Using Mass Media and ICT for Agriculture Extension: A Case Study

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Abstract— This paper examines the role of mass media and ICT in agriculture knowledge dissemination to the farmers in their own language to educate them in farm technology, animal husbandry, climatology, agronomy, plant disease management, post-harvest management, warning for flood/cyclone etc. The farmers living in the remote areas of the developing countries with little computer literacy, need the access to farming and allied technology to enhance food production, vegetable and fruit yield, livestock production. He needs information about improved variety of seed, fertilizer, and a market for sale of the products. The paper puts forward a model for using the technology to provide the farmers living in rural areas, the information right from the decision on the crop to be planted and ending with the sale of produce at the wholesale market. Video based training assisted with facilitator is found most effective in motivating farmers to adopt new agricultural practices for about one-tenth of the cost of traditional extension systems. Farmer's feedback shows that viewing a practice on a video while being told about it by a facilitator improves the effectiveness of video in inspiring changes in rural behavior. The paper concludes with a case study undertaken in Bihar (India) and analyses the benefit accrued to the farmers. The analysis further shows how the farmers are willing to adopt the new technology. The onus is on the States and the scientists to provide them the knowledge keeping in view their limitations.

Index Terms—India, Bihar, Agriculture extension, ICT, IT Application, mass media

1 Introduction

AGRICULTURE is the main source of employment, livelihood and income in developing countries. The population depending upon agriculture in these countries is 50 to 90%, out of which a significant proportion of 70 – 95% are small farmers [1]. The farmers in these countries face twin challenges; one to increase the growth of agriculture by adopting newer farm-technology and the other to get a reasonable price for their produce. Procuring inputs such as pesticides, fertilizers and 'high technology' seeds, present special problems and risks for poor farmers, and they need to borrow from lenders to make their purchases. Farmers and end- consumers are linked with a long value chain involving several stakeholders. This distance is increasing because of the poor agricultural marketing and profit seeking behavior of middle players involved in this chain. Inefficient agricultural production and marketing reflects poor dissemination of farm-technology in these countries. Although excellent research is done at agricultural institutes, Agriculture Universities and government funded research centers, the dissemination is still not up to the mark and most of the research thesis only gets stored in libraries and don't reach from lab to land. Further, ability of farmers to reach market through efficient network of Information and Communication Technology (ICT) which increases the farmers bargaining power and provides a chance to interact with trader and government agencies, is missing. This is more important in rural areas where the farmers are not able to realize the reasonable price for their produce.

Agriculture innovation is key to the growth of agriculture sector. Innovation needs constant interaction of a multitude of agents and stakeholders such as farmers, extension workers, scientists, and in the present context mass media and ICT experts. An appropriate extension service should be able to cater to the needs of farmer's knowledge on technology, farm practices, farm productivity/ efficiency, technology adoption, farm output supply and demand [2]. World Bank study acknowledged the importance of extension using radio [3]. The role of ICT in agriculture extension was visualized long ago [4]. Increase in ICT penetration has been found to have a direct relation with productivity and agriculture income. The agricultural income in many developing countries is consistent with the level of ICT penetration [5]. In further studies, it was found that farmers were immensely benefitted with the availability of information on agriculture prices, products and attributes [6]. The role of ICT and mass media to bridge the knowledge gap of services and quality inputs, quality production and safety standards, information of price and markets, post-harvest management was studied by Ferroni and Zhou [7]. The inclination of farmers to use of ICT was analyzed by picking a random sample of seventy-five farmers for pre-tested structured interview. The finding showed that most of the farmers showed positive attitude towards use of ICT [8] Many developing countries are not making enough efforts to use ICT to boost the agriculture productivity. The World Bank in its study, released recently describes this as innovation paradox, wherein the developing countries are reluctant to use the new technologies to gain the benefit [9]

