J. Agr. Sci. Tech. (2019) Vol. 21(5): 1079-1089

Digital Inclusion: Strategies to Bridge Digital Divide in Farming Community

L. Upadhyaya[1*], R. Roy Burman[2], V. Sangeetha[2], V. Lenin[2], J. P. Sharma[2] and, S. Dash[2]

ABSTRACT

Digital inclusion is a way to empower people through Information Communication Technologies (ICTs), but the existing digital divide due to differential access to ICT tools, low digital literacy and lack of sustainable usage is the greatest hindrance to digital inclusion. Considering these facts, this study aimed at finding a suitable location specific strategy to bridge the digital divide. The study was conducted in Nasik and Varanasi districts of Maharashtra and Uttar Pradesh, respectively. Thirty stakeholders were selected from both districts from Krishi Vigyan Kendras (KVKs) or Farm Science Centers and line departments having frequent interaction with clientele and basic knowledge about ICT tools and services useful in agricultural information delivery. Strategic statements were prepared using previous literature, experience from different programs in India and abroad, and expert suggestions. These were graded into hierarchies and stages and were compared pairwise. Analytical Hierarchy Process (AHP) was used as a decision making tool to select best alternatives to bridge the digital divide.

Keywords: Analytical Hierarchy Process, Access to ICT, Digital literacy, Information Communication Technologies.

INTRODUCTION

The ICT led information delivery mechanism has the ability and opportunity to reach the masses with more speed and greater accuracy. However, there is a differential rate of access to ICTs; for example in India, overall Teledensity is 88.62% while Urban Teledensity is 156.49% and Rural Teledensity is 57.18%, showing a vast difference in urban and rural infrastructure of ICT for accessing as well as using information (TRAI, 2018). When access is ensured, lack of skill to use such tools coupled with poor content and lower usage over time, the benefit of this technological innovation remains concentrated to certain regions and groups. As literature shows, farmers often lack the skill to transform the piece of information gained to tangible benefit (Kameswari *et al.*, 2011). The difference in access, skill to use, and real time usage of different ICT tools and technologies over time can be summed up as a digital divide. Digital inclusion is the opposite of the digital divide, which can be defined as empowering people through Information and Communication Technologies (ICTs). It is the ability of individuals and groups to access and use information and communication technologies encompassing not only access to ICTs but also the availability of hardware and software; relevant content and services; and training for digital literacy skills required for effective use of information and communication technologies (Becker *et al.*, 2012). In Indian context, access to ICTs, digital literacy, and their usage in farm information, is grossly uneven. Again, ICTs are not panacea, so the policies to use and

[1] Division of Agricultural Extension, ICAR-IARI, New Delhi 110012, India.
[*] Corresponding author: e-mail: laxmiiari2016@gmail.com
[2] Division of Agricultural Statistics, ICAR-IASRI, New Delhi 110012, India.

harness these technologies should be well articulated with due consideration to the need of people, their level of digital readiness, and overall digital microclimate. 'Digital Inclusion' activities are designed to promote ICT accessibility and use for the social and economic development of people with specific needs, including indigenous people and people living in rural areas, women and girls, and youth and children. The main barriers witnessed for ICT adoption in the agriculture segment are power availability, ICT infrastructure, ICT illiteracy, relevant content and standardization, integration of services, advisory services and localization. In view of this, many ICT projects are lagging at the grassroots level (Moni, 2017). In the era of digitization, capacity building programs in digital skills for stakeholders in agriculture including farmers, farm women, youths, extension personnel, line department staff, district and local administrative bodies *etc.*, should be carried out to tackle problems of technology transfer in India. These problems include low extension worker to farmer ratio *i.e.*, 1:5000 (Ragasa *et al.*, 2013*)*, unavailability of timely and up-to-date information on new technologies, research products and policies, lack of access to market information *etc.*; tackling these problems reduces the existing digital divide and promotes the digital inclusion.

