



Study on Varietal Replacement Rate of Groundnut in Saurashtra Region of India

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HIGHLIGHTS

- 41.11 per cent of groundnut farmers in Gujarat replace varieties every 3-5 years, 30 per cent haven't replaced varieties in 5 years, and 28.89 per cent opt for replacement every 2 years.
- GG-20, released by GAU in 1991, remains the most recognized and adopted groundnut variety (70.55%), highlighting the low adoption of newer varieties.
- The study finds a significant positive link ($\chi^2 = 22.32^{**}$, $p < 0.01$) between farmers' perceptions of varietal replacement rate (VRR) and their adoption behavior, influenced by factors like gender, livestock ownership, credit access, occupation, risk orientation, innovativeness, and extension service engagement.

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ABSTRACT

The study conducted during 2024 investigated the dynamics of Variety Replacement Rate (VRR) in groundnut cultivation in Gujarat, India, which contributes significantly to the country's oilseed production. The study encompasses 180 farmers from three districts in the Saurashtra region, where 40.5 per cent of the nation's groundnut production originates. The study analyzed the extent of the VRR which states that around 41.11 per cent of the respondents had replaced variety every 3-5 years followed by 30 per cent had no replacement from 5 years and the remaining 28.89 per cent of the respondents had replaced variety for every 2 years. The extent of VRR is influenced by gender, livestock possession, access to credit, occupation, risk orientation, innovativeness, and extension contact. Concerning the perception of farmers towards varietal replacement rate (VRR), 45 per cent of respondents exhibited a neutral perception, followed by 27.78 per cent having a favorable and 27.22 per cent having an unfavorable level of perception towards the varietal replacement rate, emphasizing the need for interventions. Occupation, innovativeness, training received, and awareness significantly influence VRR perception. There is a positive and highly significant relationship between perception towards VRR and the extent of VRR at a 1% significance level with a chi-square value of 22.32.

INTRODUCTION

In India, groundnut is a significant oilseed crop that ranks first in acreage and second in production, after soybean. Gujarat, Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra, and Rajasthan have the highest percentage of groundnut production. About 90 per cent of the groundnut area is made up of these six states with a share of about 25–30 per cent of the international market. India is the

second-largest producer, processor, and exporter of groundnuts worldwide with 48 per cent of the country's groundnut production coming from Gujarat, as it's India's top producer. Gujarat and Rajasthan provide most of the groundnuts used for Indian exports. Despite being a major groundnut exporter, the country faces challenges in achieving high seed replacement rates (SRR) and varietal replacement rates (VRR). Seed is the most crucial part that

affects agriculture's growth and sustainability. Seed is the medium through which technology is delivered. The ability of high-quality seeds to grow new, healthy plants is essential to produce food, the security of the food supply, and eventually the population's survival (Muschick, 2009). One of the key factors in achieving increased agricultural productivity is the VRR. VRR is defined as the rate at which the existing varieties are replaced by new and high-yielding varieties in a given period. VRR acts as an indicator of the impact of the breeding programs. So far 238 high-yielding and improved groundnut varieties have been developed in India. More than twenty public institutions spanning the country are actively involved in developing location-specific and/or pan-India varieties tolerant to major abiotic and biotic stresses along with matching crop production and protection technologies (Pal et al., 2021). In groundnut cultivation, the VRR has significantly increased over recent years. From 2017-18 to 2019-20, varieties less than 5 years old made up 11.5 per cent of the total breeder seed indent. By 2022-23, this figure had risen to 31.4 per cent. However, VRR is still low as the indent in breeder seed from varieties less than 10 years old was 57.1 per cent which indicates there is a huge prevalence of older varieties in the seed chain (Annual Report, 2022). Depending on the crop, the direct contribution of high-quality seed alone to overall production is estimated to be between 15 and 20 per cent. SRR (Seed Replacement Rate) is still quite low, making the introduction of new varieties difficult (Digital Sansad, 2023). Over time, seed-saving procedures caused the average yield of HYVs to fall to values lower than those of landrace types, (Jelliffe et al., 2018). The replacement of old varieties with new high-yielding varieties leads to increased quality and quantity which paves the way for the food and nutritional security of the country. Pre-breeding, participatory plant breeding, maintenance breeding, quality seed systems, and policy assistance are crucial strategies to speed up the rate of varietal replacement, (Singh et al., 2020). As varietal replacement is not possible without seed replacement the farmers must change seed and variety both for increased yields for a more competitive market.

