Role of multimedia tools in knowledge dissemination for profitable pig farming

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Abstract

The study evaluates the effectiveness of an e-learning multimedia platform for disseminating scientific knowledge through video based digital extension services. YouTube analytics data from 32 educational videos published on @icar-nationalresearchcentr8077 channel during 2020-2025 were analysed. A comprehensive analysis focusing on audience and content performance metrics such as views, watch time, impressions, video duration, CTR, audience demographics, subscription status, device usage and geographic distribution were considered to evaluate the impact of video based digital agricultural knowledge dissemination. Correlation analysis of audience and content performance metrics was performed to identify the relationships among the metrics. The results showed strong positive correlations between views, watch time and impressions (r=0.99-1.00) demonstrating that increased content exposure contributes significantly to increased viewer engagement and retention. A strong positive correlation between subscriber count and major audience engagement metrics (r=0.99) indicates the importance of engaging content in driving channel growth. Further, moderate positive correlation was observed between video duration with both impressions and subscriber count (r=0.49-0.54). These findings indicates that longer videos contribute slightly higher audience engagement and channel growth. While CTR showed weak correlation with other metrics indicating the viewer clicks are influenced more by video thumbnails and titles. Predictive analysis using linear regression model estimated a 5.88% increase in daily views over the next year. Device usage analysis showed that mobile phones were the dominant viewing platform contributing 59765 views and 4011 hours of total watch time. However, television users demonstrate the longest average view duration of 8.5 minutes. Audience demographic showed male viewers accounted for 91.34% of the total views and 93.07% of the watch time. Meanwhile, 25-34 years age group were the most active viewers. Non-subscriber generates 86.9% of the total views whereas subscribers have longer average views duration reflecting stronger engagement. From the geographical analysis of India, Bihar, Uttar Pradesh and Assam recorded the highest viewer engagement. Hence, this shows that ICT based e-learning platforms can support more effective and inclusive agricultural extension services.

Keywords: Pig Farming, Multimedia tools, Knowledge, Video, Extension Services

Introduction

The agricultural sector has witnessed a significant transformation in recent years due to advancements in digital technology (Singh *et al.* 2023, Khatri *et al.* 2024, Yadav *et al*. 2024). The traditional methods of agricultural extension such as field visits, physical demonstrations, farmers training programs, printed extension materials and farmer meetings have played an essential role in disseminating knowledge to farmers (Chowdhury *et al.* 2014; Adamsone-Fiskovica *et al.* 2022). However, these traditional approaches face geographical barriers, financial constraints and logistical challenges, thereby limiting the ability to reach diverse and geographically dispersed farming communities (Prajapati *et al.* 2025). Therefore, to overcome these limitations digital platforms have emerged as a powerful multimedia tool for agricultural knowledge dissemination, enabling efficient, scalable and widespread access of scientific information to farmers (Barakabitze *et al.* 2015; Zhang *et al.* 2016; Mapiye *et al.* 2023).

Pig farming plays a crucial role in the global livestock sector by making significant contributions to food security, economic growth and livelihoods of rural populations (Bharati *et al.* 2022, Das *et al.* 2021). Pork is the second most widely consumed meat worldwide contributing significantly to human protein nutrition. Major pork producing countries such as China, the United Sates, Brazil and several European nations contribute significantly to nation economies and support millions of livelihoods (Szymańska 2017). In developing countries, pig farming serves as a major source of livelihood for small holder farmers by providing a cost effective and income generating farming enterprise (Mondal *et al*. 2022). Despite its importance to the economy and food security pig farming faces several challenges, including disease outbreaks (Ata *et al*. 2022), inadequate breeding practices (Turner *et al.* 2024), poor biosecurity awareness (Mutua et al. 2021), inefficient feeding management (Pomar *et al*. 2021) and limited market access (Adesehinwa *et al*. 2024). To address these challenges, farmers require continuous access to reliable and updated information to adopt scientific and efficient farming practices. Therefore, comprehensive pig farming knowledge is essential for improving productivity, sustainability and increasing profitability.

Many small holder farmers in resource constrained regions face limited access to veterinary support, quality feed and limited technical training opportunities (Serra *et al.* 2020). The use of digital platforms like YouTube (Muneer *et al*. 2025, Wickman *et al*. 2021) enables farmers to acquire practical knowledge on disease prevention, breeding practices, biosecurity measures, nutritional management, housing management, pork processing etc. This digital platform can significantly enhance decision making among farmers leading to better herd management, reduced mortality and increase production efficiency (Vlaicu *et al.* 2024). Consequently, digital extension services serve as innovative and cost-effective ways of knowledge dissemination, effectively bridging the gap between scientific research and on farm practices (Thakur *et al.* 2018; Dahlan *et al.* 2024; Karubanga *et al.* 2024). In this regard, agricultural organisation and extension agencies can contribute to the long-term sustainability and resilience of the pig farming sector by providing high quality expert driven content accessible to pig farmers worldwide (Malak-Rawlikowska *et al.* 2021).

Considering the importance of digital platforms, ICAR-National Research Centre on Pig (NRC on Pig), Guwahati, India actively utilizes its YouTube channel to disseminate information on scientifically validated pig farming practices. The channel provides information on various aspects of pig farming including breeding, feeding, disease prevention, biosecurity, management practices and processing. Although YouTube serves as an important platform for delivering agricultural education, study regarding the effectiveness, reach, factors that drive user engagement of digital content remains underexplored. Therefore, the present study utilizes YouTube analytics from @icar-nationalresearchcentr8077 channel with 32 videos as a primary data source. The objectives of the study are as follows:

- To evaluate user engagement with pig farming educational videos by analysing engagement metrics such as views, watch time, audience demographics etc.
- To analyse the reach and effectiveness of the NRC on Pig YouTube channel as a digital extension platform for pig farming knowledge dissemination.
- To predict future viewership trends using linear regression analysis.