Digital inclusion is more subjective than objective; it is region-, technology-, and user-specific *e.g.*, farmers who are mostly growing cereal crops which require almost no value addition, less post-harvest handling and low marketing tactics, will need information in lower frequency. Those growing cash crops and horticultural crops will need frequent information on climate, market prices, and so on. Information need is highly variable and specific, and when information provided is not consistent with need of farmer, it will not be accessed and used, leading to lack of reliability upon ICT tools (Mittal, 2012). Again, the language and content will largely depend upon the basic literacy level of farmers. Thus, the policies designed to bridge the digital divide will only be fruitful if the local context of farming is taken into consideration, as "one size fits all" strategies are not working in case of information delivery through ICTs (Baart *et al.*, 2018). The critical components of digital inclusion can be access to digital tools and services of either individual access or through community infrastructure, enhanced digital literacy through awareness, training and capacity building, and sustained usage through providing economically benefitting updated content, minimizing cost of access, and convergence among information providing agencies to reduce confusion and duplication. The strategies to bridge the digital divide must be tailor-made with due attention to information need, extent of access, digital literacy level, institutional facility, *etc.*

In this context, studying the region specific lacunae and, thus, arriving at an appropriate strategy involving major agricultural information providers and stakeholders of that area will inform researchers and policy makers to design future strategies to bridge the digital divide in agricultural information delivery. This study aimed at finding a suitable location specific strategy to bridge the digital divide in Nasik and Varanasi districts of Maharashtra and Uttar Pradesh, respectively.

MATERIALS AND METHODS

Sampling

The stakeholders of digitally well-performing and responsive states and digitally weak states were selected to identify the major lacuna and design a proper strategy. The study was undertaken in purposively selected states of Maharashtra and Uttar Pradesh. Maharashtra has a faster growth rate in agriculture as well as access to different ICT tools (computer with internet-36.94%, teledensity-98.98%, according to report of Telecom Regulatory Authority of India (TRAI), 2016) whereas

Uttar Pradesh has a sluggish growth rate in both agriculture and ICT usage (computer connected to internet-17% and tele-density 68%). From the available literature, the three digitally best performing districts were identified in both states (Mumbai, Pune, and Nasik in Maharashtra and Lucknow, Agra, Varanasi in Uttar Pradesh). Out of these three districts, Nasik (Maharashtra) and Varanasi (Uttar Pradesh) districts were selected, as the other districts are mostly urban districts. Fifteen stakeholders of each Farm Science Center (KVKs), Line Departments of Nasik and Varanasi districts were selected randomly. Thus, thirty officials were selected having good knowledge of district farming conditions and a regular contact and connection with farmers.

Research Methodology

In this study, the digital divide is considered as multi-staged and multi-dimensional, so, care was taken to consider all feasible solutions. Following a comprehensive literature review, as well as thorough discussion with experts in the field and studying the situation of the districts, a set of statements were framed which were compared and analyzed pair wise, using Analytical Hierarchy Process (AHP), and then rank value was placed according to calculated weightage. The data was collected from 30 officials from various state agricultural services and KVKs having a good amount of knowledge about the farmers in the districts. Data collection was done using both focused group discussion and personal interview. The effort was given to clarify ideas behind each strategic statement then the discussions were held followed by personal interview. As the situation and conditions prevailing in the two districts were comparatively different from each other, the statements were formulated and prioritized, separately. According to the immediate need of the stakeholders and prevailing ICT scenario of the district, strategies were developed.

Analytical Hierarchy Process (AHP)

Analytic Hierarchy Process (AHP), developed by Prof. Saaty in 1980, is a method used for decision making with multiple criteria. AHP, as a decision making tool, is used in multiple fields starting from marketing and management (Attaran and Celik, 2013), media research (Adhikari and Panda, 2017), risk analysis (Fatemi *et al.*, 2017) *etc*, to reach at a plausible best-suited solution. Ratio scales can be developed from pair wise comparisons with the help of AHP. Actual measurements like weight, height, price or subjective statements like opinion or judgment can also be used as input. Some inconsistency is allowed by AHP because human are never fully consistent. Principal Eigen Vectors are used for developing weight and Consistency Ratio is developed from the principal Eigen value. The AHP provides a means of decomposing the problem into a hierarchy of sub problems, which can more easily be comprehended and subjectively evaluated. The subjective evaluations are converted into numerical values and processed to rank each alternative on a numerical scale. The methodology of the AHP can be explained in following steps:

Step 1

The problem is decomposed into a hierarchy of goal, criteria, sub-criteria and alternatives. This is the most creative and important part of decision-making. Structuring the decision problem as a hierarchy is fundamental to the process of The AHP. After thorough literature study and analysis of the situation in the case study areas, strategies and sub strategies were formulated and tested pairwise and analyzed through AHP. Pairwise comparison of each statement was made with respect to all other statements making all possible combinations for comparison and priority checking. The total number of comparisons made were *n(n-1)/2*,

where '*n*' is the total number of statements within a strategy.

Review of Literature to Build up Strategic Statement

In the past, researchers studied the problem of digital divide from many perspectives and suggested strategies to bridge the divide. The present study aimed at verifying those strategies in terms of its suitability, feasibility and importance in specific local condition (Table1).

Step 2

Data are collected from functionaries of different KVKs and Line Department corresponding to the hierarchic structure, in the pairwise comparison of alternatives on a

Table 1. List of selected strategies to bridge the digital divide.

No	Statements
Strategies to enhance Awareness (Awareness- When farmers are not aware about different ICT led information services and facilities going on, so, they are not able to get information)-	
1.	Sensitizing Village Level Workers (VLWs) and *Panchayat* level workers about different activities going on who in turn will sensitize the farmers
2.	Showing success stories during village fairs or farmers fair
3.	Advertising through local TV and radio channels
4.	Awareness campaign in villages including grass root organizations
5.	Sensitizing *kisanmitra* (farmer friend)who in turn will sensitize farmers
6.	Sensitizing rural youth and progressive farmers who in turn will sensitize farmers
Enhanced Accessibility (Accessibility- Farmers are aware of benefits of ICT led information delivery but not able to avail them due to lack of infrastructure)	
1.	Opening village tele-centers at village or cluster of villages
2.	Establishing Information Kiosks(Thomas *et al.,* 2009, other successful programmes like Dairy Information System Kiosk, Gujarat; Gyandoot in Madhya Pradesh)
3.	Emphasizing Community Service Center at *panchayat* level (Dwivedi *et al.,* 2016; Lele *et al.,* 2017; Corradini *et al.,* 2018)
4.	Community Radio (Successful cases in India and Sri Lanka)
Enhanced Digital Literacy (Digital Literacy- The farmers may access those ICT tools but they are not able to withdraw information out of it as they do not know how to operate them or they do not have anybody to operate tools for them)	
1.	Providing information through voice calls instead of SMSs to the farmers who cannot read messages(success of Kisan Call Center operating in India)
2.	Training of farmers and field level staffs on how to use ICT tools and services (Kale *et al.,* 2016)
3.	Facilitate *panchayats* with persons who can help farmers learn ICT tools
4.	Emphasizing information through local languages (Irungu *et al*., 2015; Bhat and Gandhi, 2017)
Enhancing Active Usage (Active Usage- Farmers who have access, know how to use, yet they do not use ICT led information services due to dissatisfaction over content, lack of specificity of information, *etc.*)	
1.	Collaboration of institutes sending information to farmers of a specific area to avoid multiplicity of information (Ali, 2013)
2.	Regularly updating information on portals, kiosks and SMSs
3.	Sending information at right time (For example seed treatment methods at sowing season of crop)
4.	Information must be area-, farmer-, and crop-specific
Suitable Policies	
1.	Making certain sites, portals and numbers free to farmers
2.	Provide incentives to farmers who purchase or transact online
3.	Providing SIM cards to farmers through which they can freely contact certain institutes and experts
4.	Providing smart phones at subsidized rates to farmers
5.	Subsidize internet tariffs for farmers

qualitative scale. Respondents can rate the comparison as equal, marginally strong, strong, very strong, and extremely strong (Table2).

Step 3

The pair wise comparisons of various criteria generated at step 2 are organized into a square matrix. The criterion in the i^{th} row is better than criterion in the j^{th} column if the value of element (i, j) is more than 1; otherwise, the criterion in the j^{th} column is better than that in the i^{th} row. The (j, i) element of the matrix is the reciprocal of the (i, j) element.

