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Investigating the Impact of Online Media on Agricultural Practices and Rural Development: A Content Analysis

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HIGHLIGHTS

- Examples of Layman Expertise Model, Dissemination Model and Public Engagement Model for science communication were studied.
- Digital media platforms related to agriculture and farming community were analysed qualitatively as well as quantitatively.
- Digital media is improving information accessibility, and sustainability in the agricultural community amplifying farming and rural upliftment efforts through science communication.

ARTICLE INFO

Keywords: Farming community, Digital media, Science communication, Rural development, Sustainability, Stakeholders.

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ABSTRACT

Agriculture, the primary sector of India, supporting the livelihoods of over 50% of the population, has undergone rapid modernization, highlighting the need for effective networking and knowledge dissemination among key stakeholders: farmers, policymakers, researchers, and entrepreneurs. However, due to the sector's reliance on traditional practices, an observable information gap can be seen in terms of adopting regenerative farming techniques, sustainability, policy support, and innovation. Several online media contents on agriculture and farming practices were examined using content analysis for this study, and coding was done based on three primary factors: content, message style, and interactive elements. Six sub- dimensions were coded within the content dimension, including relevance, frequency, circulation, reach, quality and audience interaction. This study held in 2024, conducted a qualitative content analysis of agricultural digital platforms to evaluate their effectiveness in bridging the gap between the farming stakeholders. The findings suggest that digital media is an effective tool for amplifying farming and rural upliftment efforts through science communication, improving information accessibility, and sustainability in the agricultural community. The role of social media among digital platforms is also showing a tremendous increase in creating scientific temper among farming communities.

INTRODUCTION

Prosperous agricultural communities are the backbone of a country's food security and economic health. Yet, access to information, markets and resources are equally important for sustaining agriculture and development (Chandra & Malaya, 2011). While the information asymmetry and communication gaps can lead to market failures they can be minimized and are not inevitable to avoid. Appropriate communication mediums and strategies are required to bridge the defaults in communication (Shingi & Mody, 1976). Against this backdrop, the emergence of digital media in the agriculture sector is a transformative opportunity as it expands its reach in remote locations too (Deichmann et al., 2016). The digital technologies provide location-specific information, policy insights and the possibility for farm-level positive interventions by the stakeholders (Ehlers et al., 2021). Unlike traditional media which advocates policy instruments such as subsidies and taxes, digital media extends avenues for nudges and sludges impacting decision-making by offering subtle obstructions and influences (Labombarda, 2023). Thus, digital media has the power to make or break the

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system, and it impacts sociological and political structures alike and the agriculture system is not an exception (Carolan, 2022).

Digital platforms act as ecosystems or networks that share a symmetric data-related objective of generating the data value which in turn incentivizes stakeholders and mediators to engage in dialogue – and results in altering the socio-economic environment. Digital media has been a novel paradigm as it enhances industrial congregation, commercial and cooperative farming in rural regions- that motivates high yielding agricultural systems and revitalization of rural farming (Leng & Tong, 2022). Supported by digital technology, AI, Remote sensing and advanced innovations, digital agriculture can increase the output, yields, income, pricing, supply chain management, market accessibility along with efficient resource management (Subaeva et al., 2020). It enables farmers to use the internet to share and collect information about resources, operations, needs, production, refinement and management comprehensively (Walter et al., 2017).

The government of India has been taking several steps for rural development such as digital India, PM Krushak Sanman Nidhi, Ujala Yojana, Kusum Yojana and so on and so forth. For rural development, the government has taken many steps. The Digital India movement was launched on the 1st of July 2015 with the objective of redefining rural India into a digitally empowered economy (PIB, 2015). Young agriculturalists are ready to adopt digital marketing due to the access they provide. (Rameshkumar, 2022). Thus Digital agriculture development inherits and represents the sustainable development, efficiency and green economy (MacPherson et al., 2022).

METHODOLOGY

The study was conducted through qualitative content analysis of selected digital media and depends on secondary data. It is also an advanced review constituting a wide range of literature from different authors related to the role of digital media in rural development and the agriculture community. To understand the role of digital media in connecting various stakeholders in farming, grounded theory is employed which includes- (a) Open Coding, (b) Axial Coding and (c) Selective Coding (Williams, & Moser, 2019). Based on the grounded theory, two blogs/websites, social media influencers, applications and YouTube channels each and an e-magazine are selected. The discourse of certain research studies with broad scope is such that validation demands qualitative interpretation over statistics and metrics. Morgan (1993). The prominence of qualitative research increased significantly from 1996-2019. (Thelwall & Nevill, 2021).