Materials and Methods

The study utilises the data collected from the official YouTube channel of NRC on Pig, India. Data extraction, processing and visualization were carried out using open-source tools. The methodology of this study comprised of three primary stages such as study design, data collection and data analysis.

Study Design

The study explores and visualizes YouTube analytics data generated from the ICAR–NRC on Pig YouTube channel over the period 2020-2025. Audience engagement, content reach and user interaction were analysed to explore the role of video-based learning in strengthening digital agricultural extension. The effectiveness and reach of educational video content were evaluated using key performance metrics such as views, watch time,

audience demographics and interaction indicators like shares, comments etc. The following key research questions were formulated to guide the study:

- How the long-form and short form videos published in the YouTube channel during 2020-2025 differs with respect to audience engagement?
- How effective is the channel in reaching its target audience, promoting user interaction and enhancing agricultural knowledge dissemination among viewers?
- What patterns can be derived from audience behaviour and interaction related to pig farming video content?

Data Acquisition

The data for this study were extracted from YouTube Studio platform that provides detailed analytics on video performance, audience engagement and channel growth of the NRC on Pig channel (as shown in fig. 1). The extracted key performance metrics includes views, watch time, average view duration, impressions and click-through rate (CTR). In addition, engagement metrics such as subscriber growth were extracted. Further, the study also examined audience demographics including age, gender and geographic distribution along with traffic sources such as YouTube Search, Suggested Videos, external sites and social media platforms. The data were exported in CSV format for further processing and visualization. The analysis of this data enabled the identification of content trends, impact of educational videos on pig farming and optimization of future video strategies for broader dissemination.

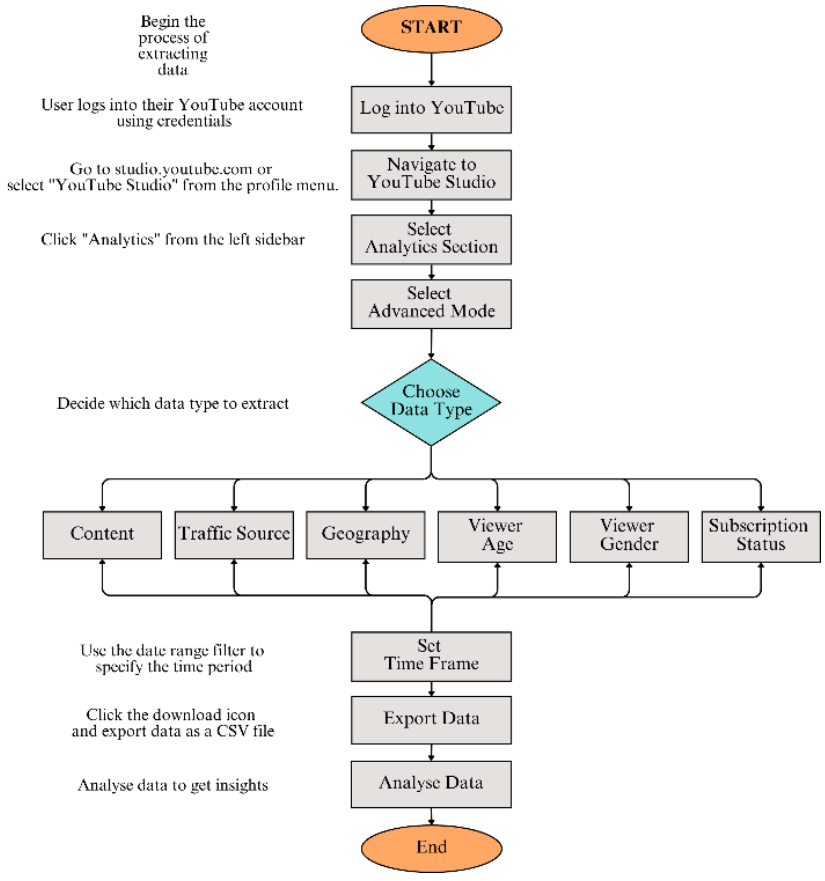


Fig. 1: Process for data extraction from YouTube Studio

Analytical Platforms and Tools

The study employed open-source analytical tool and libraries for data processing, visualization and predictive modeling. Data processing and analysis were primarily conducted using Python (v3.9) through the Anaconda distribution environment. Geographic distribution and regional engagement patterns analysis were conducted using GeoPandas library in combination with GeoJSON shapefiles both for national and global. Additional libraries were utilized to enable data cleaning, statistical analysis and predictive analytics of audience behaviour and content trends.

Results and Discussion

The analysis of viewer engagement and performance of educational videos published on the official YouTube channel @icar-nationalresearchcentr8077 were present in this section. This official YouTube channel serves as a digital extension platform for disseminating knowledge on pig husbandry, scientific farming practices and capacity building initiatives. The channel features long-form educational videos on scientific pig farming, rural development, biosecurity and disease management as well as short-form videos providing quick advisory tips on essential farm operations. To ensure broad regional outreach the video content is disseminated in multilingual such as Hindi, Assamese and English.

