Measuring perception on multimedia-based agro-advisory: A scale construction

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ABSTRACT

Access to information and effective delivery can be improved by using multimedia as a tool for advisory services. Various factors contribute to the development of an effective multimedia-based agro-advisory model. Stakeholders' perception plays a major role to design and validate it properly. To measure stakeholders' perception towards multimedia-based agro-advsiory (*Pusa Samachar*), a multi-dimensional perception scale was developed using Polychoric Principal Component Analysis (PCA). The data pertaining to this study were collected from 150 farmers using Google forms in 2021 and from 225 farmers in 2022. These farmers were sampled using stratified two-stage sampling from five districts each from Uttar Pradesh, Haryana and Punjab states. The majority of the farmers (68.6%) reported watching full weekly episode of agro-advisory telecasted as *Pusa Samachar*. Notably, farmers of Uttar Pradesh (54.67%) and Haryana (60.0%) showed affirmative perception; while Punjab (50.83%) had neutral perception towards *Pusa Samachar* model. Analysis of average perception score of farmers revealed that technical factor ranked I followed by linguistic factor (II), content and design factor (III) and timeliness factor (IV). Audio-visual quality, graphics, time duration of content, language, accent, and style of presentation with quality content could be considered as prime parameters for developing multimedia-based content. Location-specific, farmers' centric language-based, and farmer participatory multimedia-based content should be created for better information availability and acceptance among farming community.

Keywords: Agro-advisory, Multimedia, Perception, Principal component analysis

Agricultural and rural development depends mainly on access to right and timely information (Morrow *et al.* 2002, Mayer 2008, Tripp 2006). Depending on the kind of information needed, farmers utilize their various preferred information sources, such as fellow farmers, radio, television, newspapers and mobile phones (Babu *et al.* 2012, Nikam *et al.* 2020). Providing formal, systematic and organized extension services is vital for promoting small-scale agriculture and ensuring the food security of the nation (Rickards *et al.* 2018). These services contribute to increasing farmers' agricultural skills, and knowledge, help in disseminating new technologies and in changing farmers' attitudes (Khan *et al.* 2012). In India, the ratio of extension service providers (ESP) to active farm holdings is approximately 1:1156 (DFI 2017). Hampering of effectiveness of extension services due to the high extension agent-to-farmer ratio may lead to decreased frequency of visits and sporadic support. This issue is further magnified when agricultural extension professionals are assigned to many tasks to perform and serve a large number of farming communities. This situation reduces the efficacy of their advice (Antwi-Agyei and Stringer 2021).

Digital technology offers extension advisory services a unique edge (Woods and Langcuster 2014) and social media platforms like YouTube, Facebook, WhatsApp, blogs, and Twitter, can be a very effective tool for both farmers and extension agents (Gharis *et al.* 2014). Due to its distinctive features such as openness, connectivity, involvement, and dialogue, social media has received popularity in rural India as internet penetration has increased i.e. 322.77 million rural internet subscribers out of an overall 825.30 million Internet subscribers (TRAI Report 2021). A well-designed tailor-made content developed based on the needs of stakeholders

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in social media platforms can lead to higher acceptance among targeted groups indeed (Burman *et al.* 2022). Utilizing social media as a tool for information delivery, the initiatives were taken by ICAR-Indian Agricultural Research Institute, to develop a multimedia-based agro-advisory popularly known as *Pusa Samachar*. This is aimed to provide need-based, location-specific, and multi-lingual agricultural advice and query redressal services through platforms, such as WhatsApp.

Merely multimedia-based content creation does not guarantee its acceptance among stakeholders (Burman *et al.* 2022), instead, it should focus on the perception of stakeholders to enhance acceptance and refine the design based on the needs of specific communities. Studies are addressing the stakeholder perception and community needs in various contexts of multimedia-based content creation in agro-advisory services (Shanthy and Thiagarajan 2011, Ganesan *et al.* 2013). However, these studies lack the development of a structured perception scale contextualized with emerging grassroots needs. Similarly, farmers' perception towards mobile-based agro-advisory services has been analysed using one perspective whether the information is clear, understandable, timely and practicable (Singh *et al.* 2015, Reddy *et al.* 2017). There is a need to focus on stakeholders' multidimensional aspects of perception towards multimedia-based extension advisory services. In accordance with this, present study was planned to construct the multidimensional perception scale to measure farmers' perception towards multimedia-based agro-advisory services.

