

Demographic Influences on the Adoption of Herbicides in Indian Agriculture: A Study of Soybean and Sunflower Farmers

ABSTRACT

The study has conducted to identify the factors **influencing** the adoption of new molecules as an input for sustainable and viable agriculture. The adoption of herbicides reduces the drudgery in terms of manpower utilized in manual hoeing to reduce the weed infestation. The inequality in adoption behavior of farmers variably dependent on personnel as well as social factors however fast adoption is get momentum by seeing by doing or demonstrations conducted by manufactures. The study was statistically analysed using chi-square test. The sample size was 459 in eight districts of five states of India. The study has shown that a farmer's adoption behavior is significantly influenced by their age, level of education, and amount of land they own, but gender has no discernible effect. **Also, here emphasize the advancements in adoption of herbicides for an alternate approaches in management of resources which are particularly valuable to agroecology, policymakers, and stakeholders.**

Keywords: Adoption, Chi-square, Demographic factors, Herbicide, Laggards

Introduction :

Soybean known as the "GOLDEN BEAN" is a pulse legume and is one of the important protein and oil seed crop throughout the world (Movalia, 2020). Its oil is the largest component of the world's oils (Imsonget *al.*, 2023). Soybean forms a significant position as a Kharif oilseed in Indian agriculture and ranks 5th in the list of the leading Soybean producing countries. Madhya Pradesh and Rajasthan are leader in soybean producers. It is often regarded as one of the most nutritional oilseeds (Rathore, 2011). Sunflower, on the other hand, has gained popularity for its oil-rich seeds. Sunflower oil, which contains high levels of essential fatty acids and vitamin E, has emerged as a healthier alternative to typical cooking oils (Mohapatra et al., 2020). In the agricultural fields, farmers often face the difficulty of weeds. Lower yields and output quality are the major outcome of these undesirable plants competing with the economic crops for resources like nutrients, water, space and sunlight (Binjhaet *al.*, 2022). Certain weed-killing substances, from their simple origins as inorganic salts and vinegar solutions to the advanced, focused organic

chemical agents utilized today, have surely influenced the agricultural landscape with their selective character. The purpose of these compounds is to protect the main crops by either killing or suppressing the growth of weeds. The market for herbicides has expanded rapidly in the last few years. The need for herbicides is growing as the world's population rises and more food is required to feed them. The herbicide industry could be drastically altered by the release of a new herbicide. But for farmers, choose which new herbicides to use is a big decision that depends on a lot of significant aspects, one of which is their demographic profile. The congenial atmosphere during kharif season along with wide geometry of crop permits rapid growth of weeds and caused even up to 85% reduction in crop yield (Jain and Maliwal, 2022).The study focusing on awareness-raising and involvement inclusion within farmers community for overcoming the demographic hurdles in their social limitations. The survey regarding major factor deciding the adoption of newer and safer molecules from reputed companies to make the crop production more and more profitable was conducted with the help of pre-decided survey schedule supplied by the manufactures. The demographic factors have a great role in adoption besides financial management, leadership, marketing skills and ICT's.

At the moment, 4% of all herbicides are used on soybeans. The average annual herbicide usage in India is 40 g/ha, but in other developed countries it ranges from 675 to 1350 g/ha (Das *et al.*, 2012).The contemporary agricultural input market, according to Akila and Kathirvel (2013), is very competitive and changing. Many items fail to find a place in the market since today's farmers will not accept any product that does not fully satisfy them. Because of this, the modern market is focused on the needs of the consumer, and the success or failure of any product is entirely determined by its user base .According to Surender *et al.* (2021), the primary factors influencing herbicide purchases were financial concerns, followed by farmers' ignorance about herbicide products and the absence of financing options at input stores.

Methodology

The random survey of the targeted beneficiaries from 9 districts of four states (table 1) of the country was conducted using the prescribed format by individual survey during growing season. The targeted farmers using the new molecule for

controlling weeds in standing high value cash crops in their regions. The major crops are also mentioned in table 1 against respective areas. Convenience sampling technique was adopted for the present study.