Content Analysis and Prediction

This section presents a comprehensive analysis of the YouTube video performance using content-related metrics such as video title, publish time, duration, views, watch time, subscriber change, impressions and CTR. The dataset was obtained from the official YouTube channel of NRC on Pig (https://www.youtube.com/@icar-nationalresearchcentr8077) comprising comprehensive metadata for each uploaded video. Fig. 2 shows the correlation matrix of the key YouTube performance metrics such as video duration, views, watch time, subscribers, Impressions and CTR. The strong positive correlations among these metrics indicate that videos generating higher viewers generally achieve longer watch times contributing to subscriber growth and greater visibility through increased impressions. However, CTR exhibits weak correlations indicating that CTR likely influenced by additional factors such as video thumbnails, titles, viewer preferences etc.

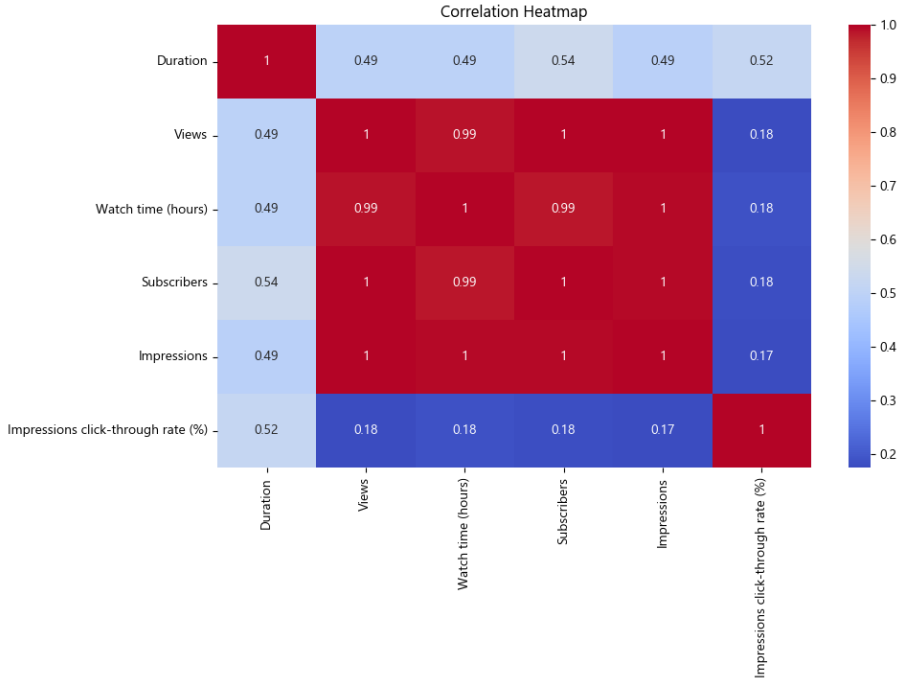


Fig. 2: Correlation heatmap illustrating the relationships between various YouTube content performance metrics

Table 1 presents the correlation coefficients among the YouTube performance metrics demonstrating extremely strong to perfect correlations among the key engagement metrics. In this table, near-perfect correlation was observed between views and watch time (r = 0.99) while impressions showed perfect positive correlation to views and watch time (r = 1.00) indicating that greater content exposure leads to greater audience reach and longer viewing durations. A strong positive correlation was also observed between subscriber to views and watch time (r = 0.99) indicating that highly engaging videos contribute significantly to channel growth. Moderate positive correlation was observed between video duration subscribers (r = 0.54), as well as views, watch time and impressions (r = 0.49) indicating that long-form videos tend to perform slightly better than short-form videos. While CTR exhibits moderate positive correlation with video duration (r = 0.52) but exhibits weak correlation with views, watch time, subscriber and impressions (r = 0.17-0.18) indicating that CTR is influenced by additional factors beyond the engagement metrics.

Fig. 3 presents the distribution of CTR across videos illustrating the effectiveness of thumbnails and titles in attracting audience engagement. CTR values range from about 2.5% to 9.5%, with majority of videos clustered within the lower range of 2.5% to 3.5%. The distribution is slightly right-skewed, indicating that most videos achieved moderate CTRs between 3% and 7%, whereas only a few videos attained CTR above 8%. The kernel density estimate (KDE) highlights this pattern demonstrating a gradual decline in frequency as CTR increases.

Fig. 4 illustrates the distribution of the number of views per video for the ICAR-NRC on Pig YouTube content, revealing a wide variation in audience engagement. Notably, the video titled *"ग्रामीण शूकरपालन के उत्थान हेतु वैज्ञानिक हस्तक्षेप पर एक फिल्म"* has received over 38,000 views, while others such as *"वैज्ञानिक शुकर उत्पादन में जैव सुरक्षा"* and *"Scientific Interventions for Upscaling Rural Piggery"* have also achieved substantial reach with view counts exceeding 4,000. In contrast, several other videos have lower view counts, ranging from around 100 to 1,000, suggesting either niche content or limited viewer interest. The figure highlights this variation, reflecting the popularity of specific topics (e.g., biosecurity, artificial insemination, indigenous breeds). Hence, the distribution indicates that while some videos achieve viral-level engagement, others serve more targeted educational purposes with modest reach.

Table 1. Interpretation of the Correlation Heatmaps

Metric Pair	Correlation Coefficient	Interpretation
Views & Watch time (hours)	0.99	Extremely strong positive correlation — more views directly lead to more watch time.
Views & Impressions	1.00	Perfect correlation — higher impressions always result in more views.
Subscribers & Views	0.99	Very strong correlation — videos with more views tend to attract more subscribers.
Subscribers & Watch time (hours)	0.99	Very strong correlation — increased watch time is associated with subscriber growth.
Impressions & Watch time (hours)	1.00	Perfect correlation — more impressions are tightly linked to more watch time.
Duration & Subscribers	0.54	Moderate correlation — slightly longer videos are somewhat more likely to gain subscribers.
Duration & Views / Watch time / Impressions	0.49	Moderate correlation — video length has a mild impact on views and watch time.
CTR & Duration	0.52	Moderate correlation — longer videos slightly tend to have better CTR.
CTR & Views / Watch time / Subscribers / Impressions	0.17–0.18	Very weak correlation — click-through rate is mostly independent from other metrics.

