

Market Share and Purchase Influencing Factors of Various Pesticide Brands in Uttar Pradesh

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Article History	Abstract
Received: 06 June 2023 Revised: 05 Sept 2023 Accepted: 14 Nov 2023	The worldwide consumption of pesticides is about two million tons per year. Out of which 45 percent is used by Europe alone, 25 percent is consumed in the USA, and 25 percent in the rest of the world. The three most commonly used pesticides are HCH (only gamma-HCH is allowed), DDT and Malathion, and these account for about 70 percent of the total pesticide consumption. India's consumption of pesticide is only 3 percent of total world's consumption of pesticides. Among different classes of pesticide, contribution of insecticide (60 percent) is high followed by fungicide (19percent), herbicide (16percent), Bio-Pesticide (3percent) and others (3percent). It is estimated that 18- 20 percent of total pesticides used in the country are applied on vegetables. The Government of India regulates the production, import, Sales, and use of pesticides through the Insecticides Act, 1968. The market in India is highly dominated by the foreign players. Bayer AG is the largest agrochemical producer in the world. Some of the big names include Yara International ASA, BASF, Bayer Crop Science Limited, Indofil Industries Limited, Makhteshim Agan Industries Ltd, Dow Agro Sciences, Monsanto, Syngenta, Aventis, Agrium etc. This study show the market shares of various brands in which 15.15% share in insecticides was Pexalon of Corteva Agriscience, 14.70% chess of Syngenta, 13.16% of coragen(FMC India Pvt. Ltd.) and remaining others. In market share 33.09% Indofil Industries, 18.23% UPL and rest in remaining. The retail trade influence was maximum on the farmers and ranked I followed by influence from company representative ranked II. Farmers meeting, distribution of literature and samples, through participation in fairs and wall painting were moderately influencing factors, which were ranked fourth, sixth, and seventh.
CC License CC-BY-NC-SA 4.0	Keywords: Supply chain strategies, Marketing of pesticides, Distribution channel, Agrochemical industry, Agricultural productivity, Farmer education, Promotional strategies

1. Introduction

Agriculture is a critical driver of India's economy, employing 59% of the population and contributing 23% to the GDP in 2016. To sustain this sector and ensure food security for over 1.21 billion people, modern farming techniques, including the use of quality pesticides, are essential. Pesticides act as a protective shield for crops, effectively controlling pests, diseases, and weeds. Over the past five decades, the use of pesticides has significantly increased agricultural productivity in India. Worldwide, approximately two million tons of pesticides are consumed annually, with Europe (45%), the USA (25%), and other regions (25%) being major consumers. Common pesticides such as HCH, DDT, and Malathion remain popular due to their cost-effectiveness. India's pesticide consumption accounts for just 3% of global usage, with insecticides (60%) being the most widely used type, followed by fungicides (19%) and herbicides (16%). About 18-20% of pesticides are used on vegetables. Vegetables are rich in nutrients, but per capita consumption in India falls below WHO standards. India ranks second in global vegetable production, contributing 14% to the world's total. The demand for vegetables is projected to increase significantly. Pests, diseases, and weeds are responsible for significant crop losses in India, amounting to around 10-30% of total production. Effective pesticide use can help minimize these losses. The Government of India regulates pesticides through the Insecticides Act, 1968, ensuring their safe use while protecting human health and the environment. Regulatory bodies like the Central Insecticides Board play a crucial role. Uttar Pradesh faces challenges related to pesticide misuse, health and environmental concerns, and the need for better monitoring and enforcement of regulations. To address these challenges, the Uttar Pradesh government, in collaboration with central agencies, conducts awareness programs, training workshops, pesticide testing, and regulatory measures. The

Indian pesticide market is dominated by foreign players, with Bayer AG being the largest global agrochemical producer. Several Indian companies also operate in this sector. Pesticides play a crucial role in agribusiness by protecting crops and enhancing agricultural productivity. Effective marketing and distribution strategies are vital for their success. Pesticide marketing involves a complex distribution system, unique challenges like continuous supply and seasonal crop production, and the need to maintain product quality. Logistics and distribution are key components.