2 Agriculture in India

Agriculture, with its allied sectors, is the largest livelihood provider in India, more so in the vast rural areas [10]. Agriculture proper & Livestock, Forestry & Logging, Fishing and related activities contribute 17.9% to the Gross Domestic Product (GDP) and account for $366.92 billion of national

- *This work was supported by World Development Foundation, India and RKVY, Government of India.*
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resource [11]. India has large areas of rich fertile land, abundant raw materials in the form of natural resources, diverse climatic conditions and a large young labor force. But, Indian farmers continue to be among the poorest in the world due to various factors, such as lack of use of advanced scientific methods in agriculture, unavailability of modern machinery to the farmers, lack of water and electricity in villages, absence of adequate storage facilities, uninformed decisions taken at various stages of cropping by farmers leading to low yield and lack of financial support. The average Indian farm family works 80 hours per week, and earns about $3000 in a year. His wife and children work with him in the field [12]. More than 65% of farmland in India consists of marginal and small farms less than one hectare in size. Farmers across the country depend more on the practices learnt by their ancestors and take various decisions based on myths. They are still dependent on the rain god for water and politicians for fixing remunerative prices or loan waiver. The food subsidy bill of Government of India has increased from $3.85 Bn in 1990-1991 to $26.72Bn in 2001-2002 to $36.15Bn in 2016. India is home to 190.7 million hungry people mostly in rural areas which accounts to 14.5% of its total population. 38.4% of children under five in India are stunted (long-term nutritional deprivation which may affect mental development), while 51.4% of women in reproductive ages are anemic [13]. Sustainable agriculture, in terms of rural employment, food security, and environmentally sustainable technologies like conservation of soil, sustainable natural resource management and protection of biodiversity, are essential for holistic rural development and solving the problem of malnutrition and hunger. The agricultural income would go up if India could increase its ICT penetration. The launch of the National Agriculture Market (e-NAM) is a step in the correct direction. Digital divide gap shall also decrease with successful and efficient implementation of projects like National e-Governance Plan, National Optical Fiber Network, National Knowledge Network, digital cities, etc. which will provide wi-fi and internet connectivity at affordable prices. However, in absence of the appropriate content from different regions in the languages they understand, all the broadband capability of networks shall remain unutilized to its potential. The farmers need to get the right information, at appropriate time in their language and on a device readily available to them. The increased penetration of broadband, the mobile explosion in India, and the rising farmer's need for content anytime, anywhere, on any device, drives a massive urgent need for appropriate content in digital format which will help in digital inclusion and empowerment of farmers to eradicate the poverty and increase their income. Digitization of agricultural sector shall play a significant role in increasing agriculture production, informed marketing, enhancing employment opportunities and thereby improving the standard of living in the agricultural sector and reducing the risk and uncertainties that Indian farmers face at present.

Bihar, a prominent State in India, is highly dependent on agriculture with its 77% of workforce deployed in agriculture, contributing to 24.84% of State's domestic product [14]. The State has fertile Gangetic alluvial soil and abundant water resources, particularly ground water resources [15]. Government of Bihar initiated various innovative agricultural development programs like Mukhyamantri Triv Beej Vistar Yojna (Chief Minister's fast seed distribution scheme)/ Vyagyanik Kisan Ke dwar (Scientist's at Farmer's door) and appointment of one Krishi Salahkar (agriculture adviser) in each of the state's 8,463 village councils to provide agricultural extension services for a rapid growth in this sector. However, the production of main crops such as rice and wheat remained below target with only marginal higher production of maize (2011-12) in spite of excellent research works undertaken in the two Agricultural Universities and thirty-eight Krishi Vigyan Kendras- KVKs (Agriculture Science Centers) in the State [16]. The SWOT analysis of the State Government reports, 'extension services in terms of creating awareness about new technologies, conducting field demonstrations, conducting training programmes and providing latest information to farmers are very poor' [14]. The state has a per capita income of $148 a year against India's average of $997 and 30.6% of the state's population lives below the poverty line against India's average of 22.15%. In order to boost the economy, an innovative idea to use mass media and ICT for extension services was conceived by World Development Foundation and implemented with the help of Bihar Agricultural University [17] program of Government of India.

