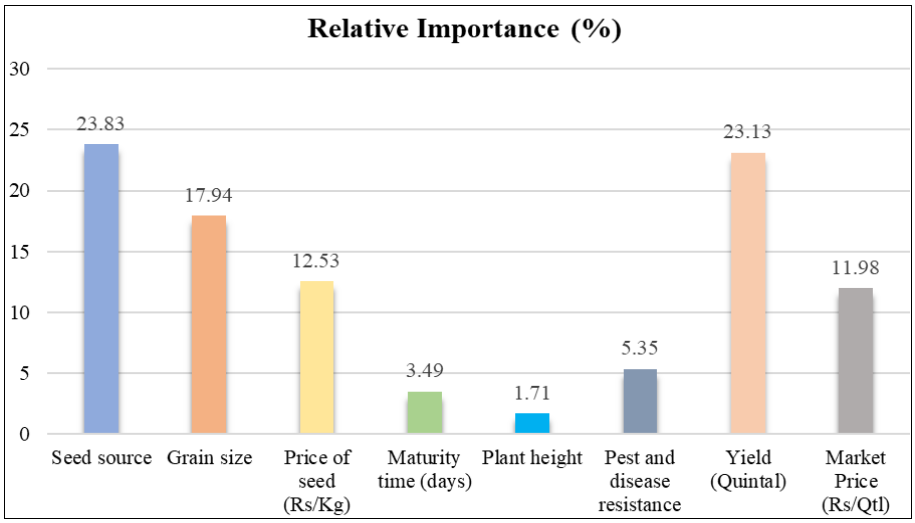

Fig 2: Relative Importance among selected attributes

Conclusion

The results show that the most desired trait of bengalgram farmers in Kurnool district that had an impact on farmers' purchasing decision is seed source, yield, grain size, price of seed, market price, pest and disease resistance, maturity time and plant height. These attributes are the key preferences of farmers in the region.

Therefore, farmers preferred varieties that are supplied at subsidized prices by the government, high-yielding varieties, the round-shaped grains could fetch better market prices and early maturing varieties with pest and disease resistance. Tall plant height is preferred as it reduces manual labour during harvesting.

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