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Uncovering Farmers' Information Need through *Kisan Call Centre* Data Analytics of Haryana State

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HIGHLIGHTS

- The Kisan Call Centre (KCC) data from Haryana reveals significant trends in agricultural support utilization.
- The number of query calls to the Kisan Call Centre in Haryana peaked in 2017, but experienced dip after 2020.
- Districts like Hissar, Bhiwani, and Sirsa showed high engagement, with wheat, cotton, and paddy being the most queried crops.
- Weather-related queries were the most common.
- Such patterns underscore KCC's vital role in providing agricultural support and the influence of external factors and seasonal variations on its usage.

ARTICLE INFO

Keywords: Crop-specific challenges, Data analytics, Farmer queries, Geospatial analysis, Kisan call centres, Temporal analysis.

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ABSTRACT

Data analytics in agriculture helps in precise decision-making, predict market trends, and address specific challenges faced by farmers resulting in sustainable agriculture. The present study investigates the information needs of farmers of Haryana by analysing 26.8 lakhs query calls made to the Kisan Call Centre from January 2009 to May 2024. The temporal and spatial analysis presents the evolution of call volumes over time along with their geographic distribution, further enabling district-wise targeted interventions. Calls are categorised based on crops and query type, providing a sense of the major crop-based challenges. Seasonal patterns in the queries and identification of critical periods are deciphered through month-wise analysis. Policymakers can formulate strategies according to the category, geographic, and chronological aspects of farmer inquiries. The research findings underscore the importance of data-driven insights in enhancing agricultural support systems, thus bettering the efficiency and effectiveness of the farming decisions in Haryana and beyond.

INTRODUCTION

Data analytics have the potential to transform agriculture by enabling precise, need-based (Kumar et al., 2015) and timely decision-making leading to increased efficiency in farm operations in terms of better adoption of modern techniques and technologies (Bana et al., 2022), prediction of weather patterns, pest outbreaks, and crop diseases, optimum resource allocation (Gautam & Bana, 2014), increased productivity, sustainability, and profitability (Verma et al., 2020). Data-driven insights support informed and need-based policy formulation, ensure long-term agricultural prosperity and sustainable development (Bana et al., 2023).

Kisan Call Centres (KCCs) are important toll-free helpline number for farmers in India, allowing them to interact with agricultural scientists, who provide timely and tailored advice on agricultural practices, and crop management; awareness of various

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government schemes and initiatives. Kavitha et al., (2017) reported the importance of timely and relevant agricultural information provided by KCC in enhancing farm productivity in the Mahaboobnagar District of Telangana. Studies by Koshy and Kumar (2016) reveal a positive perception of KCC services among dairy farmers, indicating the importance of supportive policies for their continued success. Advanced frameworks like AgriMine and AgrIntel, introduced by Godara et al., (2022 and 2023), utilize deep learning and spatio-temporal analytics on the database of farmer helpline queries to uncover patterns in agricultural issues, aiding in the diagnosis and management. Additionally, Godara et al. (2020) combined sequential pattern mining with multi-criteria decision-making (MCDM) techniques to analyse farmer queries, supporting evidence-based decision-making in agriculture. Their analysis of over four million KCC queries from Rajasthan (2009-2023) provide critical insights for refining agricultural extension services (Godara et al., 2024). Soam et al., (2015) have also emphasized the importance of KCC and urged for the need for a strong policy framework to improve KCC efficiency. Various studies underscore the pivotal role of data analytics in enhancing agricultural support systems and the need for continuous, data-driven approaches to address the diverse challenges faced by farmers.

This study uses cross-sectional analysis of 2,681,563 farmer query calls to Kisan Call Centre (KCC) of Haryana between January-2009 and May-2024 to understand the information needs of farmers. This paper analyses temporal trends, spatial distribution and classifies the queries based on crop for understanding location-specific challenges of farmers. By utilizing data analytics, the study provides insights into seasonal patterns and critical periods of high call activity. These findings are crucial for developing targeted interventions and informed policy decisions that will directly contribute to the prosperity of the farming community.

METHODOLOGY

The study employed a comprehensive methodological approach to analyse the Kisan Call Centre (KCC) dataset obtained from the KCC-CHAKSHU website (URL: https://kcc-chakshu.icar.gov.in/). The process began with data collection, where detailed records of farmer queries, including call dates, query types, crops, and geographic details, were gathered. Data pre-processing followed, involving cleaning, error correction, and the standardization of date formats to ensure the dataset's quality and consistency.