METHODOLOGY

Gujarat was purposefully selected as it is the state from which 40.5 per cent of the nation's groundnut production comes, (Oilseeds, 2023). Among the total groundnut area under cultivation in Gujarat on an average from 2019-2022, Saurashtra contributed 81.11 per cent of the area and 80.16 per cent of the production of Groundnut in Gujarat (Directorate of Agriculture, 2023). Hence the study was purposively conducted in the Saurashtra region. Out of 11 districts of the Saurashtra region, three districts were randomly selected. They are Junagadh, Rajkot and Jamnagar. From the three districts selected, two mandals from each district were selected randomly. From each Mandal two villages were selected randomly. Hence from 6 mandals a total of 12 villages were selected. From each village, a random sample of 15 farmers who are groundnut growers were selected. Hence the sample summed up to 180 farmers from all the 12 villages. Awareness was quantified by developing a schedule with major varieties recommended for Saurashtra listed on a 4-point continuum of aware and adopted, aware and not adopted, aware and discontinued, unaware. The overall summated score of all

varieties gives the awareness and adoption value. Perception of VRR was quantified by developing a schedule with statements on a three-point continuum where the overall summated score gives the perception value. Statements were scored as 1,2,3 for strongly agree, Neutral, and Disagree as they are negative statements. Based on the overall score obtained, each respondent was categorized into unfavourable, neutral, and favourable perception. Respondents with values less than the mean minus 1/2 SD were categorized as unfavorable, those above the mean plus 1/2 SD as favorable, and those in between as neutral. The extent of VRR was quantified on a three-point continuum based on the period in years in which farmers have changed the variety. The socio-personal variables included age, gender, education, occupation, total income, size of land holding, farming experience, livestock possession, risk orientation, innovativeness, access to credit, training received, extension contact, and awareness of existing varieties. Categorical variables were analyzed through frequency and percentage whereas continuous variables were analyzed and categorized into low, medium, and high based on mean and standard deviation. Respondents with values less than the mean minus 1/2 SD were categorized as low, those above the mean plus 1/2 SD as high, and those in between as medium. To find the relationship of independent variables on perception towards VRR, and the extent of VRR, different statistical analyses such as the chi-square and Fisher's exact tests were done.

Hypothesis formulation:

Null hypothesis (H_0): The independent variables are not associated with farmers' perceptions of VRR or the extent of VRR (i.e., there is no significant relationship).

Alternative hypothesis (H_1): The independent variables are associated with farmers' perceptions of VRR and the extent of VRR (i.e., there is a significant relationship).

The test statistic of the chi-squared test:

$$\chi^2 = \sum (O - E)^2 / E \sim \chi^2 \text{ with degrees of freedom } (r - 1)(c - 1),$$

O and E represent observed and expected frequency, and r and c are the number of rows and columns of the contingency table.

Fisher's exact test is typically utilized in the analysis of small samples, even though it is applicable for all sample sizes. While the chi-squared test depends on an approximation, Fisher's exact test is one of the precise tests. When more than 20 per cent of cells have projected frequencies less than 5, the approximation strategy is insufficient and Fisher's exact test must be performed.

RESULTS

The data revealed that around 36.11 per cent of the respondents belong to the medium awareness category followed by the high awareness (35.00%) and the low awareness category (28.89%) respectively. Table 1 suggests that most of the farmers have medium and high awareness about the varieties in the seed chain which indicates that farmers are interested and updated with all the new varieties in their locations.