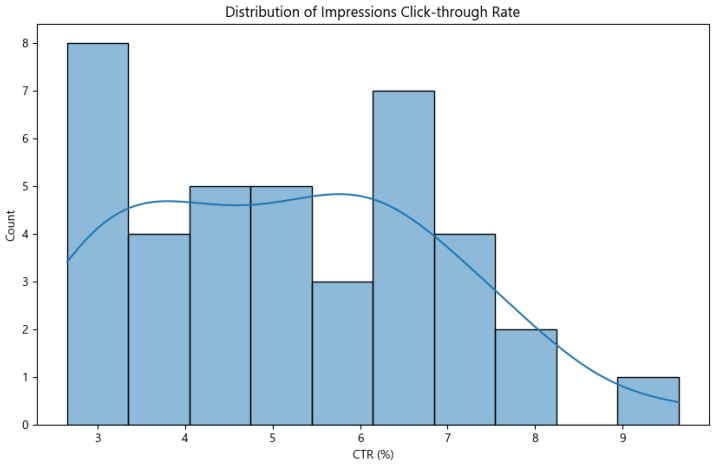


Fig. 3: Presents the distribution of Impression Click through Rate

Fig. 5 illustrates the distribution of total watch time (in hours) per video for the ICAR-NRC on Pig YouTube content. The data reveals considerable variation in viewer engagement across different videos. The video titled "ग्रामीण शूकरपालन के उत्थान हेतु वैज्ञानिक हस्तक्षेप पर एक फिल्म" dominates the chart with an exceptionally high watch time exceeding 3,275 hours, indicating strong viewer interest and sustained attention. Other notable videos such as "वैज्ञानिक शुकर उत्पादन में जैव सुरक्षा" and "Scientific Interventions for Upscaling Rural Piggery" also show relatively high engagement with watch times of over 500 and 245 hours respectively. In contrast, several videos have significantly lower watch times, ranging from 1 to 10 hours, suggesting limited viewership or shorter audience retention. These include specific technical topics like Ear Tagging, Pig Breeds: Doom and Pork Product: Sausage Part-I. This pattern highlights the effectiveness of certain topics particularly those related to scientific interventions, biosecurity and practical demonstrations in capturing viewer interest and indicate the importance of content type, language accessibility and perceived relevance in driving audience engagement on digital platforms.

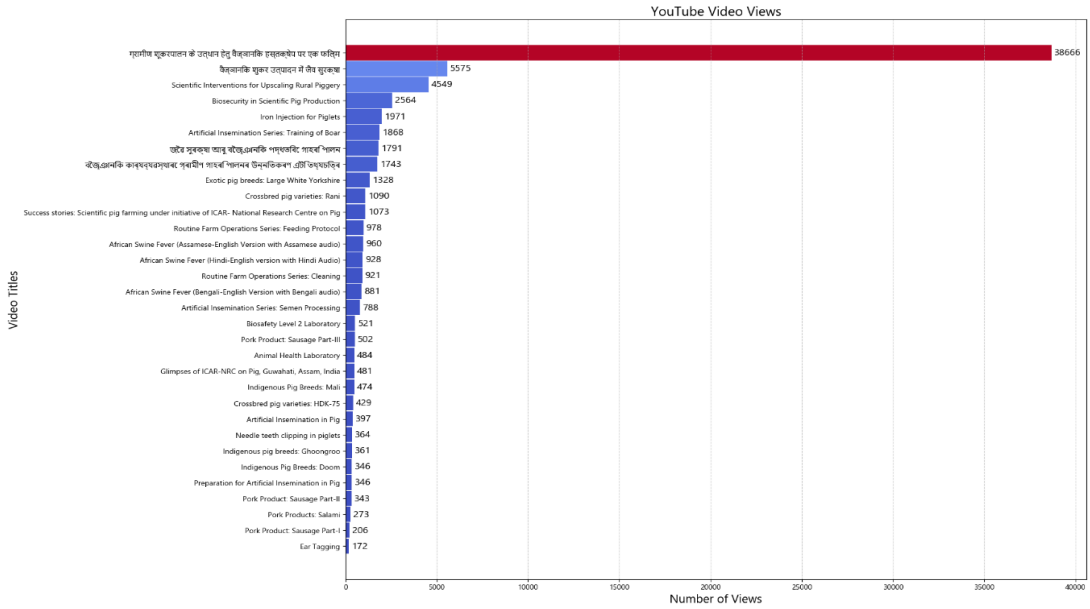


Fig. 4: Distribution of the number of views per video for ICAR-NRC on Pig YouTube content, highlighting variation in audience engagement across different topics and formats