The analysis phase consisted of three main components: temporal, geospatial, and categorical. Temporal analysis examined year-wise and month-wise trends in call volumes, revealing both long-term changes and seasonal patterns in farmers' information needs. Geospatial analysis mapped the district-wise distribution of queries, highlighting regional variations in information demand. Categorical analysis further classified calls by crop type and query type, providing insights into the specific challenges faced by farmers. The study utilized data visualization techniques, including charts and graphs, to effectively communicate these findings. Finally, the results were interpreted to identify key trends, and policy implications were derived to formulate targeted strategies for enhancing agricultural support in Haryana.

RESULTS

The Kisan Call Centre (KCC) has served as a vital lifeline for farmers in Haryana, providing timely and targeted agricultural advice over the years. Analysing the trends in query calls from 2009 to 2023 offers valuable insights into how farmers have utilized this service amidst varying challenges and changing conditions. The steps followed for the analysis have been represented in Figure 1.

Queries were categorized by crop and type for more detailed analysis. The Table 1 indicates the attributes recorded in the KCC dataset.

Figure 2 shows the number of query calls made by farmers in Haryana state from 2009 to 2023. In 2009, the number of query calls was 31,164. This number slightly decreased over the next two

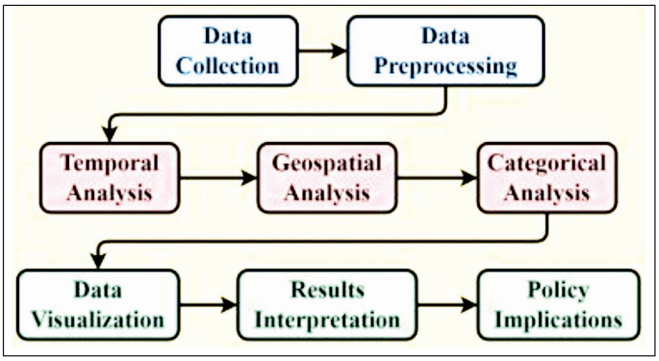

Figure 1. Methodological steps of the study

Table 1. Attributes present in the KCC dataset

S.No.	Attribute Name	Description
1	Block Name	Represents the block name of the farmer
2	District Name	Indicates the district name of the farmer
3	State Name	Specifies the state name of the farmer
4	Created On	Records the year, month, date, and time when the query was made
5	Season	Captures the season of the year during which the query was raised
6	Category	Denotes the query category
7	Crop	Identifies the target crop associated with the query
8	Query Type	Specifies the type of query made
9	Sector	Indicates the target sector of the query
10	Query Text	Presents the query in textual format
11	Kcc Ans	Records the response provided by the Kisan Call Centre in response to the query