The frequency of each response category (Aware and adopted, Aware and not adopted, Aware and discontinued, Unaware) was multiplied by its assigned score (4,3,2,1 respectively), and these

Table 1. Distribution of groundnut growers according to level of awareness and adoption

Category	Percentage
Less awareness (Up to 16)	28.89
Medium awareness (17-20)	36.11
High awareness (Above 20)	35.00
Total	100

Mean: 17 1/2 S.D:1.6

Source: Field Survey, 2024

products were summed to obtain the total score for each variety. GG-20, released by GAU in 1991, had the highest adoption rate (70.55%) among farmers, coupled with a low discontinuation rate (11.11%) even though the variety was released in 1991 which affects the VRR in the groundnut crop. This will decrease the replacement of new varieties in the crop and lead to a decrease in VRR in the crop. In contrast, newer varieties like GJG-22 and GJG-32, released by JAU in 2019-20, showed moderate adoption levels (53.89% and 43.89% respectively). Similarly, varieties released in 2019 by ICAR-DGR, Girnar-4, and Girnar-5, exhibited lower adoption rates

(23.34% and 20.00% respectively) due to unavailability in the seed chain which can be improved by increasing the seed production under certified and truthful labeled seed by public and private seed industries and increase the availability in the seed market. A few strategies such as pre-breeding, participatory plant breeding, maintenance breeding, quality seed systems, and policy assistance are crucial to speed up the rate of varietal replacement, (Singh et al., 2020)

Perception of farmers towards varietal replacement rate

Around 45.00 per cent of the respondents had a neutral level of perception toward the varietal replacement rate followed by 27.78 per cent having a favorable level of perception towards the varietal replacement rate. While around 27.22 per cent had an unfavorable level of perception toward varietal replacement rate. It suggests that both favorable and unfavorable perceptions are the same which indicates a strong need for awareness and capacity building of farmers regarding the benefits of varietal replacement. For each statement, the weighted score was calculated. The frequency of each response category (Strongly Agree, Neutral, Disagree) was

Table 2. Distribution of popular varieties in the seed chain in Saurashtra

Variety Name	Released Year and Agency	Aware and adopted (4)	Aware and Not Adopted (3)	Aware and discontinued (2)	Unaware (1)	Weighted score
GG-20	GAU, 1991	70.55%	13.34%	11.11%	5.00%	629
GJG-22	JAU, 2019-20	53.89%	26.67%	12.22%	7.22%	589
GJG-32	JAU, 2019-20	43.89%	30.00%	15.00%	11.11%	552
GIRNAR-4	ICAR-DGR, 2019	23.34%	47.22%	8.33%	21.11%	491
GIRNAR-5	ICAR-DGR, 2019	20.00%	51.11%	6.67%	22.22%	484
GG-41	JAU, 2018-19	31.67%	28.33%	10.56%	29.44%	472
GG HPS-2	JAU, 2017-18	16.67%	27.22%	9.44%	46.67%	385

Source: Field Survey, 2024

Table 3. Statement-wise analysis of the Perception of farmers regarding VRR

S.No.	Statements	Weighted Score
1.	I believe that because the new variety of groundnut is not adapted to the local environment, the production is likely to be low.	204
2.	Currently, I can grow other crops (Intercropping) in the same variety I am planting but I am not sure if I can get the production of other crops by changing the variety.	243
3.	At present the variety that I am planting is the same variety that my fellow/neighbor farmers are planting, so I plan to choose the same variety.	255
4.	I don't know if the quality of fodder in the new variety will be better than the one, I am planting or not.	258
5.	The variety that I am currently planting gives good yield even during climate change.	270
6.	We are afraid that the variety that I am planting is high-yielding, and if a new variety is planted, the yield will be higher or not.	271
7.	I believe that the variety I am currently planting is more resistant to disease and pests than other varieties.	292
8.	Seeds of new varieties can be sown if seeds are obtained from universities/corporations / KVK / other government or semi-government organizations, but seeds from private companies are not reliable.	309
9.	No experience with new varieties so I don't adopt new varieties.	312
10.	At present, the variety that I am planting has low pod loss during harvesting, and the labor cost seems less.	313
11.	The variety I currently grow has a high shelling percentage, so traders are more accepting of it.	322
12.	The variety I am planting on my land currently has more production capacity than other varieties.	335
13.	Nonavailability of new variety and high cost.	339
14.	The variety I am currently growing has a higher oil content than the other variety.	341
15.	We do not know whether the new variety will be free from aflatoxin contamination or not.	342
16.	The variety I am currently planting is government-modified.	383
17.	I believe that the seed germination capacity of the current variety that I am planting is higher than the new variety.	402