The parameters to select every digital media cannot be uniform as the types of online media differ in terms of features, usage, and metrics. Thus while selecting the media platforms qualitative factors are prioritized over quantitative metrics. The analytics and engagement metrics are collected from the specific web tools namely *similarweb* for applications, websites and e-magazines and *Social Blade* for social media profiles and YouTube channels. Further, the study evaluates the role of science communication in agricultural knowledge sharing and collaboration. Hence the models of science communication are reviewed and the application of these models in the media were considered. The bits from the articles are duly cited and analyzed qualitatively.

The parameters for blogs included; Content relevance, publishing frequency, awards/ recognition, features of the website, engagement metrics, website traffic, bounce rate and search visits, for E magazine it included Content relevance, publishing frequency, awards/ recognition, accessibility, circulation and Reach and use feedback. Similarly social media influencers were measured on content relevance, following and engagement, awards/recognition, impact created, posting frequency and collaboration with stakeholders; for applications, it was content relevance, users/ number of downloads, features, impact created, user feedback and updates and maintenance whereas YouTube Channels were measured with content relevance, subscribers and views, frequency of the content, impact created, video quality and interaction with audience

RESULTS

Mapping the role of online media in the diffusion of agricultural knowledge, indigenous wisdom, and commerce

Figure 1 highlights the role of science communication as a bridge between the varied stakeholders. By sharing scientific research in accessible formats, such as blogs and social media, scientists, researchers, educators etc. can help farmers improve their practices, policymakers can make better action plans and decisions, marketing specialists can gain insights about the needs and consumers can make informed choices about the food they buy. Digital communication in the farming sector enhances the efficiency of providing real-time data related to climate, and supports stakeholders. A study including farmers, extension workers, scientists, and input dealers found that 57.04 per cent of the stakeholders perceive social media to be effective in providing information and connecting with other stakeholders (Sandeep et al., 2023).

A study conducted in Punjab observed young farmers are increasingly using social media and reported 31 per cent rise in knowledge about pests, 32 per cent increase in implementing suggested crop varieties, 24.1 per cent rise in information about market prices (Singh et al., 2021). Similarly, primary research held at Telangana supports the arguments through survey results which state, 50 per cent of the respondents opined social media provides useful agricultural information (Sandeep, et al., 2022). A study held in Bihar states, showed the usefulness and relevance of agricultural information through social media (Mittal et al., 2018).

Further lack of training programs to facilitate the farming community's use of technological advances poses a serious challenge for rural development. In the coming years technology will be possessing high hand control and role in sustainable agricultural practices (Burrell et al., 2004). Soil data would be easily accessible in such conditions which will be possible to combine local information with data from other sources, such as weather and pollution data, to enable more precise management of pests and pesticides (Jasna et al., 2016). Ultimately, it is anticipated that production will rise in tandem with a decrease in the amount of pesticides now in use, which will reduce soil strain and increase soil fertility for sustainable farming practices (Ojha et al., 2015).

Analyzing farming data using artificial intelligence and data analytics, and then giving farmers tailored advice on better agriculture measures is also the need of the hour (Alexandros et al., 2012).