Table 1. List of localities of beneficiaries

S.No.	State	Districts	Crop under study
1	Madhya Pradesh	Dhar, Harda, Vidisha, Guna, and Sagar	Soybean
2	Rajasthan	Kota and Baran	Soybean
3	Uttar Pradesh	Lalitpur	Soybean
4	Haryana	Kurukshetra	Sunflower

Primary data was collected using a structured schedule through personal interviews with farmers in the chosen area of research. The schedule was administered on 459 (approx. 50 per district) farmers to solicit factual responses in a timely manner. It comprised close ended questions regarding demographic profile such as age, gender, education, land holding size and the farmers' behaviour toward adoption of new herbicide. The data was statistically analysed using chi square test and depicted in tables, charts etc. Regression and correlation analysis were used by Cheong (2002) to determine the association between internet usage and age and concluded that internet application and demographic factors such as gender, income, and education are significantly correlated.

Hypotheses

Hypothesis 1= There is a significant association between farmer age and product adoption level.

Hypothesis 2= There is a significant association between farmer landholding and product adoption level.

Hypothesis 3= There is a significant association between farmer education and product adoption level.

Hypothesis 4= There is a significant association between farmer gender and product adoption level.

Results and discussion

Demographic Profile

The data of 459 farmers regarding age, education, land holding, and gender was collected from the respondents and is shown in graphs below.

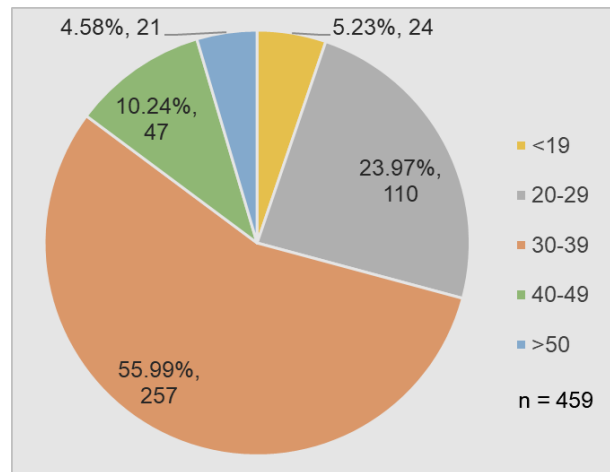


Figure 1 Farmer's distribution based on their Age

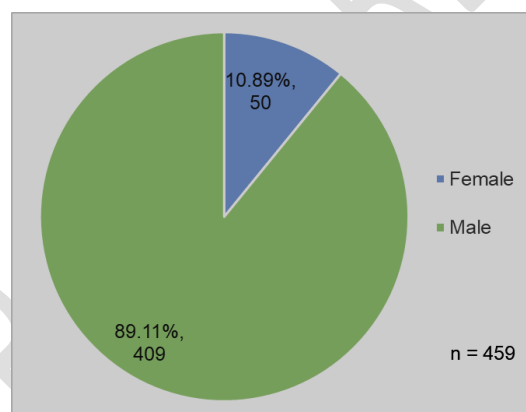


Figure 2 Farmer's distribution based on their Gender

Figures 1 showed that the age group of 30-39 comprised 55.99% of farmers, with 20-29 making up 23.97%, 40-49 making up 10.24%, and younger than 19 making up 5.23%. Farmers over 50 made up the least percentage of the population (4.58%). 89.11% of the 459 farmers were men, and the remaining were women (Fig. 2).

The distribution of farmers on the basis of land holding was as follows: medium farmers accounted for 39% of the total number, followed by large farmers (27.5%), semi-medium farmers (20.70%), small farmers (8.06%), and marginal farmers (4.79%) (Fig.3). Just 1.53% of farmers were graduates, 23% were illiterate, and 55.56% of farmers had completed their education up to the 10th standard,

19.83% to the 12th standard (Fig. 4). Thus, it may be concluded that the sustainability and viability of the product, it was essential to aware and promote advance gender equality among farming community. Further education play a major role in adoption of the product. The hurdle in these may be avoided by mass campaign through technology and result demonstrations.