3 ICT BASED AGRICULTURE EXTENSION FOR BIHAR

An Agricultural Knowledge Dissemination System in Bihar was conceived, designed and implemented to link people (farmers) and institutions (Bihar Agricultural University and KVKs) to promote mutual learning and generate, share, and utilize agriculture-related technology, knowledge, and information [18]. The system was designed to integrate farmers, agricultural educators, researchers, and extension workers to harness knowledge and information from various sources mainly Agriculture Scientists for better farming and improved livelihoods [19].

While designing the system, it was ensured that the technological complexity is confined to the dissemination side which would be maintained by the trained University staff. The literacy rate of Bihar being 61.8% (lowest in the country), with just about 6% population being computer literate, knowledge dissemination using computer or laptop as receiving device with farmer was completely ruled out. The receiving device was chosen as visual or hearing device such as a TV display or Radio receiver. The large screen display devices were installed in the KVKs where farmers could assemble and get scientist assisted training. The medium of message was chosen as video or audio in the local language/ dialect namely Hindi and Bhojpuri. The format used was talk show, drama, folk music, success story etc.

3.1 System design

The System Architecture for the creation, storage and dissemination of knowledge (ANDS) relevant to farming is shown in Fig. 1. It basically comprises of following components:

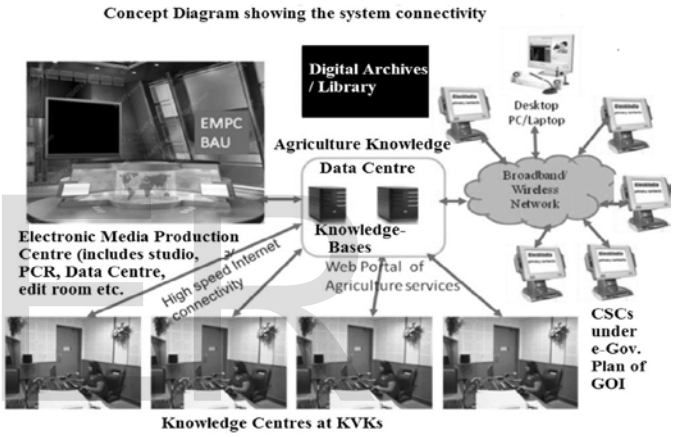
- A State of the Art Electronic Media Production Centre (EMPC) as a major hub to act as electronic media repository for storage and dissemination of research information of the University to farmers across the State. EMPC serves as a Nodal Resource Centre for production, storage, dissemination and transmission of agriculture knowledge through- out the State. The Center comprises of studio and equipment for production of audio and video with all components such as production control room (PCR), edit room, digital archives, and electronic library. A server based digital archive is used to store the digital content.

- An agriculture e-portal in local language is used to connect the video based knowledge-base to the world. Selected KVKs were upgraded to work as data access/distribution centers. These KVKs were connected to the EMPC using High Speed Data lines. Common Service Centers (Kiosks) established by State Govt. under National e-governance Plan of Government of India (GOI), work as a receive system apart from very limited numbers of farmer's own PC or PCs available with the Village head. A CSC is an information and communication technology (ICT) access point with a PC and broadband connection. The India Government project plan includes the creation of a network of over 100,000 CSCs throughout the country. The project started in 2006. Bihar had already established 5565 CSCs (Known as Vasudha e-Seva Kendras) [20].

- Knowledge-Base of relevant content on various themes such as farm technology, animal husbandry, climatology, agronomy, plant disease management, post-harvest management, market price, warning for flood/cyclone etc. were created using subject experts and stored in Digital archives/library in the form of video/audio/multimedia with their metadata. The audio is available in mp3 format while the video is available in mp4 format. The audio only was considered important since it can be listened to with availability of lower internet speed /bandwidth.