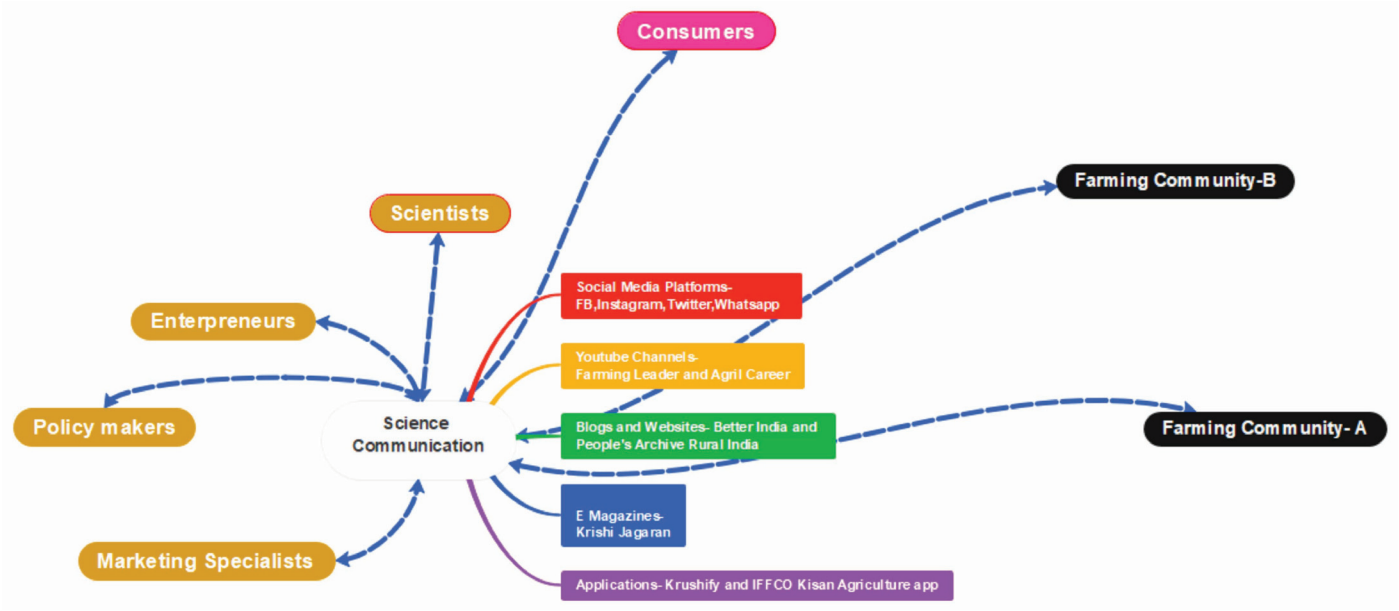

Figure 1. Science communication as a bridge between stakeholders and farming communities

The role of online media is explored further in Table 1 which is an interpretation of selected digital media platforms being the bridge between agricultural stakeholders with their relevant features enabling them to empower the farming community.

Further, the communication strategies applied in digital media are also of utmost significance and converting scientific knowledge into layman's terms is necessary (Sandeep et al., 2022). It was noteworthy that effective use of technology in farming practices will positively affect the growth of agriculture in India where farmers will be the most benefited beneficiary out of this process (Amanjeet et al., 2022).

Science communication in agriculture: Theoretical underpinnings

The sense of surprise and wonder about the happenings in this world brings the prominence of science communication to the public (Ojagh, 2020). Since communication is a multifaceted process that involves many factors, models have been created to help define, illustrate, and portray the structural aspects of communicative acts. The major models of communication in science are public engagement model, dissemination model, lay expertise model (Longnecker, 2016). In the case of communication, the most common model that has received a high level of significance is Harold Laswell's model which explains "who says what, in which channel, to whom, with what effect?" (McQuail & Windahl, 1993) focusing on sender specific message and its persuading level on receiver (less role). While science is the art of studying the functionality of the universe as a whole which is purely on knowledge created on awareness of the public (Ronald Mickens et al., 2016). The term science communication is broadly connected with many similar terms like Public Awareness of Science (PAS), Public Understanding of Science (PUS), Scientific culture (SC) and Scientific Literacy (SL) (Burns et al., 2003). As communication is a multifaceted process, models aid to define, illustrate, and portray the structural aspects of communicative acts. The major models of communication in science are the public engagement model, dissemination model and lay expertise model.

Public engagement model

In this model of science communication, two-way flow of information between various stakeholders will take place which includes scientists, communication experts (catalyst) and the layman/public. Technology and scientific influence of policy making is also a vital area under the public engagement model. The inclusion of democratic principles in policy making is the backbone of this model. Public is considered as king more than policy and resources and given the full liberty to become decision makers too. When a non-scientist also becomes the stakeholder for the discussion on science models to generate more on public knowledge on science, the results may be more powerful than any other models (Zerbe & Wilderman 2010). Public engagement models include hypothesis-driven science, like citizen science studies of how weather and urbanization affect wintering bird populations' distributions (Zuckerberg et al., 2011). It also includes initiatives that use observational data and local knowledge to address political and social goals for marginalized communities, like participatory mapping initiatives that support local group to authority over demographic factors (Peluso 2005). "Participation" refers to a broad range of methods for involving people and communities connected to distinct goals and predictive consequences (Charvolin et al., 2007). In a recent overview of participation theory (Cornwall (2008) outlined various dimensions of participation in development studies and highlighted crucial differences between participation that facilitates social transformation and involvement that is done only to gain "buy-in." recognition among the community