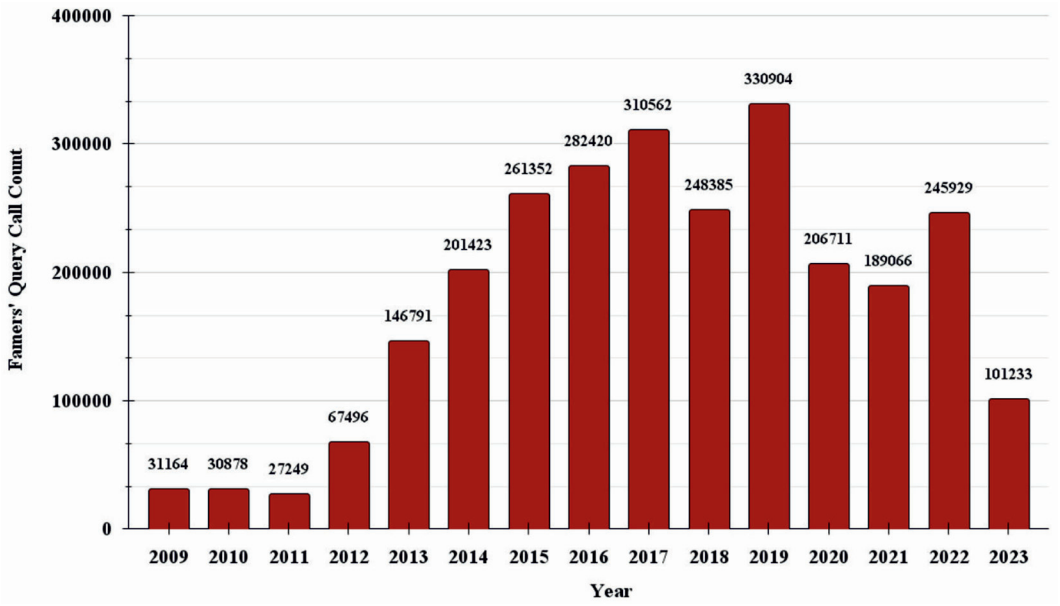

Figure 2. Year-wise Calls' Count from Haryana in the period 2009-2023

years, with 30,878 calls in 2010 and 27,249 calls in 2011, likely indicating low initial awareness or utilization of the service. A significant increase occurred in 2012, with calls increasing to 67,496 and this upward trend continued in 2013, reaching 146,791. This surge suggests increased awareness and trust in the KCC services, possibly driven by targeted outreach programs or enhanced service delivery. The number of calls continued to rise significantly, peaking at 310,562 in 2017, reflecting the growing complexity of agricultural challenges and the expanded reach of KCC services.

There was a slight dip in 2018, with 248,385 calls, followed by another peak in 2019 with 330,904 calls. The fluctuation in 2018 might be due to external factors such as climatic conditions, changes in agricultural policies, or operational issues within the KCC. Research by Glendenning, Babu, and Asenso-Okyere (2011) highlighted that farmers' demand for agricultural information, including advice via KCC, tends to be season-dependent. Call volumes typically increase during periods of critical agricultural activities, such as sowing and harvesting, while declining during off-seasons or adverse weather periods when agricultural work is reduced or delayed. A study by Mittal & Mehar (2016) found that seasonal variability and weather patterns strongly influence farmers' use of ICT for agricultural extension services. During periods of adverse weather, such as heavy monsoons or droughts, farmers often reduce their interactions with extension services, preferring to focus on immediate crisis management. A study on telecommunications in rural India by Aker & Mbiti (2010) found that extreme weather events, such as floods and cyclones, often result in telecommunication disruptions and decreased access to mobile services in rural areas.

The subsequent decline to 206,711 in 2020 and further to 189,066 in 2021 could be attributed to the COVID-19 pandemic, which disrupted normal agricultural activities and communication channels. The number of calls rebounded to 245,929 in 2022, indicating recovery as the pandemic effects waned. However, 2023 saw a significant drop to 101,233 calls, warranting further investigation into possible shifts in farmers' reliance on KCC or the emergence of alternative information sources. Overall, the data underscores the importance of KCC as a resource for Haryana's farmers, while also highlighting the influence of external factors on its utilization. These insights are valuable for policymakers and agricultural support organizations aiming to optimize the effectiveness and reach of KCC services.

Figure 3 illustrates the distribution of query calls made by farmers across different districts of Haryana state. From the results, it is noted that Hissar leads with the highest number of calls at 351,399, followed by Bhiwani with 302,892, and Sirsa with 287,938 calls. Jind and Fatehabad also report significant call volumes, with 227,490 and 202,554 calls, respectively. These high numbers suggest strong engagement of the farming communities with the Kisan Call Centre in these districts, possibly reflecting higher information needs or greater awareness and utilization of the service. Districts like Mahendra Garh (134,520), Sonepat (116,244), Karnal (113,791), Jhajjar (112,611), and Kaithal (111,490) exhibit moderate call volumes. Conversely, districts such as Gurgaon (39,664), Mewat (29,296), and Faridabad (24,722) have the lowest call volumes. The lower engagement in these districts may be due to factors such as smaller district sizes, lower awareness of KCC services, reliance on alternative information sources, or less intensive agricultural activities.