2. Materials And Methods

In this research study conducted in various districts and blocks of Uttar Pradesh, you employed a multi-stage sampling design and collected both primary and secondary data. The research was conducted in different districts and blocks of Uttar Pradesh. Data was collected from farmers, pesticide distributors, and retailers. A multi-stage sampling design was used to select samples. Blocks from different districts were randomly selected. Two villages from each randomly selected block were chosen. Five to fifteen farmers were randomly selected from each village. The sample size consisted of 400 farmers. Additionally, 100 pesticide retailers from various districts in Uttar Pradesh were randomly selected. Both primary and secondary data were collected to achieve the research objectives. Primary data was collected through surveys using questionnaires. Farmers and retailers/distributors were interviewed directly. Secondary data was gathered from various published sources and agencies, such as the Department of Agriculture, agrochemical company surveys, government publications, and research papers. Analysis techniques included tabular analysis and functional analysis. Tabular analysis was used to assess the market share of different pesticide companies. Various statistical tools were employed for tabulating, computing, and analysing the data. Garrett's ranking technique was used to rank factors influencing farmers' brand preference and promotional approaches. Descriptive statistics, pie charts, bar charts, and other statistical tools were adopted for the analysis of data.

3. Results and Discussion

The result of the present study was discussed under the two aspects, first one is market share of the various pesticides and second was purchase influencing factors.

Market share of different brands of pesticides

This section deals with the different brands of insecticides market share under insecticides, fungicides and herbicides and in discussed in the table 1,2 &3.

Table 1 Market share of different brands of insecticides in Uttar Pradesh

S.N o.	Brand Name	Companies	Average Sales/retailer or distributor/year (Rs.in Lakhs)	Total Val of 100 Retailors /Distributors	Percentage Share
1	Pexalon	Corteva Agrisciences	1.98	198.33	15.15%
2	Chess	Syngenta India Ltd	1.93	192.50	14.70%
3	Coragen	FMC India PVt Ltd	1.72	172.33	13.16%
4	Ferterra	FMC India PVt Ltd	1.68	168.00	12.83%
5	Ampligo	Syngenta India Ltd	0.97	97.07	7.41%
6	Adama Acemain	Adama india private limited	0.76	75.83	5.79%
7	Largo	Dhanuka Agritech	0.75	74.67	5.70%
8	Ulala	UPL Limited	0.72	72.00	5.50%
9	Benevia	FMC India PVt Ltd	0.61	60.67	4.63%
10	Abacin	Crystal Crop Protection	0.48	47.67	3.64%
11	Barazid	Adama india private limited	0.46	45.83	3.50%
12	Takumi	Rallis india Ltd	0.40	40.33	3.08%
13	Furatox	Pi Industries Ltd	0.40	40.00	3.06%
14	Padan	Coromandal	0.24	24.00	1.83%
	Total		13.09	1309.23	100

Source: Present Survey Data by Researcher

The table 1 depicting the market share of various insecticide brands in Uttar Pradesh provides several important results and conclusions about the insecticide industry in the region. These findings are crucial for stakeholders, manufacturers, distributors, and policymakers to understand the market dynamics and make informed decisions. Here are some key results-

1. **Market Leader Identification:** Pexalon, produced by Corteva Agrisciences, stands out as the market leader with a 15.15% share. It achieves this position through an average annual sales of 1.98 lakhs per retailer or distributor, resulting in a total value of 198.33 lakhs. This indicates that Pexalon is the preferred choice among retailers and distributors in Uttar Pradesh.
2. **Brand Diversity:** The market in Uttar Pradesh is diverse, with several brands capturing significant market shares. Chess (Syngenta India Ltd) and Coragen (FMC India Pvt Ltd) are strong contenders, with 14.70% and 13.16% shares, respectively. This diversity is a positive aspect, providing consumers with a range of choices and fostering healthy competition.
3. **Company Influence:** Some companies, like FMC India Pvt Ltd, have multiple brands (Coragen, Ferterra, and Benevia) in the top 10, collectively capturing a substantial portion of the market. This suggests that brand portfolios and company reputation play a significant role in market success.
4. **Distribution and Sales Strategies:** The table underlines the importance of effective distribution and sales strategies. Brands like Ampligo (Syngenta India Ltd) and Adama Acemain (Adama India Private Limited) might not have the highest individual sales but still hold significant market shares. This indicates that their sales strategies are effective in reaching a broader range of retailers and distributors.
5. **Market Size:** The total market size for insecticides in Uttar Pradesh is 1309.23 lakhs, reflecting a substantial demand for these products. This underscores the economic significance of the insecticide industry in the region.
6. **Opportunities for Growth:** Smaller brands, such as Barazid (Adama India Private Limited), Takumi (Rallis India Ltd), and Furatox (Pi Industries Ltd), while having smaller market shares, still represent opportunities for growth and expansion, given the size of the overall market.