- Video conferencing system in which the EMPC is used for content dissemination and connectivity to five selected KVKs through high speed Internet data network. The system is also used for data capturing from KVKs.

The System architecture for multiprotocol label switching virtual private networks (MPLS VPN) using "Any to Any" topology with last mile connectivity with microwave radio is given in Fig. 2. The places selected for conferencing are shown in Fig. 3. The connectivity of the remote rural places was a challenge due to absence of optical fiber networks in the remote villages. The optical fibers were available only up to the nearest city. This needed establishment of a microwave radio link from the optical fiber terminal in the city to the KVK. MPLS Solution, a modular suite of network and service management applications, is a network management system that defines and monitors virtual private network (VPN)



services for service providers. MPLS VPN Solution allows service providers to provision and manage intranet and extranet VPNs. The product provides the aspect of operations management that addresses flow-through provisioning, service auditing, and Service Level Agreement (SLA) measurement of IP-based MPLS VPN environments. Multiprotocol Label Switching (MPLS) is an emerging industry standard upon which tag switching is based. The logical view for video conferencing system is shown in Fig.4.

Fig. 1. System Architecture for ANDS

Fig. 2. System Architecture for Connectivity on high speed broadband optical fiber

Fig. 3 Map of Bihar (India) with places selected for video conferencing

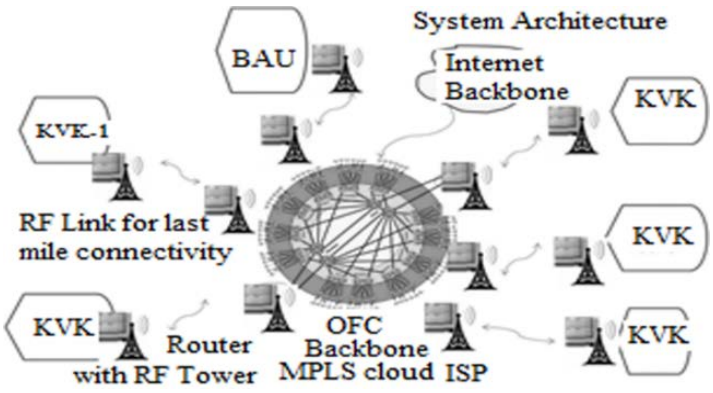


Fig. 4. Logical view of Video Conferencing system for online scientist mediated farmer interaction

3.2 Implementations

Electronic Media Production Centre (EMPC), fully treated acoustically and with three camera systems is shown in Fig. 5. It works as a production studio as well as video conferencing room connected to five KVKs. (Fig .3). The PCR cum edit room is shown in Fig. 6.

Fig. 5. Electronic Media Production Studio cum video conferencing room

Fig. 6. Production Control Room

A few brain storming sessions with subject specialists, the farmers and the production staff were conducted to decide the key methodology and subjects. Following guidelines were laid down.

i. The programmes would be of immediate relevance to the farming community. The emphasis would be on programmes based on agriculture, horticulture, education, environment, social welfare, community development etc. The programming would reflect the special interests and needs of the farming community keeping the vision of the second green revolution from Bihar. (The first green revolution started in the early 1960s and led to an increase in food grain production, especially in Punjab, Haryana and Uttar Pradesh states of India.)

ii. The content would be produced with the participation of the farming community, experts in the field, extension scientists, NGOs, self help groups etc.

iii. Programmes would preferably be in the local language and dialect(s) or Hindi

iv. The provisions of the Programme and Advertising Code as prescribed in India would be adhered.

v. Programme related to environment, rain, flood etc shall also be produced.

Video on complete information (climatology, variety, agronomy, plant disease management, post-harvest management etc.) and recommended package of practices for the mandate crops was developed and stored in the central server and made accessible to farmers using various modes including YouTube [21]. The metadata for the programme was meticulously prepared for its easy access and retrieval from the archive.