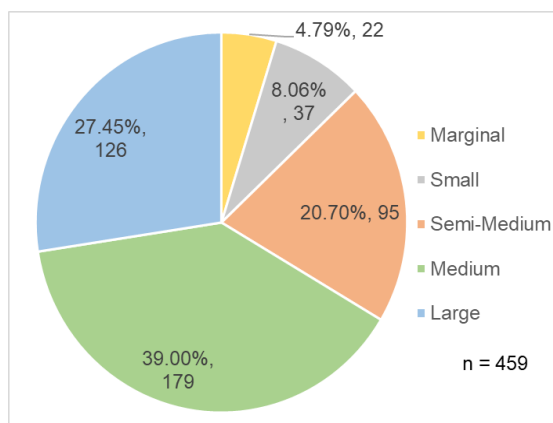


Figure 3 Farmer's distribution based on their Land Holding

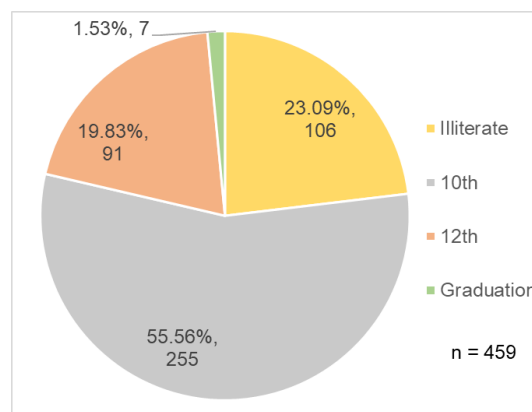


Figure 4 Farmer's distribution based on their Education

Influence of demographic factors on product adoption

Table 2 Farmer classification on basis of product adoption Category

Product adoption category	Frequency	Percentage
Innovators	85	18.52%
Early Adopters	116	25.27%
Early Majority	134	29.19%
Late Majority	76	16.56%
Laggards	48	10.46%
Total	459	100.00%

Table 2 shows that 134 (or 29.19%) belong to the early majority group, 116 (or 25.27%) to the early adopter group, and 85 (18.52%) to the innovator group. Conversely, 48 (10.46%) and 76 (16.56%) farmers belong to the laggards and late majority groups, respectively. According to Pandya *et al.* (2005), weed control is

essential to minimizing the quantity of nitrogen that weeds drain from crops and guaranteeing that the crop successfully uses fertilizer. Crops can more efficiently utilize soil nutrients when weeds are controlled. Herbicides are used on about 20 million hectares in India, or about 10% of the country's total planted area, according to Yaduraju *et al.* (2006).

Table 3 Chi Square analysis of Demographic factor and Product adoption

Demographic Variable	Chi-Square Value	p-value	Result
Age	252.37	< 2.2e-16	Alternate Hypotheses is accepted
Gender	1.2118	0.8762	Null Hypotheses is accepted
Education	68.943	5.047e-10	Alternate Hypotheses is accepted
Land Holding	260.87	< 2.2e-16	Alternate Hypotheses is accepted

Table 3 shows that a farmer's adoption behavior is significantly influenced by their age, level of education, and amount of land they own, but gender has no discernible effect. Further more, it was noted that the majority of farmers moved from innovators to laggards as their ages increased and their landholding decreased. The majority of farmers belong to the innovator, early adopter, and early majority groups at all educational levels, despite the fact that education level has a significant impact on the degree of product adoption. Conversely, the number of late majority and laggards rises as education level falls. **Mentality associated with the adoption of newer molecules encompass a complex web of policies ensuring environmental safety and effective management of herbicidal products (Parven *et al.* 2024)**

Conclusion

This study has identified the drivers of demographic variables significantly impacted the pace at which farmers accepted new molecules. The age, landholding and education were the three demographic factors significantly affected the acceptance

while gender had no effect at all. It was also concluded that as they grew older and less educated, the majority began to resemble laggards.

FUTURE SCOPE

Further studies can be done on newer molecules and new areas and involving more and more parameters, performance and sustainability can be established within the members.

Disclaimer (Artificial intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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