While explaining the participation model of science communication with agriculture, the role of media needs to be emphasized well. The media has the power to decide the content

their audiences should consume (Entman, 2007; Scheufele & Tewksbury, 2007), implying their ability in deciding which social values and ethics should be highlighted (Kellstedt, 2000) framing the issues (Greenberg & Hier, 2009), shaping the political propagandas and agendas (Soroka, 2002), nudge the public attitudes (Ahchong & Dodds, 2012), and promote certain doctrines over others (Lowe & Morrison, 1984) by creating, displaying and disseminating specific information throughout society. In the case of agriculture, this model acts as a platform for farmers to communicate with the technical experts in the field for more innovative and regenerative types of sustainable agriculture practices. Before expecting farmers to control the effects of weather and climate on crop output and adapt to vulnerability, it is necessary to help them expand their understanding of the relationship between climate and crop production through better planning and crop management (Kumar et al., 2015). According to Massey et al., (2002), there is a significant correlation between farmers' networks and their use of technology for information collection.

Dissemination model

According to this concept, the audience is considered as lacking scientific information until the communicator provides it, and science communication is therefore driven by this perceived need for science literacy (Trench, 2008). The deficit model is a top-down, one-way communication strategy that seeks to "publicize understanding of science (Joly, 2008). Likewise, science communication is a one-way process whereby scientists, who possess all the necessary information, fill in the knowledge gaps in the scientifically illiterate general population as they see fit (Miller, 2001). This model also experienced a huge gap between science and society where public understanding and activity was found to be less and not preferred (House of lords, 2000). But various research papers found that the majority of these models' underlying presumptions haven't been thoroughly examined against actual science communication procedures where the need of more studies benefiting farmers and society with the help of communication needs to be highlighted (Salmon, 2017).

Lay expertise model

This model possesses a close association with the responsible development model where the local inhabitants play a major role in the development process of science communication with the aim of reducing the gap between science and the public (Bossard, 2010). This methodology requires an appreciation of local knowledge and competence about the scientific areas that are being discussed. It highlights the value of the implicit knowledge that communities hold, for instance from elders and other opinion leaders (Lewenstein, 2010). "Knowledge and expertise that is held and validated by social systems other than modern science" is highlighted by the "lay-expertise model." While bringing the model with the purpose of farmers' development and the role of communication channels for the mainstream dealing with local proficiency and understanding of the relevant scientific fields as the advantage for communicating with the public on science. The farming community will be able to understand the contrast to traditional approaches to indigenous knowledge systems, which frequently employ contemporary scientific techniques to bolster traditional beliefs in this model which made the model not efficient for public awareness in science.

Many research papers have discussed the significance of audiences' readings of particular types of content that produced different interpretations (Davis, 2012) mentioning the reception theory along with bringing agenda setting theory where powerful elites are able to use the media to propagate their limited concept of reality to the majority. Specifically, the National Academy of Sciences (2017) offers three study themes that are exemplary: structuring science communication, dispelling myths in science communication, and employing narrative storytelling to convey science to narrow down the gap between science communication and society (Cannon et al., 2016). To make farmers also a part of science communication in a narrative way of storytelling the factors called trust and credibility plays a major role. Finding common ground, demonstrating reputability, and being open and honest about the purpose and significance of the data you wish to gather are all ways to build trust in farmers which can later be considered as communication techniques for science literacy (Alvesson, 2004). For farmers to make educated decisions, there needs to be open communication and a fair and balanced presentation of the issue in the media, including the advantages and disadvantages of any involvement. This isn't always the case, though, when scientists and the media-particularly social media-discuss a technology, suggestion, or government-endorsed law. The following table consists of the content extracted from Table 1 and identifies the science communication model applied.

The farmers own smartphones and thus access digital media which is widespread ever since the digital India policy (Kumar et al., 2017). The farming community looks forward to AKIS- Agricultural Knowledge and Innovation System for disseminating information and gaining insights from stakeholders. The digitalization of agriculture implies leveraging the synergies in AKIS. (Ingram & Maye, 2020). Central agencies have developed IDEA- Indian Digital Ecosystem of Agriculture Framework to access information and increase policy insights, outcomes, and holistic profitability (Acharya et al., 2024). Farming is a physical activity and requires a substantial amount of time and energy farmers get very less opportunities to network and effective knowledge sharing is infrequent (Singh et al., 2015). Online media has emerged as a way out to this challenge as farmers can now engage through social media, web forums, e-magazine, etc. (Burbi & Rose, 2016). Digital media also acts as a tool facilitating certain products and concepts' adoption. It integrates information from both peers and firms, enhances understanding and eliminates uncertainty (Zhang et al., 2021).