Figure 4 shows the number of query calls made by farmers in Haryana for different crops. Wheat tops the list with 344,138 calls, indicating that it is a major crop in Haryana, with farmers frequently seeking advice and information. Cotton follows with 240,076 calls, showing its significance in the agricultural landscape of the state. Paddy also has a high query volume of 206,006 calls, reflecting its importance. Mustard with 71,736 calls, indicates its importance as a major oilseed crop. Other crops like *Guar* (36,025), Onion (21,362), Bovine Cow (18,981), Sugarcane (18,220), and Pearl Millet (17,168) show substantial query volumes, suggesting the need for considerable support in their cultivation. Crops like Green Gram (16,584), Bottle Gourd (16,567), Tomato (16,387), and Potato (14,539) have fewer calls, while others like *Barseem* (12,694), Guava

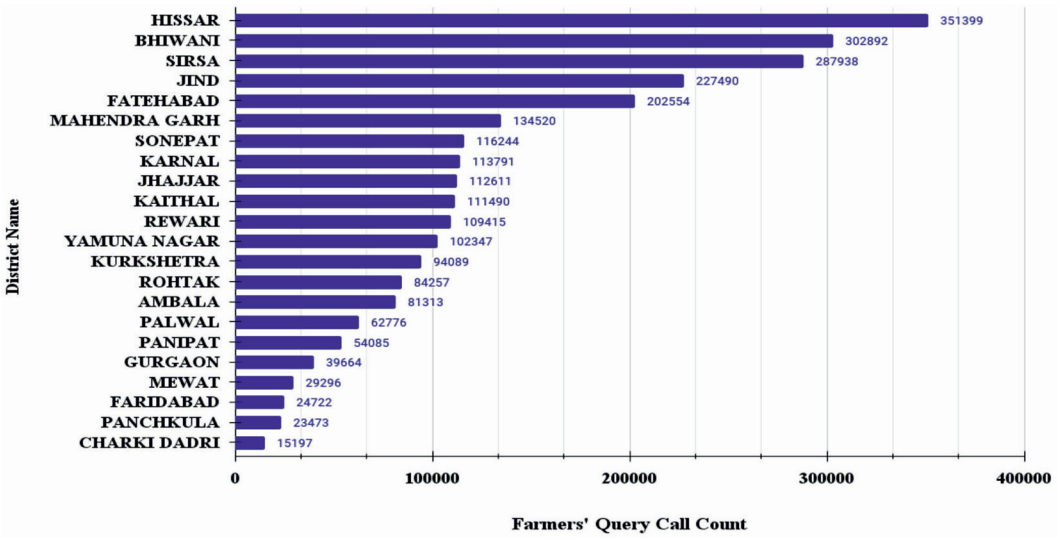

Figure 3. District-wise Calls' Count from Haryana in the period Jan 2009- May 2024

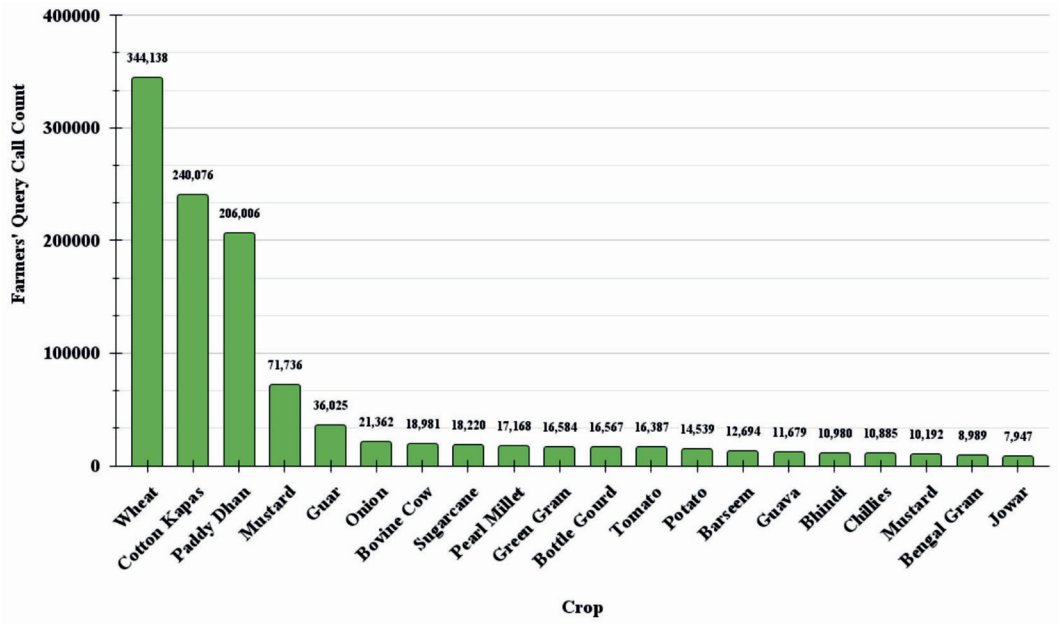

Figure 4. Crop-wise Calls' Count from Haryana in the period Jan 2009- May 2024

(11,679), *Bhindi* (10,980), and Chillies (10,885) show even lower volumes, indicating either lesser demand for information or possibly smaller areas under cultivation.