In conclusion, this table highlights a competitive and diverse insecticide market in Uttar Pradesh. While Pexalon enjoys the largest market share, there is a healthy mix of brands and companies, creating a dynamic market. Effective sales and distribution strategies, along with brand reputation, contribute significantly to market success. The size of the market indicates strong demand for insecticides in the region, which can be seen as an opportunity for both established and emerging brands. Overall, this data is essential for market participants and policymakers to understand and make informed decisions in the Uttar Pradesh insecticide industry.

Table 2 Market share of different brands of fungicides in Uttar Pradesh

S.N o.	Brand Name	Companies	Average Sales/retailer or distributor/year (Rs.in Lakhs)	Total Val of 100 retailers/Distributors	Percentage Share
1	Indofil M-45	Indofil Industries Ltd.	1.21	121.00	33.09%
2	Saaf	UPL Limited	0.67	66.67	18.23%
3	Mirador	Adama India	0.36	36.17	9.89%
4	Nativo	Bayer India Ltd.	0.30	30.00	8.20%
5	Custodia	Adama India	0.22	22.00	6.02%
6	Pulsor	IIL	0.18	18.00	4.92%
7	Acrobat	BASF	0.15	14.93	4.08%
8	Sprint	Indofil Industries Ltd.	0.11	11.33	3.10%
9	Cosavet DF	Sulphur Mills Ltd.	0.11	10.67	2.92%
10	Tilt	Syngenta India	0.08	7.58	2.07%
11	Ridomil	Syngenta India	0.08	7.57	2.07%
12	Rokko	Biostadt India	0.07	6.91	1.89%
13	Blitox	Rallis	0.07	6.81	1.86%

14	Bavistin	IIL	0.06	6.08	1.66%
	Total		3.66	365.72	100
Source: Present Survey Data by Researcher					

The table 2 detailing the market share of various fungicide brands in Uttar Pradesh provides valuable insights into the state of the fungicide industry in the region. Here are the key results and conclusions drawn from the table:

1. **Market Leader and Strong Competitors:** Indofil M-45, produced by Indofil Industries Ltd., is the dominant brand with a 33.09% market share. It achieves this position with an average annual sale of 1.21 lakhs per retailer or distributor, totaling 121.00 lakhs. However, Saaf from UPL Limited also holds a substantial market share of 18.23%, illustrating that there is a clear competition between the two brands.
2. **Company Influence:** Similar to the insecticide market, this table highlights the influence of certain companies in the fungicide market. Companies like Indofil Industries Ltd. have multiple brands (Indofil M-45 and Sprint) in the top 10, collectively capturing a significant share of the market. This indicates that the reputation and diverse product portfolio of these companies play a key role in market success.
3. **Diverse Market:** The fungicide market in Uttar Pradesh is diverse, with several brands capturing notable market shares. This diversity provides options for farmers and agricultural professionals, enhancing the overall competitiveness of the market.
4. **Total Market Size:** The total fungicide market size in Uttar Pradesh is 365.72 lakhs, indicating a substantial demand for fungicides in the region. This showcases the importance of the fungicide industry in supporting agriculture and crop protection.
5. **Opportunities for Growth:** Smaller brands, such as Rokko (Biostadt India) and Blitox (Rallis), though having smaller individual market shares, still represent opportunities for growth and expansion in the market. Given the overall market size, these brands have the potential to increase their market presence.

In conclusion, the table reveals a competitive and diverse fungicide market in Uttar Pradesh. Indofil M-45 is the leading brand, but Saaf from UPL Limited is also a strong contender. Company reputation and brand diversity play pivotal roles in market success. The size of the market highlights significant demand for fungicides in Uttar Pradesh, creating opportunities for both established and emerging brands. Agricultural professionals and policymakers can utilize this data to make informed decisions and develop strategies for the fungicide industry in the region.