CONCLUSION

The future of farming lies in the integration of digital technology and media into the agricultural ecosystem (Rambod et al., 2023). Online media will improve the dissemination of technical information and indigenous wisdom, which in turn would systematically shape the agricultural advisory and extension services (Bhattacharjee et al., 2016). Agriculture, supported by digital technology and tools is the key to the enhancement of productivity, profitability, and sustainability. Similarly, traditional

Table 1. Science communication models applied in selected media

Statement	Science Communication Model
• Kala Namak Rice Aromatic Kala Namak Rice | GI Tag. www.youtube.com. Retrieved March 26, 2024, from https://www.youtube.com/watch?v=iaEFDg9SBHI • A nutritionist Tapaswini Swain points out, "Tribal societies are said to be most closely linked to nature. They consume food items that have undergone very little processing, and the period between the farm and the table is brief, leading to high nutrient bioavailability."According to Bichitra Biswal of Living Farms, "Kondh tribal farmers were cultivating a variety of indigenous crops in the highlands and mountains." We are attempting to raise awareness about the positive aspects of their indigenous cuisine through the camps (Service, 2016).	**Public Engagement Model** This is from the Agril Career YouTube Channel and Better India Blog. The communication is a two-way process where the interviewer asks the farmer to explain Kala rice, its characteristics, and its nutritional significance. In the second instance, the author has reported comments of different experts and the report is an outcome of a two-way communication.
• They originate from a tuber plant that is native to the Andes Mountains region of South America, just like the remainder of the potato family (Solanum tuberosum). They are distinguished by their unique blue-purple-black outer skin. This vegetable has brilliant purple inner flesh that holds up even when cooked (Bose 2024). • According to a recent Science study, organic fields decrease pesticide use in their surrounding conventional fields while increasing it in organic fields. According to the findings, grouping organic fields together may help cut down on the number of pesticides used in landscapes (Shukla, 2024).	**Dissemination Model** The sentence is taken from the Better India Blog and Krushi Jagaran- e magazine mentioned in Table 2 respectively. As per the dissemination model through one-way communication, the information about the purple potato's origin, characteristics, and culinary properties is being disseminated to the audience.
• Chamnibai and her family have been diligently preserving dozens of locale seed varieties for years. Her daughters-in-law are now the beneficiaries of her knowledge transfer. She asserted, "Women save seeds better." They ensure to replenish them and take good care of them. The details serve as essential in this process (Daga, 2015). • While sitting on his balcony and concurrently taking in views of the village, the house, and the courtyard, Naganna remarks, "I remember five varieties of ragi." There were only four or five fingers on the original naatu (native) ragi." flavor and nutrition were great, but the yield was low" (Karthikeyan, 2022).	**Layman Expertise Model** The content is borrowed from the PARI website mentioned in Table 2. Local inhabitants such as Chamnibai and Naganna play a significant role in sharing knowledge about preserving seeds and Varieties of Ragi respectively through layman's terms and thus disseminate indigenous wisdom.

mass media's position in information networks is diminishing due to the growing penetration of ICT-mediated interactive communication, particularly social media (Roy et al., 2024). It also discussed that social media platforms have also become a major tool in enhancing the rural development in various ways including cultural exchange, crisis communication, community development, innovation and digital awareness for farming community becoming the most intimate medium to get information (Cruz et al., 2017).

REFERENCES

Abiri, R., Rizan, N., Balasundram, S. K., Shahbazi, A. B., & Abdul-Hamid, H. (2023). Application of digital technologies for ensuring agricultural productivity. *Heliyon*, *9*(12), e22601, https://doi.org/10.1016/j.heliyon..e22601.

Alvesson M. (2004). Knowledge Work and Knowledge Intensive Firms. Oxford University Press, London.

Amanjit, K., Gurjeet, S. W., & Ramandeep, S. (2022). Leveraging social media platforms for valuing agri-entrepreneurship in Punjab, India. *Indian Journal of Extension Education, 58*(3), 70–73.

Balkrishna, A., Singh, S. K., Pathak, R., & Arya, V. (2024). E-governance paradigm in the Indian agricultural sector. *Discover Agriculture*, *2*(1). https://doi.org/10.1007/s44279-024-00012-7

Bhattacharjee, S., & Raj, S. (2016). Social media: Shaping the future of agricultural extension and advisory services.10.13140/RG.2.2.10815.56488. https://www.researchgate.net/publication/330397283_Social_media_Shaping_the_future_of_agricultural_extension_and_advisory_services

Bonner, F. T., & Phillips, M. (1957). Principles of Physical Science. Addison-Wesley.