The video conferencing mode is used to address the farmers who assemble in various KVKs. A panel of expert professors first show the video on a specific topic and the farmers assembled in KVKs watch the video on new techniques and their queries addressed locally by KVK scientists as well as experts available at central location in the University. The camera available at KVKs allows complete interaction. They bring their samples to the KVKs and take advice from the experts by showing those plants that are affected by harmful insects. Insects like butterflies and moths are often seen as nice insects, but during their larval stage caterpillars are very destructive. Many caterpillars feed on the foliage of growing plants. Many crops can be seen on farms, which are eaten by these insects such as cabbage or maize. In Bihar, one instance of an insect larger grain borer, that causes big problems for maize farmers (nicknamed Osama for its devastating impact in stored maize). This pest starts its demolition out in the field but it is most risky when the maize is in storage. The visual inspection of this by the experts siting

remotely, on camera results in instant solution. The farmers visit periodically with samples to show the plant/crop after the treatment suggested by the experts. The scientists also advise the farmers on season for sowing and harvesting based on their analysis of weather getting data from the meteorological department.

The video and audio only are also available through an interactive dynamic Web (Fig. 7). The system can address all the farmers or farmers of specific region for advice through web browsing, email and SMS.

Fig. 7. An interactive dynamic Web

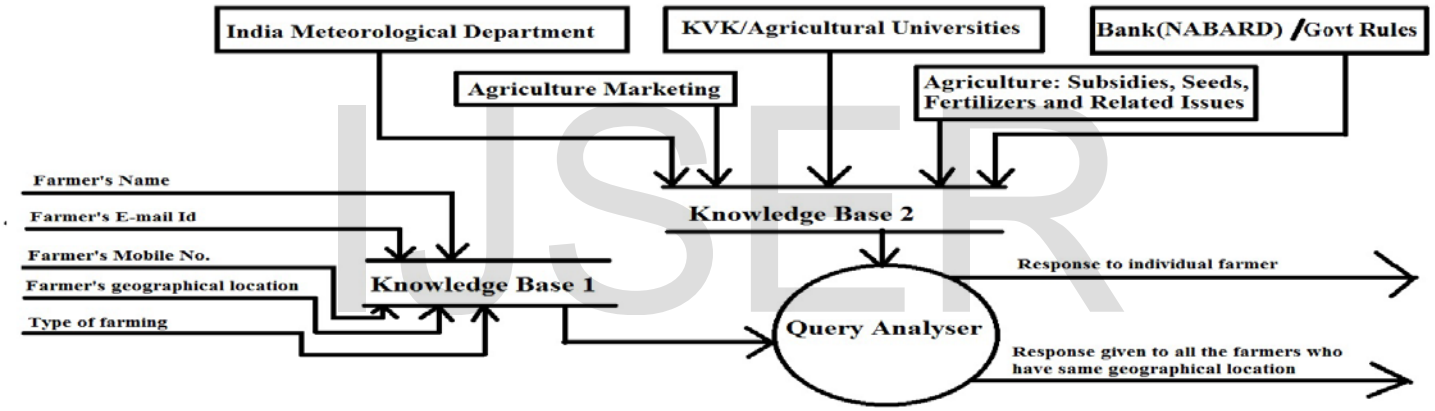


Fig. 8. Data flow Diagram

The media and meta data are stored in the servers installed at a central location. The professors. scientists and farmers can access the data locally or from a remote place using the access passwords. Farmers can watch the video through web e-portal by either going to the University/KVKs or through CSCs. The useful messages are also relayed through SMS. The underlying SQL and the database is used for addressing any query automatically.

A Community Radio station with a low power FM transmitter is used to relay the audio information and provide the answer to the farmer's query through phone-in program.

The Data Flow Diagram (DFD) given in Fig. 8 describes how data flows to the knowledge-bases from various sources. There are two knowledge bases for storage of data.

The knowledge-base-1 contains the basic details about farmers. It includes farmer's name, email, mobile no., geographical location, type of farming that he practices etc. The second knowledge-base contains all the information regarding the climate, farming techniques, bank and loan availability details etc.