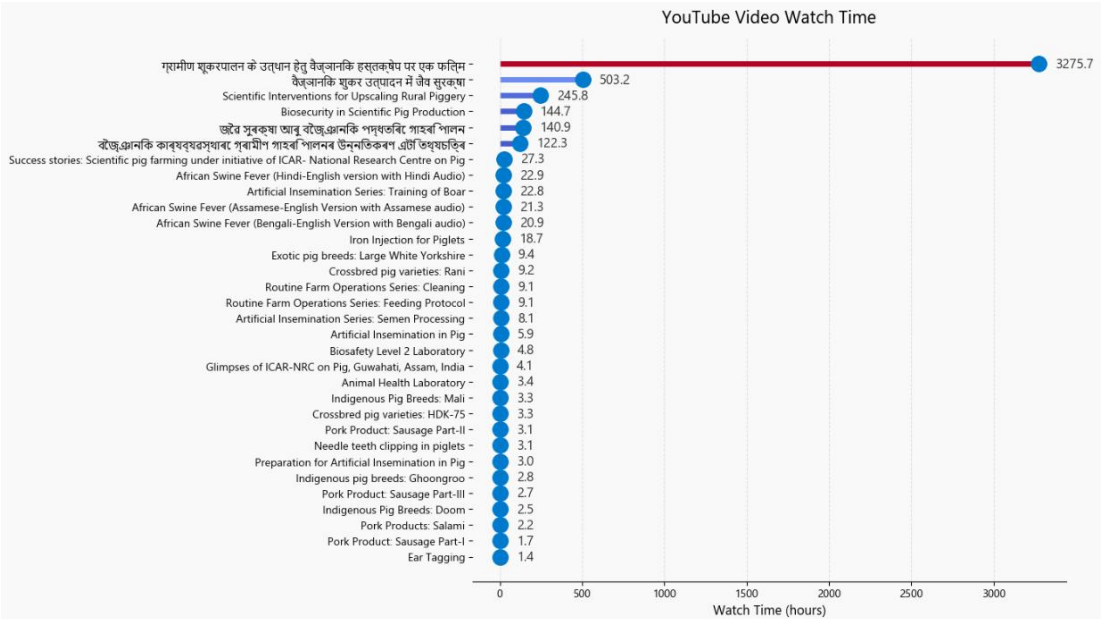


Fig. 5: Distribution of watch time per video for ICAR-NRC on Pig YouTube content, showcasing the varying levels of viewer retention and interest across different educational and awareness topics.

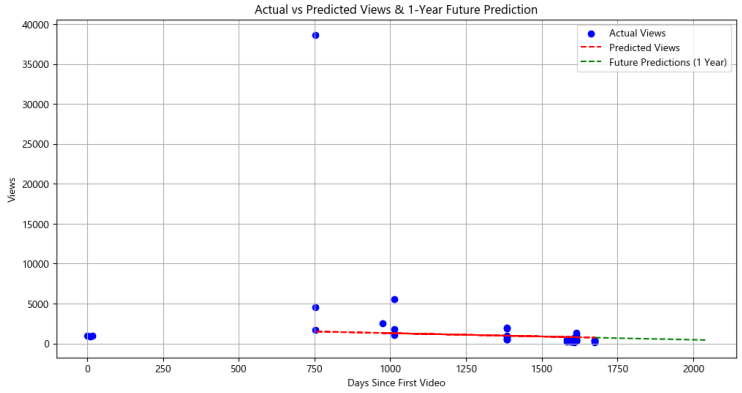


Fig. 6: Actual vs. Predicted Views with 1-Year Future Forecast using Linear Regression

Fig. 6 shows actual versus predicted YouTube video views along with a one-year forecast using a linear regression model. The x-axis represents days since the first video and the y-axis shows view counts. The model was trained on split data using Scikit-learn LinearRegression and evaluated with MAE and RMSE. Blue dots indicate actual views, the red dashed line shows predicted views on test data and the green solid line forecasts views for the next 365 days. While one video is an outlier with nearly 40,000 views, most follow a modest upward trend. The forecast predicts views rising from about 340 to 360 per day over the year a 5.88% increase indicating gradual growth if the current trend continues.

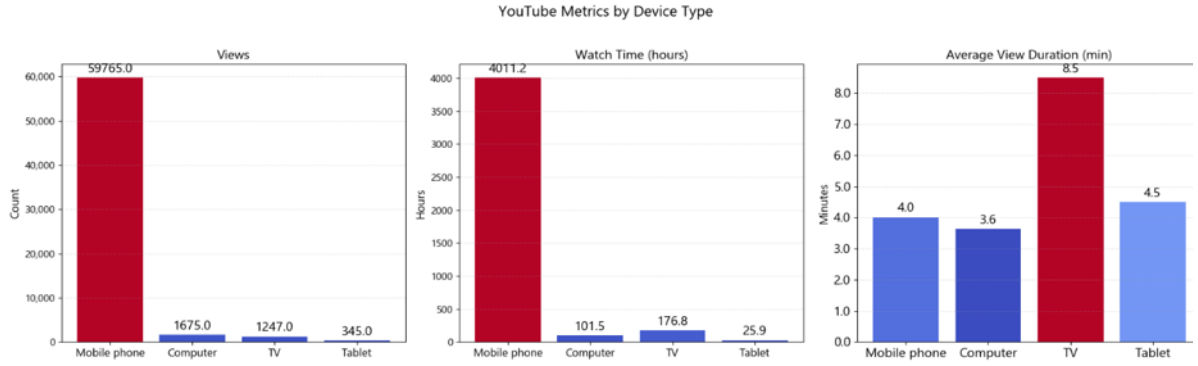
YouTube Data Analysis based on Device Type

A detailed analysis of YouTube viewership across multiple device types including mobile phones, computers, TVs and tablets is presented in this section. The analysis is based on three core engagement metrics: total views, total watch time (in hours) and average view duration (in minutes). The visual comparison of these metrics reveals important insights into how users interact with video content depending on the device used.

Views Distribution: In fig. 7(a), the bar chart of total views clearly indicates that mobile phones dominate user engagement, accounting for the vast majority of views (59,765 views). This aligns with global trends where mobile devices are the primary medium for accessing online video content. In contrast, computers (1,675 views), TVs (1,247 views) and tablets (345 views) contribute a much smaller share, indicating the mobile-first consumption behavior of YouTube users.