MATERIALS AND METHODS

Study area: In the first year of study (2021), an online survey was conducted applying Google forms (as a pilot study) to collect the perceptions of respondents. These Google forms were circulated among the WhatsApp number (phase I), and a total of 150 responses (n = 150) were collected from farmer viewers. In the same year (phase II), the perception scale was developed by taking responses from the 60 experts (n = 60) for the item validation. Conceptually, like most other psychological variable, perception is a complex psychological variable to have many underlying components that involve both personal and societal perspectives. Due to the multicollinearity effect between the statements, evaluating perception using a uni-dimensional scale may produce inaccurate results (Som *et al.* 2018). So, perception of stakeholders towards multimedia-based agro-advisory service, considering *Pusa Samachar* as a model, a multidimensional scaling method was constructed. In this study, we used the modified M-K-J-B-D (Maheshwari-Kumar-Jhamtani-Bhaskaran-Dandapani) method (Bhattacharyya *et al.* 2021) for which 100 farmers (n = 100) were selected from non-sampled district (Gautam Buddh Nagar, Uttar Pradesh), and were interviewed. Polychoric Principal component analysis was used to identify the factors of the scale. Data analysis was done by using the "survey" package in *R* software. The

sampling weighted PCA function (SWPCA) was used for the analysis.

The content of the *Pusa Samachar* Hindi episodes predominantly focuses on rice and wheat cultivation technologies (Burman *et al.* 2022). Based on data from the *Pusa WhatsApp Salah* queries it was observed that the majority of viewers were from the states of Uttar Pradesh, Haryana, and Punjab. Acknowledging the importance of the rice-wheat cropping system in India and the critical need for agricultural advisories in these regions, a purposive sampling approach for selecting the states was applied. In the subsequent year (2022), the perceptions of viewers regarding the multimedia-based extension advisory model were assessed using the constructed scale in three states situated in the Indo-Gangetic plains, namely Uttar Pradesh, Punjab, and Haryana, which were chosen purposively for the study. Stratified two-stage sampling technique was used for selection of respondents from each state. With an average viewership of *Pusa Samachar Hindi* episode was 2.25k in 2022, a sample of 225 respondents were selected as viewers of *Pusa Samachar*. This selection aimed to provide a more accurate estimate of population parameters with enhanced precision. Five districts were randomly selected from each state, and from each of these districts, one block was chosen at random. Within each selected block, 15 *Pusa Samachar* viewers were randomly chosen, resulting in a final sample size of 225 respondents (n = 225). From Uttar Pradesh, Shikarpur block of Bulandsahar district, Rajapur block of Ghaziabad district, Tappal block of Aligarh district, Hapur block of Hapur district, and Kharkhoda block of Meerut district were chosen. From Haryana, Prithla block of Palwal district, Dadasiya block of Faridabad district, Kharkhoda block of Sonipat district, Farrukh Nagar block of Gurugram district, and Daboli block of Sirsa district were selected. Lastly, from Punjab, Lambi block of Sri Muktsar Sahib district, Abohar block of Fazilka district, Firozpur block of Firozpur district, Tarn Taran block of Tarn Taran district, and Sangat block of Bhatinda were included in the sampling. This resulted in a diverse representation of blocks from each state as shown in Fig. 1. The perception scores obtained for each of the 225 respondents were classified into three categories unaffirmative, neutral and affirmative perception using the cumulative square root method based on the viewer's scoring on the perception scale.