Figure 5 shows the number of query calls made by farmers in Haryana for different agricultural categories. Cereals top the list with 554,837 calls, underscoring their critical importance to the state's agriculture, likely reflecting the prominence of staple crops like wheat and rice. Fibre crops follow with 233,112 calls, emphasizing the significance of cotton in the agricultural economy. Vegetables (144,665 calls) show substantial query volumes, suggesting a considerable interest and strong need for information regarding their cultivation and management practices. Besides, Oilseeds (89,452 calls) and Fodder Crops (60,934 calls) also show significant engagement, indicating their essential role in both crop and livestock farming. Fruits have 48,248 calls, showing moderate interest and potentially highlighting the importance of horticulture in the region. Pulses (39,773 calls) and Millets (34,170 calls) have lower query volumes, suggesting these crops may be less predominant or face fewer issues requiring advisory services.

Figure 6 displays the number of calls made by farmers in Haryana for different query types. Weather-related queries dominate the list with 1,327,962 calls, indicating that weather-related information is the most critical concern for farmers to make timely and informed agricultural decisions. Furthermore, the "Plant Protection" follows with 342,992 calls, highlighting the significance of protecting crops from pests and diseases as a major concern for farmers. There is also significant interest in Bio-pesticides and Bio-fertilizers with 128,172 calls, indicating a growing awareness towards adoption of sustainable agricultural practices. Queries related to Varieties (95,215), Cultural Practices (94,373), and Government Schemes (89,518) are also prominent, reflecting the farmers' need for information on crop varieties, best agricultural practices, and available government support. Fertilizer Use and Availability (66,608), Nutrient Management (48,323), Seeds

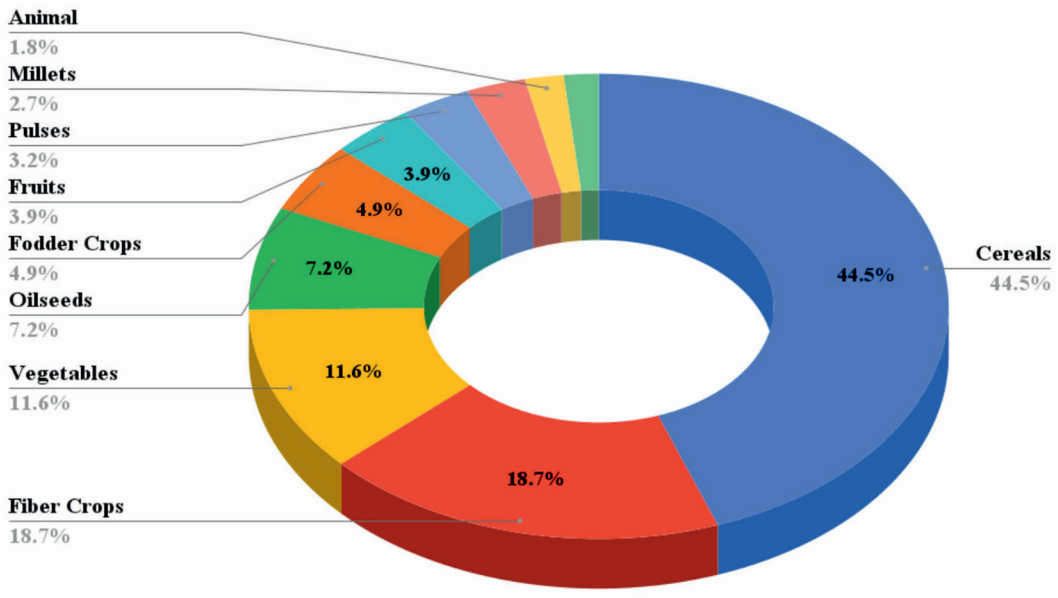

Figure 5. Category-wise Calls' Count from Haryana in the period Jan 2009- May 2024

