
ICTs for
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Global Experiments, Innovations and Experiences
R.SARAVANAN

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Chapter 4

India

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CONTENTS

1. INTRODUCTION

1.1. National Agriculture Scenario

Agriculture is the most important sector of Indian Economy, contributes 23 per cent of national GDP, accounts for 11 per cent of exports, and 50 per cent of billion depends on it. Interestingly India feeds 16 per cent of population with 2.4 per cent of global land.

In the last five decades, there has been a steady and spectacular transformation of Indian agriculture from the food deficit to food sufficient status. Diffusion and adoption of modern technologies, high yielding varieties, dedicated efforts of farmers, extension personnel and scientists and also programmatic support of central and state governments have all contributed significantly from 50 million tonnes in 1950-51 to land mark achievement of 230.67 million tonnes of food production in 2008-09.

1.2. Agricultural Sector Challenges

The challenges before Indian agriculture are immense. The agricultural growth rate is sluggish and stagnating. The sector needs to grow at a faster rate than the past to allow for higher per capita income and consumption. It is an accepted fact that the sound agricultural development is essential for the overall economic progress of India. Given its range of agro-ecological setting and produces, Indian agriculture is faced with a great diversity of needs, opportunities and prospects. The water scarce-rain fed areas, which account for 63 per cent of the cultivated land, exhibit low and also unstable yield and technology transfer gaps are much wider as compared to those of irrigated areas (Chatterjee and Prabhakar, 2009). National seminar on agricultural extension 2009 background note states that sustaining growth rate and achieving the required food grain production of 320 million tonnes by 2025 would be a Herculean task considering some of the challenges like non-expanding land, depleting soil and water resources, adverse impact of climate change, rising cost of production, diminishing agriculture labour availability and farmers reduced interest in agriculture (NSAE, 2009). If India is to respond successfully to these challenges and also to achieve accelerated growth needs, vibrant and innovative technology generation and delivery system are required. Greater attention will have to be paid to technology dissemination. To make farm information and technology transfer more effective, greater use will need to be made of modern information and communication technology among researchers, extension personnel, farmers and other stakeholders. Further, the agricultural extension requires paradigm shift from top-down, blanket recommendation of technological packages, towards providing producers with

the knowledge and understanding with which they solve their own location-specific problems. Continuous two-way interaction among the farmers agricultural scientists and extension personnel is the most critical missing component of agricultural extension (Chatterjee and Prabhakar, 2009). To assist the farmer in these changing contexts, new strategies and innovative solutions are urgently required which in turn will require technological support (Website of National Agricultural Innovation Project – www.naip.icar.org.in).

2. NEED FOR ICT IN AGRICULTURAL EXTENSION

1. To accelerate agricultural growth

Recommendation of the Planning commission of India's working group on agricultural extension for XI five yea plan (2007-2011) states that the agricultural growth is stagnating and sluggish. Hence, there is an immediate need of vibrant, dynamic and innovative approach to be adopted for agricultural extension in order to achieve targeted growth rate and serve the farmers better. Integration of ICTs in agricultural extension will provide needed impetus to agricultural sector.

2. To expand knowledge resource

India feeds 16 per cent of world population with 2.4 per cent of global land. Land and water resources are almost reaching their limits, hence achieving food security heavily relies on "Knowledge Resource". In this scenario, ICTs can complement the traditional extension system for "Knowledge Resource" delivery to the millions of the farmers.

3. To facilitate better information access

Estimates indicated that 60 per cent of farmers do not access any source of information for advanced agricultural technologies resulting in huge adoption gap (NSSO, 2005). In this context, it is expected that convergence of ICTs with traditional extension system will improve the farmers' information access.

4. To supplement inadequate technical manpower

In India, there are about 120 million farm holdings and the number is growing year by year. It proposes to provide one village extension personnel for 800-1000 farm families than the requirement of field level extension personnel which is estimated to be about 1300000-1500000, against which the present availability is only about 100000 personnel (PC, GoI, 2007). In this scenario, inadequate technical manpower to be for some extent compensate by the extensive use of ICTs.

5. For stronger research-extension –Client system linkage

ICTs are required to facilitate stronger linkages with research- extension-client system. The feedback received through ICTs to be more accurate and faster.

6. To develop efficient feedback mechanism

Lack of efficient feedback mechanism in the research- extension linkage was identified as one of the weaknesses in the existing extension systems. Hence, it is believed that the media and ICTs will offer strong potential to improve linkage mechanism.

7. For cost-effective extension delivery

The ICTs tools such as: Internet and Mobile networks have the potential to provide agro-information services that are; affordable, relevant (timely & customized), up-to-date, high accessibility and farmer friendly.

8. To develop knowledge managers

The experience of rural centres shows that ICTs can help in enabling rural development workers to gather, store, retrieve, adapt, localised and disseminate a broad range of information needed by rural families. This, in turn, leads to the emergence of knowledge workers that will result in the realisation of a bottom- up, demand- driven paradigm for technologies generation, assessment, refinement and adoption.

9. To ensure gender equity in technology transfer process

Traditional extension is widely criticised for not concentrating women cultivators. Research evidences show that ICT enabled extension system offers equal opportunity to the farm women.

10. To empower small and marginal farmers

In India 77 per cent of cultivators are marginal farmers. Land holding declined from 2.28 hectare per family to 1.41 hectare. Empowering small and marginal farmers with the right information at the right time and place is essential for improving efficiency and vitality of small and marginal holdings (NPFF, 2007).