Source: Field Survey, 2024

Table 4. Relationship between the VRR and socio-personal variables

Dependent Variable	Variables	Test	Test statistic	Sig.
Perception of VRR	Education	Chi-Square	13.92**	0.00
	Occupation	Fisher's Exact Test	8.96*	0.05
	Livestock Possession	Chi-Square	8.91**	0.01
	Innovativeness	Chi-Square	10.35*	0.03
	Training received	Chi-Square	7.31*	0.02
	Extension contacts	Chi-Square	12.58**	0.01
	Awareness	Chi-Square	10.27*	0.03
Extent of VRR	Gender	Chi-Square	6.35*	0.04
	Occupation	Fisher's Exact Test	22.59**	0.00
	Livestock Possession	Chi-Square	7.61*	0.02
	Risk Orientation	Chi-Square	22.00**	0.00
	Innovativeness	Chi-Square	22.05**	0.00
	Access to Credit	Chi-Square	11.48*	0.02
	Extension contacts	Chi-Square	20.85**	0.00

Source: Field Survey, 2024

*Significant at 0.05 level of significance, **Significant at 0.01 level of significance

multiplied by its assigned score (1, 2, or 3), and these products were summed to obtain the total score for each statement. The weighted score for each statement was then interpreted, with lower scores indicating stronger agreement with the negative statements and higher scores indicating stronger disagreement.

Extent of varietal replacement rate

Around 41 percent of the respondents had replaced variety for every 3-5 years followed by 30.00 percent had no replacement from 5 years and the remaining 28.89 per cent of the respondents had replaced variety for every 2 years. It suggests that a very low amount of farmers is replacing variety every 2 years which needs to be increased and farmers in the category of 3-5 years must be provided with new varieties at affordable cost which can help them in regular variety replacement.

Among all the variables, occupation (8.96*), innovativeness (10.35*), training received (7.31*) and awareness (10.27*) had positive and significant relationships with the perception of VRR at a 5 per cent significance level and variables such as education (13.92**), livestock possession (8.91**) and extension contact (12.58**) had a positive and highly significant relationship with perception towards VRR at 1 per cent significance level. Out of the 14 variables gender (6.35*), livestock possession (7.61*), and access to credit (11.48*) had positive and significant relationships with the extent of VRR at a 5 per cent significance level and variables such as occupation (22.59**), risk orientation (22.00**), innovativeness (22.05**) and extension contact (20.85**) had a positive and highly significant relationship with the extent of VRR at 1 per cent significance level.

Table 5. Relationship between Extent of VRR and Perception of VRR

Variables	Test	Test statistic	Sig.
Extent of VRR x Perception of VRR	Chi-Square	22.32**	0.00

Source: Field Survey, 2024

*Significant at 0.05 level of significance, **Significant at 0.01 level of significance

There is a positive and highly significant relationship between perception towards VRR and the extent of VRR at a 1 per cent significance level with a chi-square value of 22.32**. It shows that perception towards VRR and the Extent of VRR are highly significantly related; change in one could change the other.