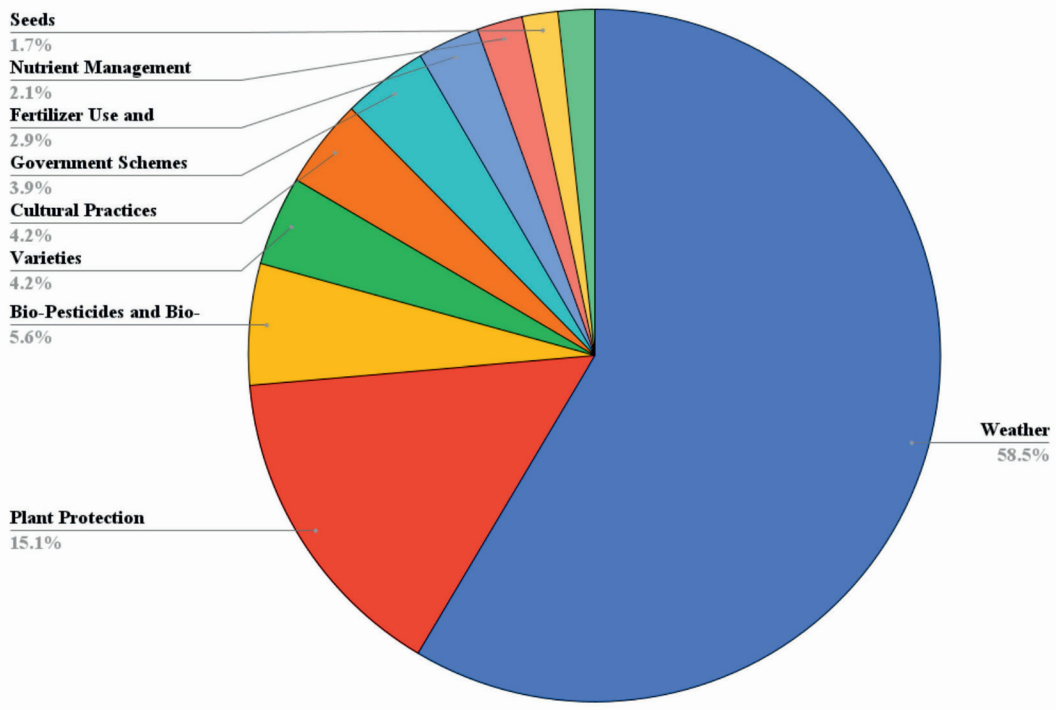

Figure 6. Query type-wise Calls' Count from Haryana in the period Jan 2009- May 2024

(38,294), and Field Preparation (37,669) have fewer calls but remain essential areas where farmers seek guidance.

Figure 7 highlights the monthly distribution of query calls made by farmers in Haryana. July tops the list with 289,773 calls, reflecting heightened agricultural activity likely tied to the onset of the monsoon season, which is crucial for many crops. August follows with 282,937 calls, continuing the trend of intense farming activity and challenges related to the monsoon. September also sees a significant number of calls (265,790), likely focused on crop maintenance during the monsoon. Moderate volumes of queries are observed in January (236,201), June (233,368), May (222,098), and October (214,892), corresponding to key stages in the agricultural cycle, such as land preparation, sowing, and harvesting. November, with the lowest number of calls at 155,279, indicates a lull in agricultural activities after the harvest. February (183,137), April (190,872), and December (199,049) also have lower query volumes, suggesting these months are less intensive in farming activities.

DISCUSSION

The data from the Kisan Call Centre (KCC) in Haryana from 2009 to 2023 illustrates significant fluctuations in query call volumes, highlighting the evolving nature of farmer engagement with this vital agricultural advisory service. These trends can be explained by several interrelated factors, including changes in service awareness, the complexity of agricultural challenges, and external