Step 4

The principal Eigen value and the corresponding normalized right eigenvector of the comparison matrix give the relative importance of the various criteria being compared. The elements of the normalized eigenvector are given weights with respect to the criteria or sub-criteria and ratings with respect to the alternatives.

Step 5

The consistency of the matrix of order n is evaluated. Comparisons made by this method are subjective and the AHP tolerates inconsistency through the amount of redundancy in the approach. The consistency ratio calculated by computing principal Eigen value ($\lambda_{max,}$ which is sum of the products between each element in the priority vector and column total of original pairwise comparison matrix), then, Consistency Index (CI) was found out using the formula, λ_{max}*-n/(n-1),* where n is the number of statements being compared, then, the Consistency Ratio (CR) is found out by dividing *CI* by random index (given in Table 3 below). If this *CR* fails to reach a required level, then, answers to comparisons may be re-examined. The consistency for the present study was calculated for individual stakeholder and due care was given to select those matrices where consistency was well below 0.1 (but cases with consistency level somewhere between 0.1 and 0.15 were also considered after due reference to literature, blogs of researchers). Consistency Ratios that were below 0.15 were taken for further calculation of weightage (attached in Appendix).

RESULTS AND DISCUSSION

Awareness is the beginning step in the hierarchy of digital inclusion. Lack of awareness can be the most plausible reason of digital divide **(**Babu *et al*., 2012). There can be many ways to build awareness among

Table 2. Scoring pattern for pairwise comparisons in AHP.

Intensity of importance	Definition	Explanation
1	Equal importance	Two factors contribute equally to the objective.
3	Somewhat more important	Experience and judgment slightly favor one over the other.
5	Much more important	Experience and judgment strongly favor one over the other.
7	Very much more important	Experience and judgment very strongly favor one over the other. Its importance is demonstrated in practice.
9	Absolutely more important	The evidence favoring one over the other is of the highest possible validity.
2, 4, 6, 8	Intermediate values	When compromise is needed

Table 3. Random index table.

n	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49

members of a community. The perceived best fit for the farmers of both districts with respect to enhancing awareness is presented in Table 4. Upon interviewing the officials, it was found that, to enhance awareness among Nasik farmers about the benefits of ICTs, the best way would be sensitizing and training young farmers who, in turn, can raise awareness for others. The reason for this can be attributed to engagement of large numbers of youth in agriculture in field and studies, as well owing to more agricultural institutions in the district. The stakeholders could agree to utilize the youth resource of the district to bridge the digital divide with a relative weight of 0.47(47%). In Varanasi, the best way to achieve the same was found to be organizing campaigns and programs involving grassroots institutions, so that a better trust can be built regarding authenticity and usefulness of the ICT led information delivery mechanism.

The most obvious factor characterizing the digital divide was the extent of physical access to ICTs and the internet (Loader *et al.*, 2004) as digital technologies had advantaged those who already had access to other resources than people who didn't have such resources (Van Dijk, 2006). In a developing country like India, access to ICT remains a major factor for the digital divide. The basic requirement for reducing the digital divide for countries is to give priority to the development of their telecommunication and IT infrastructure in order to provide universal and affordable access to information to people in all geographical areas of the country (Singh, 2007). The accessibility to ICT can be enhanced either by enhancing ownership or by mobilizing farming community to access these tools in group. ICT tools and services can be provided to a group of farmers within their reach by tele-centers, community service centers, community radio, information kiosks *etc.*, as these methods are well proven and performing well in other parts of globe. A potent way of enhancing accessibility of ICT led services in Nasik was found to be establishing a Community Service Centre (CSC) with a relative weight of 0.39, and establishing information kiosks was found to be the next best alternative. With a similar approach, we found that establishing community radio was the best alternative with relative weight of 0.55, followed by tele-centers, community service centers, and information kiosks (Table 5). The higher computer literacy and more knowledge about benefits of computer led services prompted the farmers of Nasik to opt for a Community Service Center. Some past studies also supported that a common service center structure could be helpful in places where individual access is low (Rothenberg-Aalami *et al.*, 2005; Dahalin *et*

Table 4. Relative weight and rank order of strategies to enhance awareness of stakeholders of Nasik and Varanasi districts.