RESULTS AND DISCUSSION

In the first year of study, the focus was to find out the different viewing patterns and factors pertinent for the development of an ideal multimedia-based extension advisory model. The findings (Table 1) reveal that among the 150 farmers surveyed, a significant majority of 68% viewers indicated a preference for watching the entire episode on a weekly basis whereas 20% of the respondents expressed a preference for selectively viewing only those portions of the episode that directly address their specific needs. In case of fortnightly viewers, only 2.00% watched the complete episode while 2.66% focused on relevant
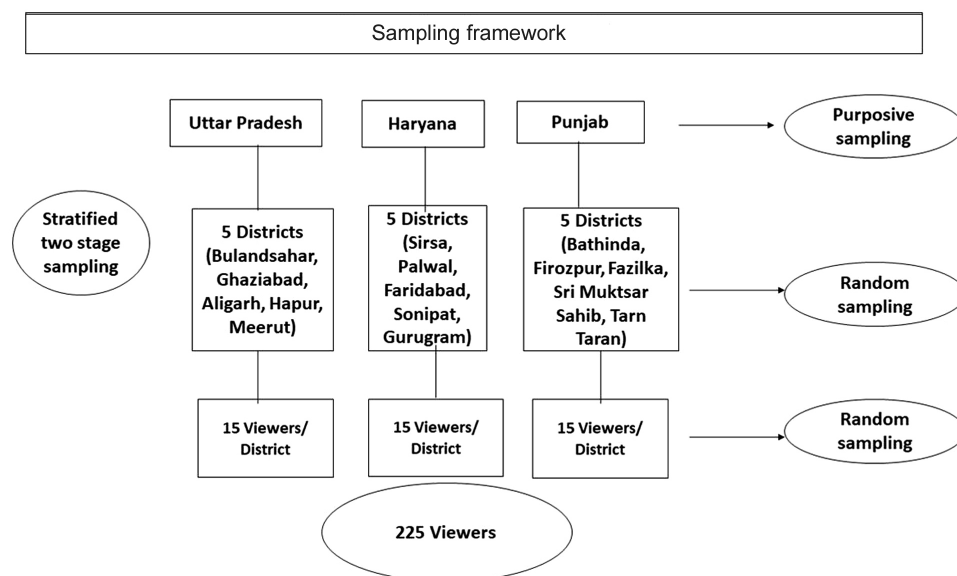
Fig. 1 Sampling framework for the respondents.

requested to check relevancy on five-point continuum from 'highly relevant' to 'highly irrelevant'. Relevancy weightage was calculated for each statement by using the formula given by Kumar and Popat (2016). Accordingly, statements having a mean relevancy score >3.5 and relevancy weightage >0.70 were considered for final selection. By this process, 11 statements were deemed irrelevant, as their relevancy weightage and mean relevancy score were below the pre-determined cut-off. Consequently, 24 statements were selected for further analysis, ensuring the inclusion of only the most pertinent factors in the assessment.

Step 3: Item analysis: After modifying and rewriting 24 statements, they were administered to 100 farmers of Gautam Buddh Nagar (non-sampled district) of Uttar Pradesh. The participants were requested to provide their response on a five-point continuum ranging from 'strongly agree' to 'strongly disagree'. Subsequently, PCA was employed to select the final set of statements, along with determining their factor loadings and scale values. SWPCA was run by using a polychoric correlation coefficient as data input instead of directly using the data set as it was ordinal type (Kolenikov and Angeles 2004). Among the 24 statements that passed the relevancy test, eight were dropped due to their commonality values falling below the predetermined cutoff point of 0.80. The remaining 16 statements demonstrated communality values exceeding the cutoff threshold and were thus retained for further analysis.

Step 4: Conducting the factor analysis: The Kaiser-Meyer-Olkin (KMO) test yielded a score of 0.734, indicating adequate sampling adequacy. Bartlett's test produced a significant result, leading to the rejection of the null hypothesis of non-collinearity. Through SWPCA, four components were extracted, collectively explaining 79.04% of the total variance, as illustrated in Table 2 and Fig. 2. The scree plots highlighted components with eigenvalues greater than 1, elucidating their contribution to the variance. Based on careful consideration of the factor loadings of various statements on different factors as shown in Table 3, the factors were named taking experts' consultation and review of the literature. Statements that showed more loadings on component I were related to audio and video quality, graphics and time duration of each episode and each crop segment which was named as 'Technical factor'. Similarly, components II, III, and IV named as 'Linguistic factor', 'Content and design factor' and 'Timeliness factor' respectively.

portion. As far as monthly viewers are concerned, 4.66% watched full episodes whereas 2.00% watched the relevant portions of episodes. The majority of viewers engage with the weekly full episodes, indicating that the weekly broadcast episodes are well suited for the audience. Moreover, this observation has provided valuable insights into potential dimensions for further perception studies. As a result, additional parameters have been integrated into the scale to enhance its comprehensiveness. These parameters include timely delivery of information aligned with crop seasonality, content duration, audio and video quality, visual graphics, and language delivery style.