The knowledge-base 2 gets its data from following dynamic databases:

i. India Meteorological Department: This department also referred as MET Department provides the information about the climate conditions of specific geographical area of Bihar. It is dynamic data which gets updated regularly for each district of the State.

ii. KVK/Agricultural Universities: These departments provide information about various farm technologies/horticulture/animal husbandry.

iii. Bank [22] /Govt Rules: From these sources the knowledge base gathers information of basic financial facilities provided to farmers such as loans, subsidy, regulation regarding GM crops etc.

iv. Agriculture Market Information [23]: This provides information about various wholesale prices. The data dynamically changes.

v. Agriculture: Subsidies, Seeds, Fertilizers and Related Issues [24]: This provides data about different types of seeds, best quality of seeds, best quality of fertilizers etc.

These five dynamic databases regularly update the knowledge-base-2 so that the solutions provided to farmers are latest and accurate.

ANDS uses MySQL a relational database management system, as the underlying database. MySQL was chosen to provide highest levels of scalability, security, reliability, and uptime and to reduce the risk, cost, and complexity in developing, deploying, and managing agri-critical applications. Microsoft Windows was used as the development platform. Videos on YouTube, also uses MySQL.

The next main component is the query analyzer which takes input from the farmers i.e. their queries regarding their problems, matches the query to the right solution, finds the answers with the help of knowledge bases and provides solution to the farmers. The query asked by the farmer is examined by the analyzer and compared with the information available in the knowledge bases. The analyzer has intelligence to send the solution to a specified geographical location or the farmers of entire State depending upon the relevance and usefulness of the information. The solution is given in the local language of the farmer and it has special relevance because of lack of knowledge of English among most of the farmers.

For the uninitiated and new farmers, a friendly user interface is provided on the web. For example, it is possible to select any of the crop for getting further details such as by clicking on paddy, large verity of video programs on various aspects of paddy growing such as preparation of field, selecting the type, preparing the nursery, use of new technology, balanced use of fertilizers, management of irrigation, controlling the weeds, different type of disease and their control etc. can be viewed. Video giving the details on each topic with solution can be viewed by clicking the related hyperlink. After having watched the video, if there is any additional query, the farmers can go on the main page and send the query to the server through a message which will be stored in the server for being replied by the subject expert. The subject expert in the back end can use the query language and make any complex query to the database.

On clicking on the district map the data being broadcast by Indian Metrological Department (IMD), the weather forecast for next 5 days for a specific district can be accessed.

4 Analysis of Result

The result was first analyzed after six months of implementation. In about 6 months, more than 10000 farmers had been brought to the KVKs and were trained in new technology by face to face interaction with the experts using video conferencing system and also with the help of local scientists posted in KVKs.

We also used YouTube statistics to know the receptivity of the videos placed on it. We were aware of the limitations of computers, broadband, skill and reluctance to watch an agriculture knowledge video using costly Wi-Fi, especially in the context of India. However, the results received in 2013 (Fig. 9 & Table 1) were quite encouraging. 94.8% males watched the video which showed the lower computer literacy rate in females in rural India in 2013. The most exciting finding was that about 40% males with age group 55-64 watched the video from YouTube in spite of poor Internet connectivity. Further it was found that the users from different parts of the globe watched the videos. 28,665 users accounting to 72.11% of total users were from India. The users from Saudi Arabia, UAE, US, Pakistan and UK also watched in descending numbers. The audio being in the native (Hindi) language, the viewers from US and UK were a surprise.