Watch Time (in Hours): In fig. 7(b), mobile devices again lead significantly, with a total of 4,011.17 hours, reinforcing the device's popularity and user retention capabilities. Interestingly, TVs recorded a higher watch time (176.75 hours) than computers (101.54 hours), even though the view count on TVs was lower. This suggests that users watching YouTube on TVs tend to engage for longer durations per session likely due to a lean-back viewing experience associated with large screens and comfortable environments.

Average View Duration: In fig. 7(c), the analysis of average view duration provides further depth to the behavioral patterns of users across devices. TVs exhibit the highest average view duration of approximately 8.5 minutes, followed by tablets (4.5 minutes) and mobile phones (4.02 minutes). Computers showed the shortest average view duration at around 3.63 minutes. These results indicate that although mobile phones drive the most traffic, TV viewers tend to spend more time per video, suggesting a more committed viewing behavior.



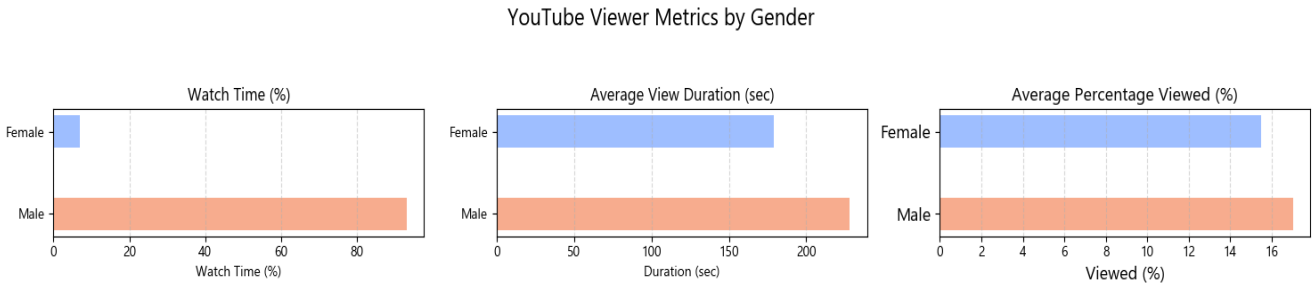
a b c

Fig. 7: a) Total number of views across different device types showing mobile phones as the dominant platform for YouTube consumption. b) Watch time (in hours) by device type, with mobile phones leading and TVs showing higher engagement compared to computers and tablets. c) Average view duration (in minutes) indicating that viewers on TVs tend to watch content for longer periods, followed by tablets and mobile phones.

YouTube Data Analysis based on Gender Type

The YouTube viewership is analysed based on gender, highlighting audience distribution and engagement trends. Male viewers dominate the audience, accounting for 91.34% of total views, while female viewers make up just 8.66%. This notable disparity suggests that the content currently appeals more to male viewers possibly due to content type or viewing preferences.

In fig. 8(a), the watch time distribution further confirms this pattern, with males contributing 93.07% of the total watch hours (93.07 hours), while females contribute only 6.93% (6.93 hours). In terms of average view duration as shown in fig. 8(b), male viewers exhibit longer engagement, watching content for an average of 3 minutes and 48 seconds, while female viewers average 2 minutes and 59 seconds. Similarly in fig. 8(c), the average percentage of the video viewed is slightly higher among males (17.02%) compared to females (15.49%), indicating deeper engagement by the male audience.



(a) (b) (c)

Fig. 8: Gender-wise YouTube engagement metrics: (a) Total watch time (hours), (b) Average view duration (seconds), and (c) Average percentage of video viewed, illustrating variations in viewing behavior across gender categories.

YouTube Data Analysis based on Age Group

This explores the YouTube viewer engagement by age group, offering insights into demographic interaction with the content. As shown in Fig. 9, the 25–34 years age group dominates viewership with 65.43% of total views, followed by the 35–44 years group (16.48%) and 18–24 years (13.26%). Older age groups (45–54, 55–64, and 65+ years) collectively account for less than 5%, indicating limited engagement. Fig. 10(a) shows watch time is highest among the 25–34 group (71.13 hours), aligning with their viewership share, followed by 35–44 years (16.51 hours) and 18–24 years (11.17 hours). In Fig. 10(b), average view duration is also led by the 25–34 group at 3 minutes and 39 seconds, with 35–44 and 18–24 close behind. Interestingly, as Fig. 10(c) highlights, older viewers (55–64 and 65+ years) have lower total viewing time but higher average percentage viewed (28.58% and 24.85%), suggesting they watch a larger portion of the videos they choose to view.

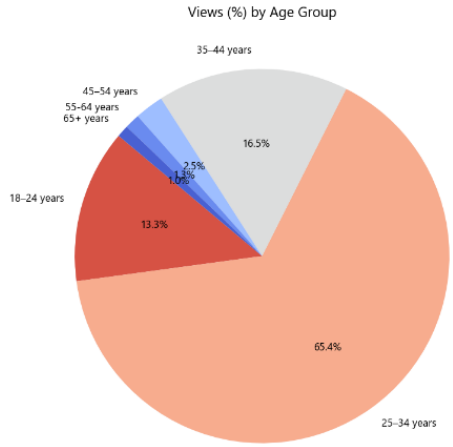
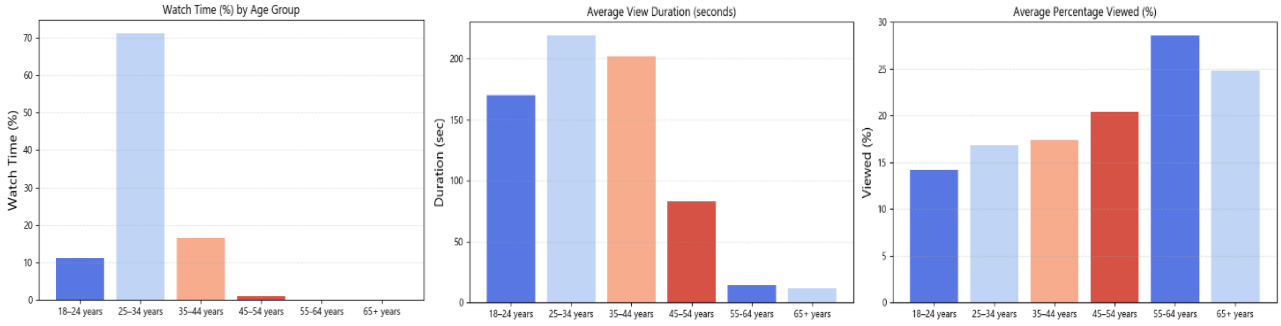