Construction of multimedia perception scale: PCA-based scale construction is done using the following steps.

Step 1: Collection of multimedia based extension advisory perception statements: An exhaustive list of items was collected covering all aspects of multimedia-based extension advisory from published literature and informal discussions with the researchers, and professionals including focus group discussions with farmers. After preparation of statements, 35 statements were retained for the development of scale.

Step 2: Relevancy test of the selected statements: Statements selected in step 1, were administered to 60 scientists of IARI (involved in content creation and delivery) through personal contact. Scientists were

Table 1 Distribution of farmer viewers according to their self-reported watching pattern and watching frequency

		Watching pattern (n = 150)	
		Full episode (%)	Relevant episode (%)
Watching frequency	Weekly (%)	68.66	20.00
	Fortnightly (%)	2.00	2.66
	Monthly (%)	4.66	2.00

Table 2 Total variance explained by the factors

Component	Total	Initial Eigen values		Total	Extraction sums of squared loadings		Total	Rotation sums of squared loadings	
		Per cent of variance	Cumulative %		Per cent of variance	Cumulative %		Per cent of variance	Cumulative %
1	4.901	30.632	30.632	4.901	30.632	30.632	4.404	27.524	27.524
2	3.599	22.492	53.125	3.599	22.492	53.125	3.039	18.996	46.52
3	2.351	14.695	67.82	2.351	14.695	67.82	2.888	18.049	64.569
4	1.796	11.228	79.048	1.796	11.228	79.048	2.317	14.479	79.048

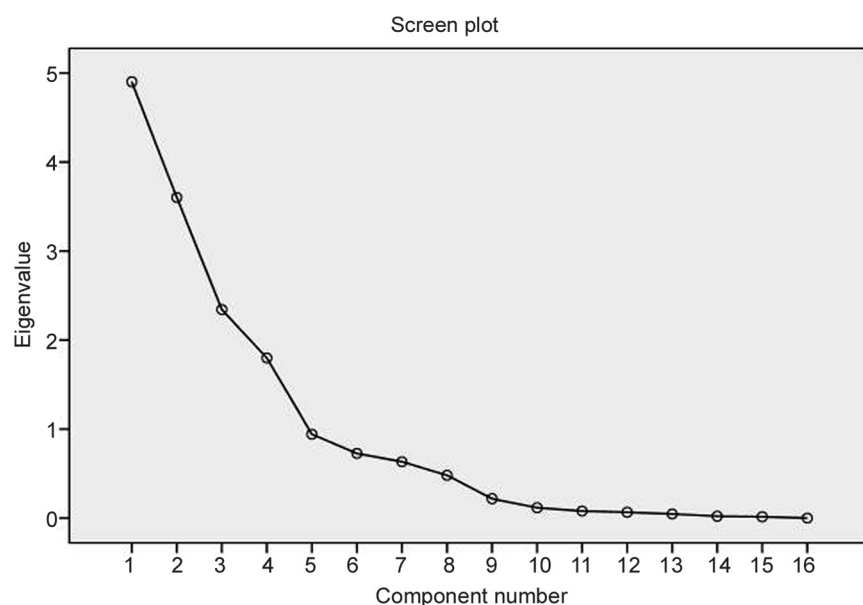Note: Only components with eigenvalues >1 is shown in the table.

Fig. 2 Screen plot showing the graph of component and eigen values.