Borrero, J. D., & Mariscal, J. (2022). A case study of a digital data platform for the agricultural sector: a valuable decision support system for small farmers. *Agriculture*, *12*(6), 767. https://doi.org/10.3390/agriculture12060767

Bose, H. K. (2024, January 2). *Black Potatoes? Meet the Man Taking Black Super Crops to 15 States*. The Better India. https://www.thebetterindia.com/337247/black-potato-kaala-aaloo-shetland-farmer-in-uttar-pradesh-antioxidants/

Brossard, D., & Lewenstein, B. V. (2010). *A Critical Appraisal of Models of Public Understanding of Science: Using Practice to Inform Theory*. Routledge, London, United Kingdom.

Burbi, S., & Rose, H. (2016). *The role of the Internet and social media in the diffusion of knowledge and innovation among farmers*. Retrieved February 26, 2024, from https://ifsa.boku.ac.at/cms/fileadmin/IFSA2016/IFSA2016_WS15_Burbi.pdf

Burns, T. W., O'Connor, D. J., & Stocklmayer, S. M. (2003). Science communication: A Contemporary Definition. *Public Understanding of Science, 12*(2), 183-202. https://doi.org/10.1177/09636625030122004

Carolan, M. (2022). Digitization as politics: Smart farming through the lens of weak and strong data. *Journal of Rural Studies*, *91*, 208-216.

Chamroy, P. (2023). People's Archive of Rural India as alternative media. *Media Asia*, *50*(3), 333-354.

Chandra, D. G., & Malaya, D. B. (2011, April). Role of e-agriculture in rural development in Indian context. In *2011 International*

Conference on Emerging Trends in Networks and Computer Communications (ETNCC) (pp. 320-323). IEEE.

Cruz-Benito, J., Borras-Gene, O., Garcia-Penalvo, F. J., Blanco, A. F., & Theron, R. (2017). Learning communities in social networks and their relationship with the MOOCs. *IEEE Revista Iberoamericana de Tecnologias del Aprendizaje*, *12*(1), 24-36.

Daga, S. (2015, October 7). *Keepers of the seeds* (S. Joshi, Ed.). People's Archive of Rural India.https://ruralindiaonline.org/en/articles/keepers-of-the-seeds/

Deichmann, U., Goyal, A., & Mishra, D. (2016). Will digital technologies transform agriculture in developing countries? *Agricultural Economics*, *47*(S1), 21-33.

Dixit, A., Sharma, S. K., & Sharma, D. P. (2021). Impetus on big data to boost Indian MSME sector and economy using cloud storage. *International Journal of Computer Applications*, *174*(21), 17-23.

Ehlers, M. H., Huber, R., & Finger, R. (2021). Agricultural policy in the era of digitalisation. *Food Policy*, *100*, 102019.

House of Lords. Science and Society. London: Select Committee on Science and Technology; 2000. Available from: https://publications.parliament.uk/pa/ld199900/ldselect/ldsctech/38/3802.htm.

How will digitalization change agriculture? - ProQuest. (n.d.-b). https://www.proquest.com/openview/4a1252125dc9db848f8c6c9ab7af2787/1?pq-origsite=gscholar&cbl=47429

Ingram, J., & Maye, D. (2020). What are the implications of digitalisation for agricultural knowledge? *Frontiers in Sustainable Food Systems*, *4*, 66.

Jasna, V. K., Burman, R. R., Padaria, R. N., Sharma, J. P., Varghese, E., Chakrabarty, B., & Kumar, S. (2016). Constraints in adoption of climate resilient technologies in rainfed agro-ecosystem. *Indian Journal of Extension Education, 52*(3&4), 30-34. https:// epubs.icar.org.in/index.php/IJEE/article/view/144101

Joly, P. B., & Kaufmann, A. (2008). Lost in translation? The need for 'upstream engagement' with nanotechnology on trial. *Science as Culture, 17*(3), 225–247.

Kaloxylos, A., Eigenmann, R., Teye, F., Politopoulou, Z., Wolfert, S., Shrank, C., Dillinger, M., Lampropoulou, I., Antoniou, E., Pesonen, L., & Nicole, H. (2012). Farm management systems and the Future Internet era. *Computers and Electronics in Agriculture, 89*, 130-144.