Fig. 9: Illustrate the percentage distribution of YouTube views across different age groups



(a) (b) (c)

Fig. 10: YouTube engagement metrics by age group: (a) Total watch time (in hours), (b) Average view duration (in minutes and seconds), and (c) Average percentage of the video viewed.

YouTube Data Analysis based on Subscription status

This subsection analyses YouTube audience engagement based on subscription status, highlighting how subscribed and non-subscribed viewers interact with the content. Fig. 11 presents three pie charts that compare the proportion of views, watch time and average view duration between subscribed and non-subscribed viewers. From the data, a significant portion of the viewership comes from non-subscribed users, who account for 86.9% of the total views, while only 13.1% of the views are from subscribed users. This trend continues in terms of watch time, where non-subscribers contribute 91.4% of the total hours watched and subscribers only account for 8.6%. These statistics indicate that the content is reaching a broad audience outside the core subscriber base. However, when considering average view duration, subscribed viewers exhibit a notably higher level of engagement. Subscribers contribute 38.4% of the average view duration (in seconds), while non-subscribers account for 61.6%. This suggests that although fewer in number, subscribers tend to watch videos for a longer period on average, demonstrating more consistent and attentive viewing behavior.

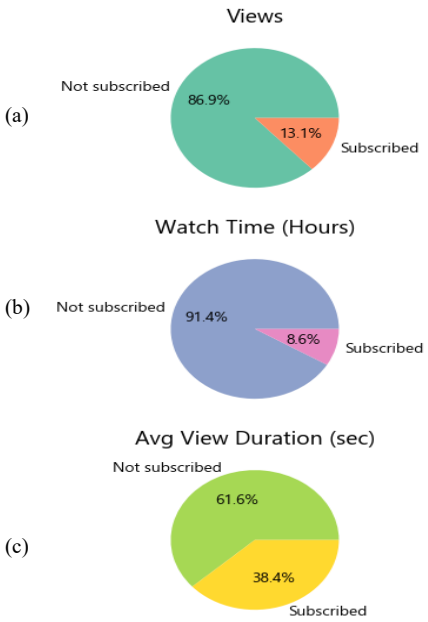


Fig. 11: Illustrate YouTube audience metrics based on subscription status: (a) proportion of views, (b) distribution of total watch time (hours), and (c) average view duration (in seconds) between subscribed and non-subscribed viewers.

YouTube Data Analysis based on Geography

An in-depth analysis of YouTube viewership based on geographic location, examining both domestic (India) and international audience engagement is presented in this section. The insights are derived from view counts, watch time (in hours) and average view duration across different regions and countries.

Regional Viewership within India

The majority of YouTube traffic originates from various Indian states as shown in fig. 12, accounting for a substantial portion of total views and watch time. Fig.13 and 14 illustrate the geographical distribution of YouTube video performance metrics specifically focusing on the number of views and watch time (in hours) across various Indian states. These figures collectively highlight how audiences from different regions engage with the content both in terms of reach and viewer retention.

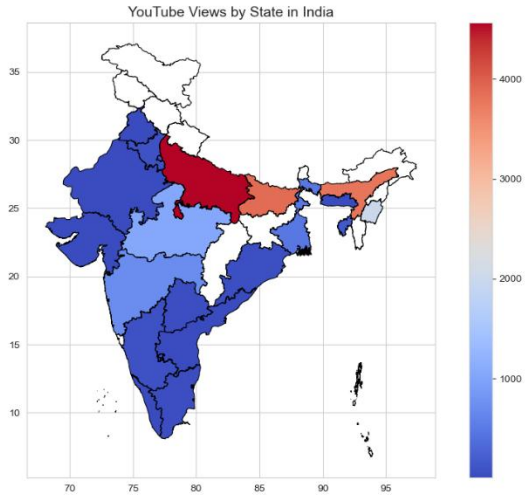


Fig 12. Geographical distribution of YouTube views

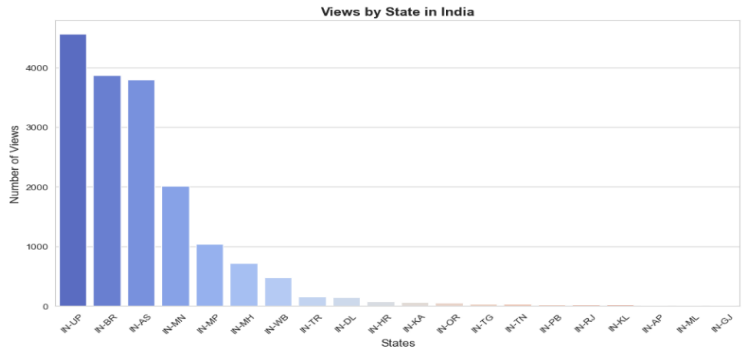


Fig. 13: State-wise distribution of viewership and audience engagement metrics across India.