Step 5: Calculation of scale values of selected statements: Based on criterion of eigen values>1, an equal number of components were extracted by using the Varimax rotation method. Then, the extracted rotational component matrix was multiplied by the eigen values, i.e., the 1st eigen value was multiplied with the 1st extracted component column, and 2nd eigen value was multiplied with the 2nd extracted component column, considering only absolute values, and so on. The values obtained were added in the case of each statement to get scale values for that particular statement.

Step 6: Reliability and validity of the developed scale: The scale was administered to randomly selected 100 farmers from the non-sampled area and calculated Cronbach's α was found to be 0.725 for the developed scale. The contents of the developed scale were derived through the opinions of researchers of the concerned study area, and all the scale construction steps were taken carefully. Thus, it may be concluded that the developed perception scale was valid.

Final implementation of the perception scale: In the year of 2022, data were collected from 225 farmers of Uttar Pradesh, Haryana, and Punjab state by incorporating the selected statements of the scale into the final format of the interview schedule. Each of the statements was provided

with a 5-point continuum, varying from 'strongly agree' to 'strongly disagree'. These responses were multiplied by the scale value of that particular statement. Summation of all these scores reflected a farmer's perception score is shown in Table 4. It was observed that majority of farmers of Uttar Pradesh and Haryana had affirmative perceptions. This trend could be attributed to the spatial similarity between the regions as well as linguistic alignment with the advisory model of *Pusa Samachar*. On the other hand, farmers of Punjab exhibited a neutral perception, which may be due to the reason of their preference of advisory in local language.

Further, an analysis of the average perception score of all the statements using farmers' responses, is presented in Table 5. Starting from the technical factor, according to the scores, statement 2 concerning audio quality ranked first followed by video quality, graphics, time duration of each crop section and time duration of each episode. Content producers should concentrate on making short videos of 6–10 min (Guo *et al.* 2014) which could be useful for learning new skills, serving as a substitute for a practical demonstration, or providing up-to-date information on the weather, diseases, and pest management for effective content delivery while ensuring viewers' engagement and comprehension. On the other hand, long-duration videos play a crucial role in teaching a full package of practice, or while producing technical information for mastering new technologies and enhancing productivity (Yee *et al.* 2020). So, it is evident that according to viewers' perception, among the items in technical factor we should focus on the content timing of crop segment and full episode without compromising high-quality video, audio (Sidaty *et al.* 2014) and graphics for higher acceptance and better delivery of information. Among the linguistic factors, style of presentation of experts ranked I followed by their language (II), accent (III) and use of technical jargons (IV). Creators' inadequate understanding of language-based local needs can contribute to low content

Table 3   Rotated component matrix showing factor loadings of statements on different factors

	Rotated Component Matrix			
	Component			
	I	II	III	IV
Delivery of information is matching with the crop duration				0.521
Information is rightly delivered during pest and disease infestation				0.913
Information is in accordance with the seasonality				0.901
Weather information is delivered timely				0.500
Content has been presented systematically			0.857	
Design is appropriate for learning experience			0.893	
Content is clearly comprehensible			0.771	
Language used is simple		0.918		
Less use of technical jargons in information delivery		0.701		
Accent of language is comprehensible		0.930		
Video quality is good	0.962			
Audio quality is good	0.928			
Graphics are attractive	0.933			
Time duration each episode is optimum	0.871			
Time duration of each crop section is optimum	0.855			
Style of presentation of experts is easily comprehensible		0.866		

Extraction Method: Principal Component Analysis; Rotation Method: Varimax with Kaiser Normalization; Rotation converged in 5 iterations.

Table 4 State-wise classification of viewers according to Perception score

Perception level (score range)	Uttar Pradesh (n = 75) (%)	Haryana (n = 75) (%)	Punjab (n = 75) (%)
Affirmative (17.07–19.48)	54.67	60.00	11.67
Neutral (14.38–17.06)	36.00	34.67	50.83
Un-affirmative (10.97–14.37)	9.33	5.33	37.50

relevancy (Dossani *et al.* 2005). The presentation style and language employed are generally well-received by viewers. However, there is a need to pay attention to the accent and technical terminology used in the content delivery. This is particularly important because stakeholders have their dialects which differ from the language commonly used in literature. Put simply, when discussing a particular disease in rice, such as 'Blast', it is known by different terms in the three study areas of Uttar Pradesh, Punjab, and Haryana. Therefore, it's essential to ensure that content is localized and accessible to the target audience by adapting to their regional language and terminology preferences.