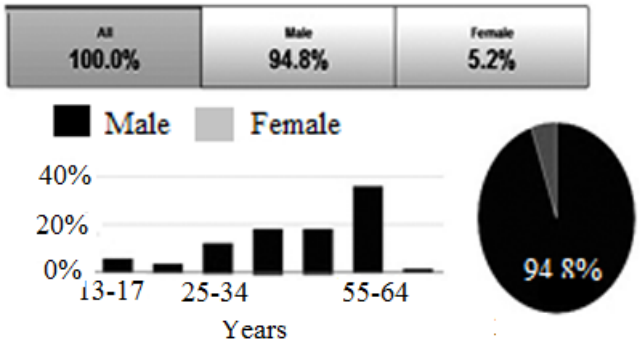


Fig. 9. Age/gender distribution of video viewing as per YouTube analytics as in 2013

TABLE 1
DEMOGRAPHICS (TOP GEOGRAPHIES) OF VIDEO VIEWING AS PER YOUTUBE ANALYTICS AS IN 2013

Country	Viewers	% of Total
India	28,665	72.11%
Saudi Arabia	2,574	6.47%
United Arab Emirates	1,864	4.68%
United States	1,504	3.78%
Pakistan	774	1.94%
U.K.	639	1.6%

We compare the similar data as of now (21st Nov. 2017) to see the viewer's growth by gender/ age and geographical demographics. (Fig. 10 & Table 2) We observe about two million views of the video with a surprising change in the age group of viewership. More than 40% viewers are in the age group of 25-35 years. The earlier highest viewer age group of 55-64 years slipped to just 10%. The younger viewer groups in the age range of 25-54 years accounted for 60% of viewing. This could be attributed to availability of smart phones in this age group in India. The highest viewing has been by most of the countries who understand the language of audio (Hindi). Surprisingly viewers from US continue to watch the video. The majority of viewer is males even now.

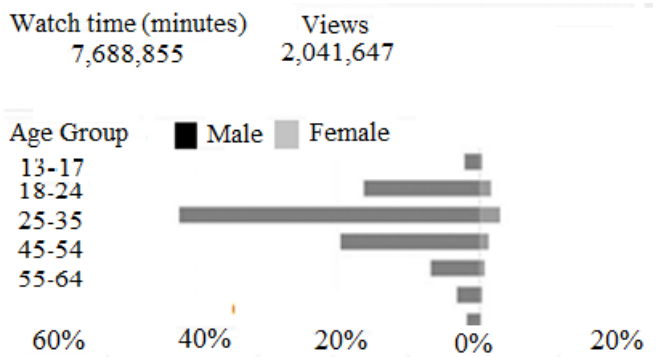


Fig. 10. Age/gender distribution of video viewing as per YouTube analytics as on 21/11/2017

TABLE 2

DEMOGRAPHICS (TOP GEOGRAPHIES) OF VIDEO VIEWING AS PER YOUTUBE ANALYTICS AS ON 21 NOV. 2017

Country	Watch time	Views
India	5,218,782 (68%)	1,389,162 (68%)
Saudi Arabia	676,176 (8.8%)	164,211 (8.0%)
United Arab Emirates	342,654 (4.5%)	87,053 (4.3%)
Pakistan	162,733 (2.1%)	61,885 (3.0%)
United States	147,706 (1.9%)	36,495 (1.8%)

The study indicates that the number of the farmers using the information from the system has been constantly increasing. Further, with the availability of mobile and access to the Internet, the younger generation is keen to learn new technique in farming. Focal problems such as extreme weather, pests, worms, subsidy or any political advert has been a drive to the farmers to seek for basic information they would require and the extension system has been providing them with that information through ANDS.

For qualitative assessment of the system, in-depth face-to-face interviews were undertaken with various stakeholders, namely farmers, researchers, extension scientists and university professors. Interviews provided an exhaustive overview on the main factors that affect the adoption of technological innovations in the explored context. The main outcome of the interviews are summarized below.

- The universities have a major role to play in the production of knowledge content for ANDS, especially, in relation to improved agricultural practices, poverty alleviation and community development.

- Socio-demographic features of farmers, such as age and educational level, affect the process of innovations' adoption. However, new generation of farmers are very interested in technology.