S.No.	Statements	Nasik		Varanasi	
		Item Weight	Rank	Item Weight	Rank
1.	Sensitizing *Panchayat* level workers about different ICT led programmes going on, who in turn will sensitize the farmers	0.08	VI	0.11	V
2.	Showing success stories during village fairs or farmers fair	0.09	V	0.12	IV
3.	Advertising through local TV and radio channels	0.15	II	0.09	VI
4.	Awareness campaign in villages including grass roots organizations	0.10	III	0.36	I
5.	Sensitizing VLWs or *KisanMitra* (Farmer Friend), who in turn will sensitize farmers	0.10	IV	0.17	II
6.	Sensitizing rural youth and progressive farmers, who in turn will sensitize farmers	0.47	I	0.16	III

Table 5. Relative weight and rank order of strategies to enhance accessibility to ICTs among stakeholders of Nasik and Varanasi districts.

S No	Statements	Nasik		Varanasi	
		Item weight	Rank	Item weight	Rank
1.	Opening village tele-centers at village or cluster of villages	0.16	IV	0.17	III
2.	Establishing information kiosks	0.23	II	0.10	IV
3.	Emphasizing Community Service Center at *panchayat* level	0.39	I	0.17	II
4.	Community Radio	0.20	III	0.55	I

al., 2017). Telecenters have considerable potential for alleviating digital inequalities in remote, rural and otherwise disadvantaged communities by linking village telecenters and agri-clinics to farmer needs and involving unemployed agricultural graduates in this activity, where possible (Gelb *et al*., 2008). The Varanasi stakeholders were more leaned towards community radio, as more of the farmers were radio listeners.

Skills can be measured as the readiness of a user to operate ICT tools and technology. A study on e-readiness in Indian states revealed that 95% of the mobile advisory beneficiaries are less e-ready and only 5% are e-ready. Variables like mass media exposure, innovativeness, economic motivation, risk orientation and self-confidence affect individual e-readiness level (Naik, 2014). Thus, farmers are digitally divided in terms of their skill to operate ICT tools and technologies. For sustainable use, digital literacy of stakeholders should be enhanced. Where stakeholders are not digitally literate, one can also tackle the problem by providing the alternative solutions like changing the mode of delivering information. Considering these, the following statements were suggested and pairwise comparison was made to get the best solution in both districts.

From Table 6, it could be decoded that the officials of Nasik perceived the skill training for farmers and other stakeholders to be the best method to enhance digital literacy, followed by the idea of facilitating one person per *panchayat* who could help farmers to learn ICT tools. Then, providing information through local languages emerged to be the third approach to solve the problem of digital illiteracy in Nasik district. A similar approach for Varanasi yielded that providing information through local languages could be the best method with a relative weight of 0.61, followed by providing information through voice calls and skill training to farmers.

In many cases, although farmers were well aware of ICT led information services, had a good access, and possessed the requisite skills to use ICT tools, still they did not continue using the ICT led information services for long due to many institutional constraints leading to lower satisfaction and consequently lower frequency and quality of use. The most frequent criticism that farmers in India had regarding information provided through mobile phone services was that the information was generic and was considered old and routine (Tripathi, 2010). These problems can be tackled by institutional collaboration, customization of information, and by provision of timely and up to date information.

Table 7 shows that, among all these suggested methods, the institutional collaboration within a specific area was found to be the best method, with a relative weight of 0.38, followed by provision of customized information (0.30). In many instances, the ICT led information services

Table 6. Relative weight and rank order of strategies to enhance digital literacy of stakeholders of Nasik and Varanasi districts.