From content and design factor, it is depicted that content is comprehensible (I) followed by design enhancing learning (II) and systematic presentation of content (III). *Pusa Samachar* content and design are perceived as affirmative among the stakeholders as it is helping for better learning experience and can be improved by systematic presentation of the content.

Among the statements of timeliness factor, timely delivery of weather information ranked I followed by the information delivery according to the seasonality (II), during disease and pest infestation (III) and matching with crop duration (IV). Focus group discussion with farmers during data collection, it is observed that they need complete information for specific crops during a crop period which will help for better management and a time reference source for information as it is available on an open accessible Youtube platform. Weather information delivered by this model is timely and the information delivered about crops is according to the seasonality. Since context-specific information might vary in terms of space, time, and degree of specificity at the farm level; individuals generally connect better with locally created content (Cecchini and Scott 2003, Subramanian *et al.* 2005, Thomas 2009). More focus is needed about the disease pest infestation from sowing to harvesting period as it differs in every region which also aligns with the 'Principle of Timing' of learning principles. As we focus on overall perception score rankings of each factor technical factor ranked I followed by linguistic factor (II), content and design factor (III) and timelinness factor (IV) as reported in Table 6. Despite the potential expense and effort involved in producing localised information, viewer

Table 5 Ranking of statements according to the average Perception score of respondents

	Statement	Average perception Score	Rank
Factor I (Technical)			
Statement 1	Video quality is good	23.96	II
Statement 2	Audio quality is good	24.33	I
Statement 3	Graphics are attractive	23.70	III
Statement 4	Time duration each episode is optimum	21.98	V
Statement 5	Time duration of each crop section is optimum	23.50	IV
Factor II (Linguistic)			
Statement 1	Language used is simple	17.22	II
Statement 2	Less use of technical jargons in information delivery	14.16	IV
Statement 3	Accent of language is comprehensible	15.29	III
Statement 4	Style of presentation of experts is easily comprehensible	18.64	I
Factor III (Content and design)			
Statement 1	Content has been presented systematically	7.94	III
Statement 2	Design is appropriate for learning experience	11.15	II
Statement 3	Content is clearly comprehensible	11.8	I
Factor IV (Timeliness)			
Statement 1	Delivery of information is matching with the crop duration	5.09	IV
Statement 2	Information is rightly delivered during pest and disease infestation	10.55	III
Statement 3	Information is in accordance with the seasonality	11.05	II
Statement 4	Weather information is delivered timely	11.19	I

Table 6 Ranking of factors according to the average Perception score of respondents

Factors	Perception score	Rank
Factor I(Technical)	23.48	I
Factor II(Linguistic)	16.33	II
Factor III (Content and design)	10.31	III
Factor IV (Timeliness)	9.47	IV

will access more quality content that is more relevant to their local interests and needs.

Conclusion and policy implications

The pivotal role of localized content creators, particularly Krishi Vigyan Kendras (KVKs), State Agricultural Universities (SAUs), line departments, and research institutes, in delivering personalized agricultural advisory services is essential for tailoring information to the specific needs and contexts of farming communities. Perception of stakeholders towards multimedia-based agro-advisory services is required in addressing challenges related to location-specific issues. This could greatly serve the need of language-specific demand-driven information in agriculture. Moreover, fostering collaboration among the concerned stakeholders including community participation in content creation can enrich the knowledge base and enhance the relevance and effectiveness of these services. Prioritizing the capacity-building of local agro-advisory service providers including KVKs, can create enabling environment for content creation required as agro-advisory through multi-media. Such efforts can further be strengthened by the approach of co-designing and co-creation of advisory-related content required to meet multiple challenges of farmers while ensuring sustainability in agriculture.

Ethical statement

The authors affirm that all data presented in the paper are genuine and authentic. Prior to participating in the study, all the respondents provided informed consent for their inclusion, and shared the information in digital and hard copy forms.

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