- The adoption and implementation of ICT at different levels of the agricultural value chain, along with the access to and the management of technological information (economic variables, data, prices and market information, communication with peers, business transactions, etc.) will result in improvements in providing better price to the farmers.

- The low level of knowledge, competence and training could fuel a certain degree of skepticism against innovation and therefore there is need for training and skill development for use of technology. Since investing in training requires time and money, it can be a barrier to the adoption of technological innovations. The onus for education and training should be on State.

- Technological innovations could provide many benefits and opportunities for improvement in a sector that needs urgent attention.

- Finally, institutions and market environment play an important role in dissuading or supporting farmers from accepting technological innovations. India is having a long chain between farmer and end consumer with many middle men pocketing the profit. These middle men would make all efforts not to succeed the innovation.

5 NEW TECHNOLOGIES

A recent survey was undertaken with a vision to capture some important dimensions of the preparedness of youth in rural India with respect to their ability to lead productive lives as adults [25]. The survey surprisingly shows that 59% population of age group 14-18 have never used a computer and 64% have never used internet. Girls and young women have far lower access to computer and internet as compared to boys. While 49% of males have never used the internet, close to 76% of females have never accessed internet. While 72% male and 76% female have got bank accounts, only 7% male and 2% female have ever used internet banking. The poor availability of internet and low knowledge of basic computer operation, is a great obstacle in ICT use in rural areas. However, the silver lining is that mobile phone usage is widespread in the 14-18 age group. 73% of the young people have access to a mobile phone. Small size, ease of use and manageability of new technological devices, namely smartphones are becoming popular with the younger generation. Captivating features, new applications and ease of watching videos on mobile increases the positive attitude towards its adoption. Data collection and transfer are nowadays facilitated by Wi-Fi devices and cloud based storing solutions. This can be done by the University for its extension services. The video cloud services can be accessed by any farmer at any place irrespective of the type of smartphone a farmer has. It can be using any telco or any operating system such as Android, iOS, Windows. The video cloud can also solve the problem of low internet speed by using a technology known as multiple rendering on video cloud to suit the devices and its internet speed. State needs to play a significant role in providing extension services in rural areas. The data charging should be affordable, easy and quick, and overtake practical problems (vocal identification software are an example). Software for farm management systems should be designed with the aim of providing a simplified overview on farm's performance, reducing uncertainties and supporting farmers and technicians in their decision process. On the University side, the data analysis must provide easy to understand feedbacks and ready-to-use information outputs.

6 CONCLUSIONS

It will be seen from the above analysis that the education and training of farming community using video, ICT and mass media have been very well received and it is an effective mode of communication with the farming community. The continued interest of the farming community in these videos proves that mass media and ICT penetration make the farming community more productive. The farming community in the younger age group being drawn to the ICT, may be due to greater availability of mobile phones with wi-fi as of now as compared to 2013. The agriculture income in India at present is consistent with the level of ICT penetration. The income would go up if India increases its ICT penetration. The schemes of Government such as National Agriculture Market (e-NAM), National e-Governance Plan, National Knowledge Network, National Optical Fiber Network, smart cities, etc. in India, will ease the present problems of internet availability and access of market information to farmers. There is urgent need to produce appropriate content from different regions in the languages they understand. The farmers need the right information, at appropriate time, in their language and on a device, readily available to them.

The ubiquitous reach and ease of use of the mobile phones by farmers makes it the most relevant channel for outreach especially in rural areas, having erratic power supply. Mobile penetration in India has reached to one billion with 450 million feature phones. We find similar trends in other developing countries [26]. The newer technology such as video cloud with relevant content and multiple adaptive rendering [27] can be used to help the farming community. The innovation done in India can be adopted by developing countries for increasing the agriculture yield and poverty alleviation and achieve the Sustainable Development Goals (SDGs) of UN to end poverty, fight inequality and injustice, and tackle climate change by 2030 [28].

ACKNOWLEDGMENT

The author wishes to thank the entire team associated with the project. This work was supported by World Development Foundation & RKVY.

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