S No	Statements	Nasik		Varanasi	
		Item weight	Rank	Item weight	Rank
1.	Providing information through voice calls instead of SMSs to the farmers	0.04	IV	0.18	II
2.	Training of farmers and field level staffs on how to use ICT tools and services	0.54	I	0.10	III
3.	Facilitate *panchayats* with persons who can help farmers learn ICT tools	0.21	II	0.08	IV
4.	Emphasizing on information through local languages	0.19	III	0.61	I

were blamed for the multiplicity of information. There was no registered authority to send the information in a certain area leading to lack of trust and confusion about accuracy of information (Subashini *et al.*, 2017). Upon in-depth enquiry, it was revealed that, in Nasik, private agribusiness companies were more pro-ICT and developed numerous Android applications providing diverse information to stakeholders. Farmers were greatly confused about which information to use, prompting them to choose "collaboration and convergence among information sending institutes" as the best alternative to enhance sustainable use of information accessed. Study in Varanasi showed that providing customized information to the farming community (0.61) was the most important way to achieve sustainable use. Other researchers also proved that localized and farmer customized information can increase acceptability of the information (Holmes, 2009).

Changes in the policy must be thought of to gear up the pace of digitization for farm information access and usage. The following strategies were suggested and then prioritized for both studied districts. It was found that the provision of SIM cards to farmers and making certain site and numbers toll free can be the best strategy in both places. IFFCO Kisan Sanchar Limited (IKSL) Green SIM was also one of the successful endeavors in the past, which can be reviewed and taken up by the policy makers to benefit farmers through better information access.

CONCLUSIONS

The present study tried to build up certain location specific strategies to bridge digital divide with the help of government officials working closely with farmers. It is clearly evident from the study that the problem and solution for different farming communities are different with respect to access, skills, and usage of ICT. "One size fits all" is not suitable for the developing world, which is on the way to become tech savvy. Again, the complex nature of farming and farmers' information seeking behavior makes information provider's task even more challenging. For effective delivery of ICT led information delivery, therefore, the strategies must be designed afresh by analyzing the digital climate of the place involving major stakeholders in program design and implementation. However, effort was given to make the study extensive through thorough literature study and expert suggestions, but there is a lot more to be done. Action research can be done in both locations to check the suitability of recommended strategies. Other stakeholders *viz.* Block Development Officers, Officers from other development departments, Village Level workers, and Input dealers *etc.* can be interviewed as respondents to make strategies more holistic. The present study

Table 7. Relative weight and rank order of strategies to encourage sustainable use of ICT led information delivery services of stakeholders of Nasik and Varanasi districts.

S No	Statements	Nasik		Varanasi	
		Item weight	Rank	Item weight	Rank
1.	Collaboration of institutes sending information to farmers of a specific area to avoid multiplicity of information	0.38	I	0.19	II
2.	Regularly updating information on portals, kiosks, and SMSs	0.17	III	0.11	III
3.	Sending information at right time (*e.g.*, seed treatment methods at sowing season of crops)	0.15	IV	0.09	IV
4.	Information must be area-, farmer-, and crop- specific	0.30	II	0.61	I

Table 8. Relative weight and rank order of strategies for policy level changes for higher digitization of stakeholders of Nasik and Varanasi districts.

S No	Statements	Nasik		Varanasi	
		Item weight	Rank	Item weight	Rank
1.	Making certain sites, portals and numbers free to farmers	0.20	II	0.27	II
2.	Provide incentives to farmers who purchase or transact online	0.10	V	0.09	IV
3.	Providing SIM cards to farmer through which they can freely contact to certain institutes and experts	0.27	I	0.31	I
4.	Providing smart phones at subsidized rates to farmers	0.18	III	0.25	III
5.	Subsidized internet tariffs for farmers	0.17	IV	0.08	V

can be replicated in other places as well to find out reliability of this study. However, the study can serve as a base to build future pillars of work in this particular area, which has immense scope and significance.

ACKNOWLEDGEMENTS

The continuous support and guidance from my MSc. research advisory committee (Agricultural Extension Division, Indian Council of Agricultural Research (ICAR)-Indian Agriculture Research Institute (IARI)), financial help from ICAR through Junior Research Fellowship, and cooperation of KVK Staff, Agriculture and Horticulture Department Officers of Nasik, Maharashtra and Varanasi, Uttar Pradesh was substantial in conducting the research work.