Karthikeyan, A. (2022, March 28). *In TN: the new ragi universe of Nagi Reddy*. People's Archive of Rural India. https://ruralindiaonline.org/en/articles/in-tn-the-new-ragi-universe-of-nagi-reddy/

King, A. (2017). Technology: the future of agriculture. *National Outlook, 544*(7651), 21–23.

Kumar, S., Singh, R., Rao, D. U. M., & Chauhan, J. (2017). Information needs of Indian farmers: an elixir for connect and disconnect of agriculture. *Indian Research Journal of Extension Education*, *18*(1), 37-44.

Labombarda, O. (2023). Digital nudges: bringing awareness of excessive consumption of digital content in smartphone Users. Retrieved from https://urn.kb.se/resolve?urn=urn:nbn:se:mau:diva-62202

Leng, X., & Tong, G. (2022). The digital economy empowers the sustainable development of China's Agriculture-Related industries. *Sustainability*, *14*(17), 10967. https://doi.org/10.3390/su141710967

Longnecker, N. (2016). An integrated model of science communication - More than providing evidence *JCOM, 15*(5), Y01. https://doi.org/10.22323/2.15050401

MacPherson, J., Voglhuber-Slavinsky, A., Olbrisch, M., Schöbel, P., Dönitz, E., Mouratiadou, I., & Helming, K. (2022). Future agricultural systems and the role of digitalization for achieving sustainability goals. A review. *Agronomy for Sustainable Development*, *42*(4). https://doi.org/10.1007/s13593-022-00792-6

Massey, C., Morriss, S., Alpass, F., & Flett, R. (2002). Building innovative capacity: a report on an investigation into technological learning in the New Zealand dairy industry. NZ centre for SME Research, Wellington.

McQuail, D., & Windahl, S. (1993) *Communication Models for the Study of Mass Communication*, 2nd edn. Pearson Prentice Hall, London, United Kingdom.

Miller, S. (2001). Public understanding of science at the crossroads. *Public Understanding of Science, 10*(1), 115–120.

Mishra, A., Malik, J. S., & Bhavesh. (2024). Constraints faced by paddy farmers in adoption of climate smart agricultural practices: A comparative study. *Indian Journal of Extension Education*, *60*(2), 95–99. https://doi.org/10.48165/IJEE.2024.602RN1

Mittal, S., Padmaja, S. S., & Ajay, A. (2018). Agricultural information and knowledge network in rural India: a case of Bihar. *The Journal of Agricultural Education and Extension*, *24*(5), 393–418. https://doi.org/10.1080/1389224x.2018.1491871

Morgan, D. L. (1993). Qualitative content analysis: A Guide to Paths not Taken. *Qualitative Health Research, 3(1), 112–121*. doi:10.1177/104973239300300107 10.1002/abio.370040210

Murthy, L. (2020, November 20). *Seeking media PARI-ty in rural India*. The Story. https://medium.com/thestory-asiapacific/seeking-media-pari-ty-in-rural-india-4cdcdbc5db5d

Nagaraj, R. (2022). Impact of digital marketing in the agricultural sector. *International Journal of Multidisciplinary Research Review, 8*(3), 18-22.

Ojagh, S. Z., & Zardar, Z. (2020). From the ancient world of Elam to modern science communication. *A Global Perspective*, 395.

Parekh, A., & Parekh, D. (2013, November 1). When the News can change you. Mint. https://www.livemint.com/Leisure/N3PPjMfTuvjf0It23AdzoO

Peluso, N. L. (2005). Seeing property in land use: local territorialisation in West Kalimantan, Indonesia. Geografisk Tidskrift. *Danish Journal of Geography, 105*(1), 1-15.

PIB, Government of India, Ministry of Communications, (2015). Prime Minister to Launch Digital India Week on the First July. (2015). Pib.gov.in https://pib.gov.in/newsite/printRelease.aspx?relid=122837

Rameshkumar, N. (2022). Impact of digital marketing in agricultural sector. *EPRA International Journal of Multidisciplinary Research (IJMR)*, *8*(3), 18-22.

Risk, I. A. (2008). Science and public communication: Third-order thinking about scientific culture. In: Handbook of public communication of science and technology. Routledge; 2008. p. 213–226.

Ronald, M., & Charmayne, P. (2016). What is Science? *Georgia Journal of Science, 74*(2), Article 3. http://digitalcommons.gaacademy.org/gjs/vol74/iss2/3

Roy, P., Maji, S., Jirli, B., Singh, P., & Nain, M. S. (2024). Scopus Indexed Indian Journal of Extension Education: Crafting improvement strategy through altmetric and bibliometric analysis. *Indian Journal of Extension Education*, *60*(2), 1-10.