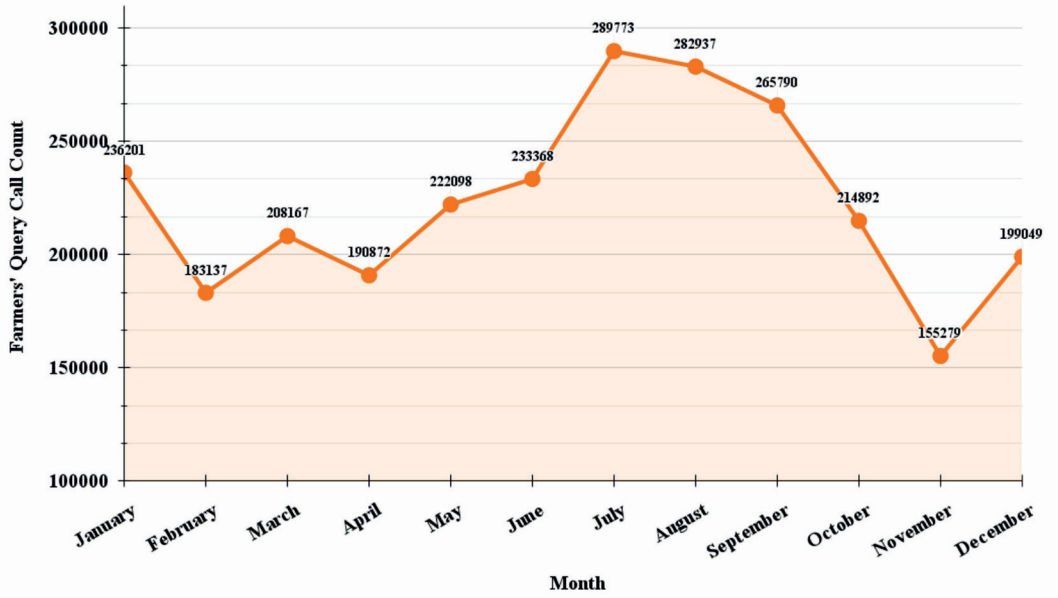

Figure 7. Month-wise Calls' Count from Haryana in the period Jan 2009- May 2024

influences such as climatic conditions, socio-economic factors, and the COVID-19 pandemic. Additionally, Satapathy et al., (2024) emphasise that constraints such as limited knowledge and financial support hinder farmers' adoption of Information Communication Technology (ICT), impacting their engagement with KCC services. Addressing these barriers is crucial for maximizing the benefits of KCC and improving agricultural productivity and farmer satisfaction. Niranjan et al., (2023) also advocated exploiting the potential of ICTs for adoption of sustainable agricultural practices which require developing awareness and skill of the farmers to use ICT tools for their farming benefits (Panda et al., 2019).

The early years (2009–2011) showed relatively low call volumes, which likely reflected low initial awareness and utilization of the service. This aligns with research by Patil & Patel (2022), who emphasize that participation in extension services, such as the Kisan Mobile Advisory Service (KMAS), is significantly influenced by factors like age, education, and awareness. The significant surge in query calls from 2012 to 2017 can be attributed to increased awareness of the KCC services, improved outreach, and enhanced service delivery. During this period, farmers faced increasing complexity in agricultural challenges, such as crop management and weather-related concerns. Shaba & Alam (2024) found that addressing service quality dimensions, such as effective communication and responsiveness, can greatly improve farmer satisfaction with agricultural extension services, including KCC.

The dip in 2018, followed by a peak in 2019, could be attributed to external factors such as changes in agricultural policies or operational issues within the KCC. Das et al., (2023) highlight that socio-economic factors like education, landholding size, and income influence how farmers engage with services like KCC, indicating that shifts in policy or regional agricultural challenges can cause fluctuations in call volumes. Additionally, Mittal & Mehar (2016) find that seasonal variability and adverse weather patterns, such as droughts or floods, significantly influence farmers' use of ICT-based advisory services. This supports the theory that climatic conditions may have contributed to the fluctuations in KCC engagement. Moreover, Godara et al., (2023) present an in-depth analysis of over two million farmer queries to the Kisan Call Centre in Punjab from 2009 to 2023, revealing key insights into temporal trends, seasonality, geographical distribution, and query categorization by crop type. This data closely parallels the trends observed in Haryana, with seasonality and region-specific agricultural challenges playing a significant role in KCC engagement.

The steep decline in calls during 2020 and 2021 can largely be attributed to the COVID-19 pandemic, which disrupted normal agricultural activities and restricted communication channels. During this period, farmers may have faced difficulties accessing advisory services due to limited mobility, labour shortages, and overall uncertainty. Sarangi et al., (2024) observed similar fluctuations in call volumes in Odisha, where farmers' use of KCC services varied by district and season, pointing to a need for enhanced awareness and accessibility. In addition to these challenges, Ramasamy et al. (2024) found that farmers in Trichy's Manachanallur block in Tamil Nadu had a favourable attitude toward KCC but faced issues like a lack of information on essential inputs such as seeds and pesticides, as well as technical language barriers. This highlights the need for simpler communication and possibly a conferencing system to better address farmers' queries.