REFERENCES

1. Adhikari, K. and Panda, R. K. 2017. Social Media Brand Communities and Brand Loyalty: An Integrated AHP Approach. *Int. J. Vir. Com. Soci. Net.*, **9(2):** 62-79.
2. Ali, J. 2013. Farmers' Perspectives on Quality of Agricultural Information Delivery: A Comparison between Public and Private Sources. *J. Agr. Sci. Tech.*, **15(4):** 685-696.
3. Attaran, S. and Celik, B. G. 2013. Analytic Hierarchy Process: An Application in Green Building Market Research. *Int. Rev. Manage. Market.*, **3(3):** 122-133.
4. Baart, A., Bon, A., de Boer, V., Tuyp, W. and Akkermans, H. 2018. Kasadaka: A Voice Service Development Platform to Bridge the Web's Digital Divide.
5. Babu, S. C., Glendenning, C. J., Asenso-Okyere, K. and Govindarajan, S. K. 2012.

Farmers' Information Needs and Search Behaviors. *International Food Policy Research Institute (IFPRI)*, **1165**: 1-37.
6. Becker, S., Crandall, M., Coward, C., Sears, R., Carlee, R., Hasbargen, K. and Ball, M. A. 2012. *Building Digital Communities: A Framework for Action*. Institute of Museum and Library Services.
7. Bhat, H. A. and Gandhi, S. S. 2017. Role and Importance of Information and Communication Technology in E-Governance of India. *J. Adv. Soci. Sci. Human*., **3(6**).
8. Corradini, F., Forastieri, L., Polzonetti, A., Riganelli, O. and Sergiacomi, A. 2018. Shared Services Center for E-Government Policy.
9. Dahalin, Z. M., Ibrahim, H. H. and Yusop, N. I. 2017. ICT Adoption and Value Creation: A Telecentre Ecosystem Approach.
10. Dwivedi, Y. K., Sahu, G. P., Rana, N. P., Singh, M. and Chandwani, R. K. 2016. Common Services Centres (CSCs) as an Approach to Bridge the Digital Divide: Reflecting on Challenges and Obstacles. *Trans. Gov. People Process. Pol.*, **10(4):** 511-525.
11. Fatemi, F., Ardalan, A., Aguirre, B., Mansouri, N. and Mohammadfam, I. 2017. Constructing the Indicators of Assessing Human Vulnerability to Industrial Chemical Accidents: A Consensus-Based Fuzzy Delphi and Fuzzy AHP Approach. *PLoS Curr.*, **9.**
12. Gelb, E., Maru, A., Brodgen, J., Dodsworth, E., Samii, R. and Pesce, V. 2008. Adoption of ICT Enabled Information Systems for Agricultural Development and Rural Viability. In *ICT Adoption Workshop at the IAALD-AFITA-WCCA Conference*.
13. Holmes, T. 2009. Local Content in Brazil: Conceptual Framework and Methodological Implications.
14. Irungu, K. R. G., Mbugua, D. and Muia, J. 2015. Information and Communication Technologies (ICTs) Attract Youth into Profitable Agriculture in Kenya. *East Afr. Agri. Fore. J.*, **81(1):** 24-33
15. Kale, R. B., Meena, M. S. and Rohilla, P. P. 2016. Determining Factors and Levels of E-skills among Agriculture Experts of Krishi Vigyan Kendras in India. *J. Agr. Sci. Tech.*, **18:** 1749-1760.
16. Kameswari, V. L., Kishore, D. and Gupta, V. 2011. ICTs for Agricultural Extension: A Study in the Indian Himalayan Region. *Electron. J. Inf. Syst. Dev. Countries (EJISDC)*, **48(1):** 1-12.
17. Lele, U. and Goswami, S. 2017. The Fourth Industrial Revolution, Agricultural and Rural Innovation, and Implications for Public Policy and Investments: A Case of India. *Agri. Econ.*, **48(S1):** 87-100.
18. Loader, B. and Keeble, L. 2004. *Challenging the Digital Divide?: A Literature Review of Community Informatics Initiatives*. Joseph Rowntree Foundation.
19. Mittal, S. 2012. *Modern ICT for Agricultural Development and Risk Management in Smallholder Agriculture in India*. International Maize and Wheat Improvement Center, CIMMYT.
20. Moni, M. 2017. *Document on Digital Inclusion for Fostering Rural Prosperity and Grassroots Development, Time-Scale Measures towards Rural India to Smile, Shine and Roar*. Department of Information Technology, National Informatics Centre, Ministry of Communications and Information Technology, New Delhi.
21. Naik, V. R. 2014. Effectiveness and Impact Analysis of Innovative Information and Communication Technology Based Extension Models. Doctoral Dissertation, Division of Agricultural Extension, ICAR-Indian Agricultural Research Institute, New Delhi.
22. Ragasa, C., Ulimwengu, J., Randriamamonjy, J. and Badibanga, T. 2013. *Assessment of the Capacity, Incentives, and Performance of Agricultural Extension Agents in Western Democratic Republic of Congo* (1283). *Int. Food Policy Res. Inst. (IFPRI)*,
23. Rothenberg-Aalami, J. and Pal, J. 2005. Rural Telecenter Impact Assessments and the Political economy of ICT of Development (ICT4D).
24. Saaty, T.L. 1980. "The Analytic Hierarchy Process." McGraw-Hill, New York.
25. Singh, N. 2007. Bridging the digital divide in India: some challenges and opportunities.
26. Subashini, K. P. and Fernando, S. 2017. Empowerment of Farmers through ICT Literacy. *In Info. Tech. Conf. (NITC)*, PP. 119-124.
27. Thomas, P. 2009. Bhoomi, Gyan Ganga, e-Governance and the Right to Information:

ICTs and Development in India. *Tele. Info.*, **26(1):** 20-31.
28. TRAI. 2016. *Report on Telecom Sector in India; A Decadal Profile.* Telecom Regulatory Authority of India.
29. TRAI. 2018. *Report on Telecom Sector in India: A Decadal Profile.* Telecom Regulatory Authority of India.
30. Tripathi, G. 2010. *Socio-Economic Impact of Mobile Phones on Indian Agriculture.* Dev. Econ. Working Papers.
31. Van Dijk, J. A. 2006. Digital divide research, achievements and shortcomings. *Poetics*, **34(4-5):** 221-235.

دربرگیری دیجیتالی: راهبردهایی برای پل زدن روی شکاف دیجیتالی در جوامع کشاورزان

ل. اوپادهیایا، ر. روی بورمن، و. سانگتا، و. لنین، ج. پ. شارما، و س. داش

چکیده

دربرگیری دیجیتالی (digital inclusion) روشی است برای توانمند سازی افراد در فناوری های ارتباطات اطلاعاتی (ICT)، اما به لحاظ تفاوت در دسترسی به ابزارICT، کم بودن سواد دیجیتالی، و پایدار نبودن کاربرد این فناوری، شکاف دیجیتالی موجود بزرگترین محدودیت برای اجرای دربرگیری دیجیتالی است. با در نظر داشت این واقعیت ها، هدف پژوهش حاضر یافتن راهبردی مناسب و مکان-ویژه برای پل زدن روی شکاف دیجیتالی بود. پژوهش در دو ناحیه Nasikو Varanasiبه ترتیب در استانهای Maharashtraو Uttar Pradesh اجرا شد. به این منظور، از هر دو ناحیه ۳۰ نفر از ذینفعان از مراکز علوم مزرعه (KVKs)و دپارتمان های تخصصی انتخاب شدند که دارای معلومات نهادین در باره ابزار و خدمات ICT لازم برای انتقال اطلاعات کشاورزی بودند و تعامل مکرری با ارباب رجوع داشتند. سپس، با استفاده از منابع علمی، تجربیات برنامه های مختلف در هندوستان و خارج کشور، و پیشنهادهای متخصصان، گزاره هایی راهبردی تهیه شد. این گزاره ها به صورت سلسله مراتبی و مرحله ای دسته بندی گردید و به صورت جفتی (pairwise) مقایسه شد. سپس، از فرآیند سلسله مراتب تحلیلی (AHP) به عنوان ابزاری برای تصمیم گیری در باره انتخاب بهترین گزینه ها برای پل زدن روی شکاف دیجیتالی استفاده شد.