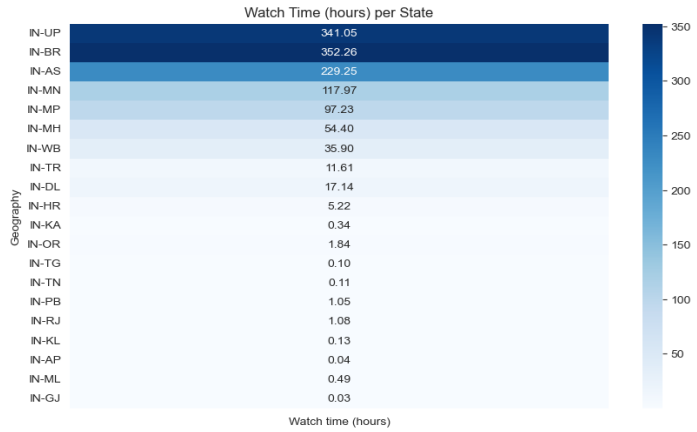


Fig. 14: Hourly watch time distribution across Indian states, highlighting regional engagement trends

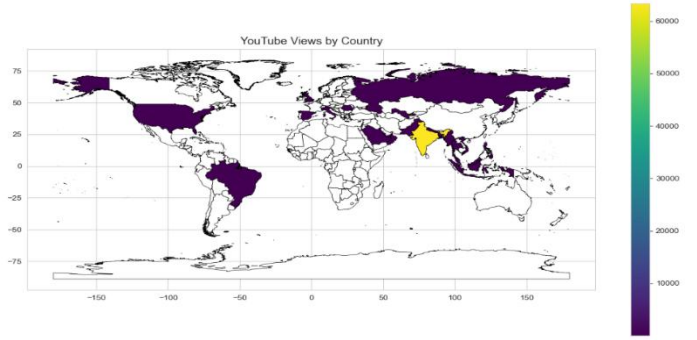


Fig. 15: Global distribution of YouTube video views outside India, illustrating international audience engagement across

In Fig. 13, the state of Uttar Pradesh (IN-UP) recorded the highest number of views at 4,561, indicating a strong interest in the content. This is closely followed by Bihar (IN-BR) with 3,876 views and Assam (IN-AS) with 3,794 views. These three states alone represent a significant portion of the total viewership suggesting that the content resonates well with audiences in these regions. Other states such as Manipur (IN-MN), Madhya Pradesh (IN-MP) and Maharashtra (IN-MH) also show a considerable number of views with 2,017, 1,045 and 720 views respectively, further expanding the geographical reach of the videos. Fig. 14, on the other hand, focuses on the total watch time contributed by each state. Interestingly, Bihar (IN-BR), despite having fewer views than Uttar Pradesh, registers the highest watch time at 352.26 hours. This suggests that viewers from Bihar tend to spend more time watching the videos, indicating a higher level of engagement or interest. Uttar Pradesh follows closely with a watch time of 341.05 hours, and Assam also maintains a strong viewer engagement with 229.25 hours. These trends imply that while the number of views is important, the duration for which content is consumed can provide deeper insights into viewer behavior. Notably, Delhi (IN-DL), with only 153 views, still contributes 17.14 hours of watch time, pointing to longer individual viewing sessions and higher per-view engagement. In contrast, several states including Karnataka (IN-KA), Telangana (IN-TG), and Andhra Pradesh (IN-AP) display both low viewership and minimal watch time less than 1 hour in total. This could be attributed to limited regional relevance of the content, language barriers or lack of promotional reach in those areas. Hence, the combined data from these two figures provide a comprehensive understanding of how different regions interact with the content, revealing both the breadth of its reach and the depth of audience engagement across the Indian states. This pattern reveals

that the content has high resonance in North-Eastern and North-Central parts of India, particularly among viewers in states like Uttar Pradesh, Bihar, and Assam.

Global Viewership Distribution

Fig. 15 presents the global distribution of YouTube video performance metrics specifically, the number of views outside of India, showcasing the extent of international audience engagement. While India (IN) remains the dominant source of viewership with a substantial 63,357 views, the content has also reached a diverse range of international regions, reflecting its broader appeal. Among foreign countries, Bangladesh (BD) leads in terms of view count with 207 views, followed by Russia (RU) with 149 views, and Myanmar (MM) with 120 views. Other countries contributing notably include Uzbekistan (UZ), Nepal (NP) and the United States (US) each recording moderate levels of viewership. This figure point toward a growing interest from South Asia, Eastern Europe and North America. Additional contributions come from the Philippines (PH), the United Arab Emirates (AE), Vietnam (VN) and Saudi Arabia (SA) along with a mix of countries from the Middle East, Southeast Asia and Europe such as Pakistan (PK), Indonesia (ID), Brazil (BR), Italy (IT), Spain (ES), Kuwait (KW) and Oman (OM). Despite lower individual view counts, the presence of these nations in the data indicates the content's expanding international footprint. Hence, there is a noticeable level of international reach, particularly from neighboring South Asian countries and a scattering of viewers across the globe. This highlights the content's growing visibility and potential to resonate with audiences beyond national borders.

Conclusion

The study demonstrates the potential of data driven video analytics and predictive modelling for developing effective educational content for pig farmers. The evaluation of key audience analytics and content performance metrics provides valuable insights for the development of effective digital educational content. Hence, the results show the significance of ICT based e-learning platforms to enhance agricultural knowledge dissemination through accessible and localized educational content.

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Disclosure statement

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