The recovery in 2022, with a notable rebound in call volume, indicates that as pandemic-related disruptions eased, farmers once again relied heavily on KCC services for crucial information. However, the significant drop in 2023 to 101,233 calls suggests either a shift in farmer reliance on KCC or the emergence of alternative information sources. Sahu et al., (2024) found that in some regions, farmers have increasingly turned to private agencies, especially input dealers, for agricultural advice, which may explain the drop in KCC usage. Yadav et al., (2022) also reported that factors like income, education, and land ownership significantly influence farmers' engagement with government initiatives, indicating that demographic shifts could be a contributing factor. Yadav et al., (2024) recommend avoiding irrelevant discussions and utilizing local languages to improve the communication and service

quality at KCC, ensuring that information is both accessible and relevant.

The district-wise analysis shows that Hissar, Bhiwani, and Sirsa lead in the number of calls, while districts like Gurgaon, Mewat, and Faridabad lag behind. This disparity may reflect differences in agricultural intensity, awareness of KCC services, or reliance on alternative advisory mechanisms. Starasts (2015) underscores the importance of improving digital literacy and tailoring information services to regional needs to ensure equitable access to agricultural advisory services across all districts.

Crop-wise, wheat and cotton dominate the queries, reflecting their importance in Haryana's agricultural landscape. The high number of queries related to plant protection (342,992) and weather (1,327,962) underscores the importance of timely information on crop management and climate conditions. Puneeth & Naika (2022) highlight that farmers often face challenges in explaining plant symptoms over the phone, which can hinder the effectiveness of advisory services. Promoting integrated pest management (IPM) programs and raising awareness of bio-pesticides and bio-fertilizers could help address the high volume of plant protection-related queries, as recommended by Choudhary et al., (2022). Moreover, Nikam et al., (2022) found that farmers in cotton-producing regions of Maharashtra often face unmet information needs, such as pest management and market prices. They recommend enhancing information delivery through mobile technology and community-based centers to empower farmers and improve agricultural outcomes.

Technological advancements like the "Smart Sampark" system, proposed by Ajawan et al., (2020), could further streamline KCC operations by utilizing natural language processing to provide virtual assistance. This system achieved an accuracy of 86 per cent with data from Belagavi district, Karnataka, showing potential for improvement and expansion through larger datasets. The month-wise analysis reveals that peak call volumes occur during the monsoon season (July–September), coinciding with critical stages of crop growth. This trend aligns with Sharma et al., (2021), who emphasized that farmers' queries are often seasonally driven, with key agricultural activities driving demand for advisory services.

The fluctuations in call volumes at the Kisan Call Centre in Haryana from 2009 to 2023 can be attributed to a combination of increased awareness, climatic factors, external disruptions like the pandemic, and evolving agricultural challenges. Addressing the gaps in service delivery, such as improving accessibility, simplifying technical language, and ensuring district-specific advisory services, will be crucial for optimizing the effectiveness of KCC and ensuring continued support for Haryana's farmers. Policymakers should focus on enhancing digital literacy, expanding awareness campaigns, and tailoring services to meet the diverse needs of farmers across the state. Puneeth et al., (2024), in their study from Karnataka, found high farmer satisfaction with KCC's technical knowledge and expert availability, emphasizing the importance of continued innovation and support for these services to enhance agricultural productivity and sustainability.

CONCLUSION

The study underscores the importance of data analytics in identifying farmers' needs by analysing over 2.6 million calls from Haryana's Kisan Call Centre. Weather-related queries are predominant, highlighting the need for enhanced localised weather forecasting and more weather stations to provide region-specific updates. Addressing the high volume of plant protection queries suggests a focus on integrated pest management (IPM) and promoting sustainable practices like bio-pesticides and bio-fertilizers. Additionally, prioritizing advisory services for key crops like wheat and cotton, along with developing crop-specific guidelines, is essential. The future policy should allocate resources to high-query districts such as Hisar, Bhiwani, and Sirsa, while boosting outreach in areas with fewer queries. The study also suggests the need for aligning advisory services with the agricultural calendar, particularly from July to September, and improve awareness and accessibility of government schemes by simplifying applications and ensuring timely information dissemination.

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