Salmon, R. A., Priestley, R. K., & Goven, J. (2017). The reflexive scientist: an approach to transforming public engagement. *Journal of Environmental Studies and Sciences*, *7*(1), 53–68.

Sandeep, G. P., Ganesamoorthi, S., Raghuprasad, K. P., Gowda, V. G., Benherlal, P. S., & Kumar, T. L. M. (2023). Exploring stakeholder attitudes towards digital agricultural communication and services. *Indian Journal of Extension Education*, *59*(4), 91-96.

Sandeep, G. P., Prashanth, P., Sreenivasulu, M., & Madavilata, A. (2022). Effectiveness of agricultural information disseminated, through social media. *Indian Journal of Extension Education*, *58*(2), 186-190.

Service, W. F. (2016, December 26). *Why Odisha's Tribal Women Are Returning to Their Natural Roots for Guidance on Food*. The Better India. https://www.thebetterindia.com/79661/odisha-tribal-women-new-source-good-food-forest-food/

Shanmuka, A., Lenin, V., Sangeetha, V., Muralikrishnan, L., Ramasubramanian, V., & Arora, A. (2022b). Analysis of factors affecting social media utilization of extension agents. *Indian Journal of Extension Education*, *58*(2), 110–114.

Shingi, P. M., & Mody, B. (1976). The communication effects gap: A field experiment on television and agricultural ignorance in India. *Communication Research*, *3*(2), 171-190.

Shukla, S. (2024, March 22). *New study reveals surprising side effects of organic farming*. Krishijagran.com.https://krishijagran.com/agriculture-world/new-study-reveals-surprising-side-effects-of-organic-farming/

Singh, G., Singh, P., Tiwari, D., & Singh, K. (2021b). Role of social media in enhancing agricultural growth. *Indian Journal of Extension Education*, *57*(2), (69-72). https://epubs.icar.org.in/index.php/IJEE/article/view/111678/43805

Singh, M., Burman, R. R., Sharma, J. P., Sangeetha, V., & Iquebal, M. A. (2015). Effectiveness of mobile based agro-advisory services in addressing information need of the stakeholders: a case of m krishi®. *Indian Journal of Extension Education*, *51*(1&2), 32-38.

Subaeva, A., Низамутдинов, M., & Mavlieva, L. (2020). Changes of the agricultural staff potential in the transition to digital agriculture. *BIO Web of Conferences*, *17*, 00178. https://doi.org/10.1051/bioconf/20201700178

Thelwall, M., & Nevill, T. (2021). Is research with qualitative data more prevalent and impactful now? Interviews, case studies, focus groups and ethnographies. *Library & Information Science Research*, *43*(2), 101094.

Trench, B. (2008). Towards an analytical framework of science communication models. In: Cheng, D., Claessens, M., Gascoigne, T., Metcalfe, J., Schiele, B., Shi, S., editors. Communicating science in social contexts. Dordrecht: Springer, pp 119–135.

Walter, A., Finger, R., Huber, R., & Buchmann, N. (2017). Smart farming is key to developing sustainable agriculture. *Proceedings of the National Academy of Sciences*, *114*(24), 6148-6150.

Williams, M., & Moser, T. (2019). The art of coding and thematic exploration in qualitative research. *International Management Review*, *15*(1), 45-55.

Zerbe, F., & Wilderman, C. (2010). Monitoring IMPACTS of new gas-drilling technologies. Pages 1–4 in E. Ely, editor. The volunteer monitor. US Environmental Protection Agency Office of Water, Washington, D.C., USA.

Zhang, W., Chintagunta, P. K., & Kalwani, M. U. (2021). Social media, influencers, and adoption of an eco-friendly product: Field experiment evidence from rural China. *Journal of Marketing*, *85*(3), 10-27.

Zhou, X., Chen, T., & Zhang, B. (2023). Research on the impact of digital agriculture development on agricultural green total factor productivity. *Land*, *12*(1), 195. https://doi.org/10.3390/land12010195

Zuckerberg, B., Bonter, D. N., Hochachka, W. M., Koenig, W. D., DeGaetano, A. T., & Dickinson, J. L. (2011). Climatic constraints on wintering bird distributions are modified by urbanization and weather. *Journal of Animal Ecology 80*(2), 403–413. http://dx.doi.org/10.1111/j.1365-2656.2010.01780