DISCUSSION

The study reveals that farmers in the Saurashtra region show a positive inclination towards staying informed about groundnut varieties, with a significant proportion falling into medium and high awareness categories. The results align with Singh et al., (2015) in which most respondents had a medium level of knowledge (65.5%) about sustainable groundnut production. The results of awareness of farmers about existing seed varieties state that the adoption of old varieties such as GG 20 was still very prominent in the Saurashtra region because of its export potential and demand. New varieties such as GG 32 were adopted and discontinued in a few areas because of their bitter taste. Varieties such as Girnar 4 and 5 released from ICAR-DGR (Directorate of Groundnut Research) had low adoption rates due to the unavailability of seed in the seed chain and adulteration of seed by creating seed mixtures which led to a loss of credibility among the farming community. The findings from this study reveal critical factors influencing farmers' decisions regarding the adoption of new groundnut varieties, based on the weighted scores assigned to specific statements. Concerns related to the adaptation of new varieties to local environments, implications for intercropping practices, and conformity with neighboring farmers' choices are highlighted. Factors such as uncertainties about fodder quality, perceived stability of yields under changing climatic conditions, and apprehensions regarding potential yield reductions with new varieties also shape farmers' perception towards VRR. Furthermore, preferences for seeds sourced from trusted institutions highlight farmers' perceptions of seed reliability and institutional trustworthiness. These findings are consistent with Kumar et al. (2012), who observed that poor knowledge of high-yielding varieties, high seed costs, and market malpractices were significant constraints in adopting groundnut production technologies. Similarly, Verma and

Yadav (2011) reported that farmers had low knowledge of the use of HYVs among all the given practices in groundnut cultivation. The study also reveals a notable opportunity to encourage more frequent variety replacement, particularly among farmers who replace their varieties every 3-5 years. This group represents a significant segment that could benefit from access to new varieties at affordable costs, facilitating more regular and strategic variety turnover. If this segment of farmers is trained and supported, they could play a key role in increasing the variety replacement rate (VRR) by adopting new varieties. Perception of VRR is associated with occupation, innovativeness, training received, and awareness. Additionally, education, livestock possession, and contact with agricultural extension services further enhance this perception and show significant relation at a 1 percent level of significance. In terms of the extent of VRR, gender, livestock possession, and access to credit play significant roles, while occupation, risk orientation, innovativeness, and extension contact have a highly significant impact. These results suggest that both individual characteristics and access to resources and support services are crucial in the development of positive perception and greater adoption of VRR technology. The results are in line with (Nuthalapati et al., 2020) who state that the ability to obtain information about new technologies, their applications, and their sourcing strategies is essential in the process of technological change. According to the findings, farmers who get their variety information from media sources switch to new varieties 87 percent faster than farmers who do not. The only varietal characteristic variable for soybeans that has been identified to affect varietal turnover is fodder palatability same as groundnut. The only deviation of the study is access to credit as it's not significant in the study by (Nuthalapati et al., 2020) but as groundnut has a much higher cost of cultivation than soybean due to its higher seed cost, access to credit plays a significant role in groundnut cultivation. Shasani et al. (2020) also found that social participation, mass media exposure, and extension participation positively correlate with the adoption of groundnut cultivation technology. The results are in line with the study by (Jalu et al., 2022) which revealed a positive and significant association between the extent of adoption of recommended groundnut production technologies and size of land holding, annual income, mass media exposure, extension contact, innovativeness, scientific orientation, risk orientation, economic motivation, and yield index in demonstrator farmers.

CONCLUSION

Improved cultivars can only be widely diffused and adopted quickly if a robust seed distribution and multiplication system is in place. If the public sector supports this system, it may decrease cultivation costs while increasing production. Market demand also emerged as a crucial factor, showcasing the rational approach of farmers in aligning their choices with market dynamics. However, concerns related to adaptability to local environments, potential yield reductions, and peer influence on variety selection emphasized the need for targeted awareness campaigns and interventions. Findings emphasize the importance of addressing farmers' misconceptions, enhancing awareness, and providing support for

making informed decisions. The results state the need for collaborative efforts involving agricultural extension services, research institutions, and policymakers to design interventions that promote the availability, accessibility, and affordability of quality seeds of the new varieties to the farming community.

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