Table 3 Markets share of different brands of Herbicides in Uttar Pradesh

S.N o.	Brand Name	Companies	Average Sales/retailer or distributor/year (Rs.in Lakhs)	Total Val of 100 Retailors/Distributors	Percentage Share
1	Nomini Gold	PI Industries Ltd.	0.96	95.83	24.2%
2	Laudis	Bayer Crop Science	0.73	72.80	18.4%
3	Tinzer	Syngenta India Ltd	0.60	60.00	15.1%
4	Glycel	Excel Crop Protection	0.38	38.00	9.6%
5	Gramoxone	Syngenta India Ltd	0.22	21.58	5.4%
6	Council	Bayer Crop Science	0.21	20.70	5.2%
7	Rifit	Syngenta India Ltd	0.19	19.33	4.9%
8	Chempa	Dhanuka Agritech	0.19	19.33	4.9%
9	Dost supper	UPL Ltd.	0.15	15.47	3.9%
10	Tata Metri	Rallis India Ltd	0.14	14.00	3.5%
11	Tata Panida	Rallis India Ltd	0.11	11.00	2.8%
12	Clincher	Corteva Agrisciences	0.09	8.62	2.2%
	Total		3.97	396.67	100%
Source: Present Survey Data by Researcher					

The table 3 illustrating the market share of various herbicide brands in Uttar Pradesh provides significant insights into the herbicide industry in the region. Here are the key results and a discussion of these findings:

1. Market Leader and Competitors: Nomini Gold, manufactured by PI Industries Ltd., emerges as the market leader with a substantial 24.2% market share. Laudis from Bayer Crop Science follows with an 18.4% market share. These two brands clearly dominate the market. This indicates that certain herbicides are preferred by retailers and distributors in Uttar Pradesh.

2. Company Influence: Similar to the previous tables, the influence of the manufacturing companies is evident. PI Industries Ltd. and Bayer Crop Science have their brands, Nomini Gold and Laudis, among the top contenders. This underscores the importance of brand reputation and diversified product portfolios in market success.

3. Diverse Market: The herbicide market in Uttar Pradesh is diverse, with several brands capturing notable market shares. This diversity provides choices for farmers and agricultural professionals, contributing to market competitiveness.

4. Total Market Size: The total herbicide market size in Uttar Pradesh is 396.67 lakhs, indicating substantial demand for herbicides in the region. This underscores the critical role of the herbicide industry in supporting agriculture and weed control.

5. Opportunities for Growth: Smaller brands, such as Clincher by Corteva Agrisciences, though having a smaller individual market share, still represent opportunities for growth and expansion in the market. Given the overall market size, these brands have the potential to increase their market presence.

6. Brand Preferences: The data also highlights that certain brands are preferred over others. For instance, Syngenta India Ltd. has multiple herbicide brands (Tinzer, Gramoxone, and Rifit) with notable market shares, reflecting the trust and recognition these brands have among retailers and distributors.

In conclusion, this table reveals a competitive and diverse herbicide market in Uttar Pradesh, with Nomini Gold and Laudis leading the way. The success of certain brands and companies indicates the importance of reputation and a diversified product portfolio in capturing market share. The substantial market size highlights strong demand for herbicides in the region, providing opportunities for both established and emerging brands. This data is invaluable for agricultural professionals, policymakers, and businesses in making informed decisions and formulating strategies for the herbicide industry in Uttar Pradesh.

Purchase influencing factors for farmers

In this section factors were discussed which have influence the farmers in brand preference.

Table 4 Factors influencing farmer's preference for various brands of pesticides in study area

S.no.	Attributes	Total Score	Mean Score	Rank
1.	Retailer Recommendation	2500	25.5	I
2.	Competitive Price	2400	24.5	II
3.	Quality	2350	23.5	III
4.	Previous Experience	1850	18.5	IV
5.	Brand Popularity	1840	18.4	V
6.	Timely Availability	1800	18.0	VI
7.	Co-farmer Opinion	1350	13.5	VII
8.	Sales Promotional Activity	1260	12.6	VIII
9.	Advertisement	750	7.5	IX
Source: Present Survey Data by Researcher				

The table provides insights into the factors that influence farmers' preferences for various pesticide brands in the study area. Here are the key findings:

- 1. Retailer Recommendation:** Retailer recommendations emerged as the most influential factor with a total score of 2500 and a mean score of 25.5. This indicates that the advice and suggestions of retailers significantly impact farmers' brand preferences, making it the top-ranking attribute.

2. **Competitive Price:** Competitive pricing is the second most important factor, with a total score of 2400 and a mean score of 24.5. This suggests that farmers are price-sensitive and consider cost when selecting pesticide brands.
3. **Quality:** Quality ranks third, with a total score of 2350 and a mean score of 23.5. This highlights that farmers prioritize the effectiveness and reliability of pesticides.
4. **Previous Experience:** Previous experience with a brand is the fourth most influential factor, with a total score of 1850 and a mean score of 18.5. Farmers' past interactions with specific brands shape their preferences.
5. **Brand Popularity:** Brand popularity is ranked fifth, with a total score of 1840 and a mean score of 18.4. While brand recognition plays a role, it is not as important as other factors.
6. **Timely Availability:** Timely availability ranks sixth, with a total score of 1800 and a mean score of 18.0. Farmers value the accessibility of pesticides when making their choices.
7. **Co-farmer Opinion:** Co-farmer opinions are the seventh most influential factor, with a total score of 1350 and a mean score of 13.5. The opinions of fellow farmers hold significance but are not the primary driver of preference.
8. **Sales Promotional Activity:** Sales promotional activity ranks eighth, with a total score of 1260 and a mean score of 12.6. Promotional efforts have a moderate impact on farmers' decisions.
9. **Advertisement:** Advertisement is the least influential factor, ranking ninth, with a total score of 750 and a mean score of 7.5. This suggests that advertising alone has minimal impact on farmers' brand choices.

The data highlights several key takeaways regarding the factors influencing farmers' preferences for pesticide brands in the study area:

- **Retailer Recommendations Reign Supreme:** Retailer recommendations hold the greatest sway over farmers' decisions. Farmers trust and rely on the advice of local retailers, emphasizing the pivotal role of these intermediaries in influencing brand choices.
- **Price and Quality Matter:** Competitive pricing and product quality are paramount factors. Farmers seek cost-effective solutions without compromising on the efficacy of the pesticides they use.
- **Experience Carries Weight:** Previous experience with a brand plays a substantial role in shaping preferences, indicating the lasting impact of product performance on farmers' choices.
- **Popularity and Promotion Have Moderate Influence:** While brand recognition and promotional activities do influence decisions, they are not as impactful as retailer recommendations, price, and quality.
- **Advertisement Holds Minimal Significance:** Advertising alone does not significantly impact farmers' choices, reinforcing that practical considerations like advice from retailers and product performance are more compelling.

Overall, this information provides valuable insights for pesticide manufacturers and marketers, emphasizing the importance of strong relationships with retailers, competitive pricing, and delivering quality products to meet the preferences of farmers in the study area.

Table 5 Influence of promotional activities on farmers purchase behaviour

S.no.	Attributes	Total score	Means core	Rank
1.	Retail Traders Influence	7270	80.78	I
2.	Company Representative Influence	6721	74.68	II
3.	On Farm Demonstration	5954	66.16	III
4.	Farmer Meetings	5455	60.61	IV
5.	Distribution of Literature	5066	56.29	V
6.	Through Participation in Fairs	4616	51.29	VI
7.	Wall Paintings	4420	49.11	VII
8.	Banners	3773	41.92	VIII
9.	Posters	3479	38.66	IX
10.	Radio	2988	33.20	X
11.	Local Papers	2524	28.04	XI

12.	Theaters	1734	19.27	XII
Source: Present Survey Data by Researcher				

The table provides insights into the influence of promotional activities on farmers' purchasing behaviour in the study area. Here are the key findings:

1. **Retail Traders Influence:** Retail traders exert the most significant influence on farmers' purchasing behaviour, with a total score of 7270 and a mean score of 80.78. This indicates that farmers highly value the recommendations and guidance provided by local retail traders when making their purchasing decisions.
2. **Company Representative Influence:** Company representatives hold the second most considerable influence on farmers, with a total score of 6721 and a mean score of 74.68. Farmers trust and are influenced by the guidance and information provided by representatives of pesticide companies.
3. **On Farm Demonstration:** On-farm demonstrations rank third, with a total score of 5954 and a mean score of 66.16. This indicates that practical demonstrations of product efficacy in real farm conditions significantly impact farmers' purchasing behaviour.
4. **Farmer Meetings:** Farmer meetings are the fourth most influential factor, with a total score of 5455 and a mean score of 60.61. These meetings provide farmers with a platform to learn and exchange information, which affects their buying decisions.
5. **Distribution of Literature:** The distribution of literature, such as brochures and pamphlets, is the fifth most influential factor, with a total score of 5066 and a mean score of 56.29. Farmers value written materials that provide information about products.
6. **Through Participation in Fairs:** Participation in fairs holds the sixth position in terms of influence, with a total score of 4616 and a mean score of 51.29. Engagement at agricultural fairs plays a role in shaping purchasing decisions.
7. **Wall Paintings:** Wall paintings are the seventh most influential factor, with a total score of 4420 and a mean score of 49.11. Visual promotions, such as wall paintings, impact farmers' awareness and choices.
8. **Banners:** Banners are ranked eighth in influence, with a total score of 3773 and a mean score of 41.92. They provide visual cues and information that influence farmer behaviour.
9. **Posters:** Posters hold the ninth position in influence, with a total score of 3479 and a mean score of 38.66. Posters are less influential compared to other promotional methods.
10. **Radio:** Radio promotions rank tenth in terms of influence, with a total score of 2988 and a mean score of 33.20. While radio can reach a wide audience, it is less influential than more direct methods.
11. **Local Papers:** Local newspapers are the eleventh most influential factor, with a total score of 2524 and a mean score of 28.04. They have a moderate impact on purchasing behaviour.
12. **Theatres:** Theatres hold the twelfth and last position in influence, with a total score of 1734 and a mean score of 19.27. Promotions through theatres are the least influential among the listed methods.

The data provides significant insights into the impact of various promotional activities on farmers' purchasing behaviour in the study area:

- **Retail Traders' Recommendations are Paramount:** Retail traders have the most significant influence on farmers. Their recommendations and guidance are highly valued by farmers, emphasizing the importance of strong relationships with local retailers.
- **Company Representatives Play a Key Role:** Company representatives are the second most influential group, underlining the significance of personal interactions with farmers in influencing their choices.
- **Practical Demonstrations Matter:** On-farm demonstrations are also highly influential, highlighting the value of showing product efficacy in real farm conditions.

- **Diverse Promotion Methods:** Farmers are influenced by a variety of promotional methods, including literature distribution, farmer meetings, and visual promotions like wall paintings and banners.
- **Traditional Media Less Influential:** Traditional media like radio, local papers, and theaters have a less pronounced impact on purchasing decisions compared to more direct and personal methods.

Overall, this information is valuable for pesticide manufacturers and marketers, demonstrating the importance of personal interactions, practical demonstrations, and a mix of promotional methods in influencing farmers' purchasing behaviour in the study area.

4. Conclusion

In conclusion, Pexalon, Chess, and Coragen are among the leading insecticide brands in Uttar Pradesh, with Pexalon holding the highest market share. The data reflects a competitive market with various brands, highlighting brand diversity. Certain companies have multiple brands, emphasizing the role of brand portfolios and company reputation. The total market size for insecticides is substantial, underlining the significant demand for these products in Uttar Pradesh. Indofil M-45 and Saaf are the dominant fungicide brands in Uttar Pradesh. Company influence is notable, with brands from certain manufacturers consistently ranking high. Nomini Gold and Laudis are the leading herbicide brands, with a substantial market share. The total market size for herbicides is substantial, reflecting high demand in Uttar Pradesh. Retailer recommendations and competitive pricing are the most significant factors influencing farmers' preferences for pesticide brands. Quality, previous experience, and brand popularity also play crucial roles in shaping farmer preferences. Retail traders' influence is the most significant, highlighting the importance of their recommendations in shaping farmers' purchasing behaviour. Company representatives hold the second most considerable influence, underscoring the significance of personal interactions with farmers. The present research provides a comprehensive picture of the agricultural input markets in Uttar Pradesh. They emphasize the importance of various factors such as brand reputation, product quality, pricing, and personal interactions in shaping farmers' preferences and purchase behaviour. Understanding these dynamics is critical for agricultural businesses and policymakers to make informed decisions and effectively cater to the needs of farmers in the region.

Author's Contribution

Conceptualization and designing of the research work (Mr. Arun Kumar Rai, Dr. Kushagra Kulshrestha); Execution of Field/Lab experiments and data collection (Mr. Arun Kumar Rai); Analysis of data and interpretation (Mr. Arun Kumar Rai); Preparation of manuscript (Mr. Arun Kumar Rai).

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