11. To serve the farm stakeholders beyond technology transfer role

There is a growing recognition that extension must go beyond transferring new food crop technology to farmers and focus on helping the rural poor by promoting agriculture diversification, increasing rural employment and

helping farmer gain access to biotechnology and access to export markets and also environment awareness and rural health awareness. To perform this expanded role, extension systems should be equipped with ICTs.

3. ICT INFRASTRUCTURE SCENARIO

Strategic reforms in telecommunications sector since 1990's, facilitates strong ICT infrastructure in India. As on May 2009, 452.91 million fixed land line telephones, 415.25 million wireless and 6.4 million broadband subscribers were estimated by the Telecom Regulatory Authority of India (TARI, 2009). The tele density has reached 38.88 (number of telephone subscribers per 100 individuals). However, there is huge gap between urban and rural tele density, 64.48 and 9.03, respectively. Despite several policy initiatives to promote rural ICT penetration, growth in tele density continues to be skewed in favour of urban India. Total internet users are 49.40 million. In rural India, only 1.2 per cent people have internet access, whereas, it is 12 per cent in urban India. The overall urban and rural mobile penetration remains 43.88 and 4.92 per cent, respectively. It is estimated that by the end of the year 2010, India will have 500 million mobile phone subscribers.

4. NATIONAL POLICY ON ICT IN AGRICULTURAL EXTENSION

National policy framework for agricultural extension (2000) stated that information technology revolution is unfolding and has very high visibility. Harnessing information technology for agricultural extension will receive high point in the policy agenda. Extensive use of modern information technology will be promoted for communication between researchers, extension workers and their farmer clients to transfer technologies and information more cost effectively. Further, it emphasised IT application in marketing, wider use of electronic mass media for agricultural extension, farmer participation in IT programmes and support to the state government for using IT in agricultural extension, promoting IT based information kiosks and capacity building for use of IT (DoA&C, 2000).

National policy for farmers (2007) indicated that the potential of ICT would be harnessed by establishing gyan chaupels (Knowledge centres) in villages. Further, the Common Service Centres (CSCs) of the Department of Information Technology, Ministry of Communications and Information Technology, Government of India and those set up by the state governments and private initiative programmes will be evolved for inclusive broad-based development. Last mile and last person connectivity would be facilitated with the help of technologies such as broadband internet, community radio or

internet-mobile phone synergies (NPFF, 2007).

Document of ICAR Framework for Technology Development and Delivery System in Agriculture (2008) outlined the need for the construction of Agri – India knowledge portal – A single electronic gateway to be developed through a peer review process with the help of 15 content accreditation centres from 15 agro – climatic regions of the country. Each accreditation centres will be coordinate with other Agricultural Universities and agricultural institutions in their region for development of content in regional language as well as in English and also do its validation, which will be collected in the central data warehouse integrated in the knowledge portal. The portal will also serve as a platform for facilitation of interaction among researchers and extension personnel in the KVKs through high speed server intranet (ICAR-FFTDDSA, 2008).

National e-Governance Plan indicated that the typical services envisaged in Agriculture as a Mission Mode Projects (MMP) to provide information to the farmers on seeds, fertilizers, pesticides, Govt. Schemes, Soil recommendations, Crop management, Weather and marketing of agriculture produce. Several projects such as ASHA in Assam, KISSAN and e-Krishi in Kerala and Krishi Maratha Vahini in Karnataka have been initiated by the Department of Agriculture and Co-operation (DoA&C), Government of India. To spearhead implementation of MMP in Agriculture, DoA&C has adopted twin strategy through AGRISNET & two portals AGMARKNET & DACNET (Mathur *et al.,* 2009).

5. REVIEW ON BEST PRACTICES OF ICT FOR AGRICULTURAL EXTENSION

5.1. aAQUA - almost All QUestions Answered

The *aAQUA* is effectively an online, yet archived, discussion forum accessible using a web browser, allowing members to create, view and manage content in their mother-tongue (Hindi, Marathi *etc.,*). It aims to incorporate innovations from the perspective of cross-lingual multimedia information storage and retrieval and intelligent databases. Thus, aAQUA empowers the members in a community to create their own content and provides an easy to use interface. The aAQUA eases the creation of content *i.e.*, text, images, short audio, video and animations, thus helping the users move from being passive consumers to active content creators. More than 90 per cent of the current English, Hindi and Marathi content of aAQUA was created locally by the community. Assistance in creating content for aAQUA is provided by the telecenter/ kiosk operator. This takes the technology to users who are

unfamiliar to computers and often not literate. They can now experience the internet as well as participate through it. This is a great motivating factor for people as it showcases the benefits of using a computer in their everyday lives.

aAQUA provides language independent discussion services which are not limited to text and can have audio-visual elements to provide a simple, yet rich interface accommodating novice users. The user can formulate questions in a natural manner and is not forced to limit the query to a few words. This feature has been found to be popular among our rural community. It thus provides a communication framework for easy and fast access to reliable information (both through artificial agents and Human Experts from all over the world). The system performs "Meaning Based Search" through the available repository of information. Textual content is stored in a language independent fashion. This is intended to allow users to ask questions in their own language, access content in another language and view it in their own language (Ramamritham *et al.*, 2009).

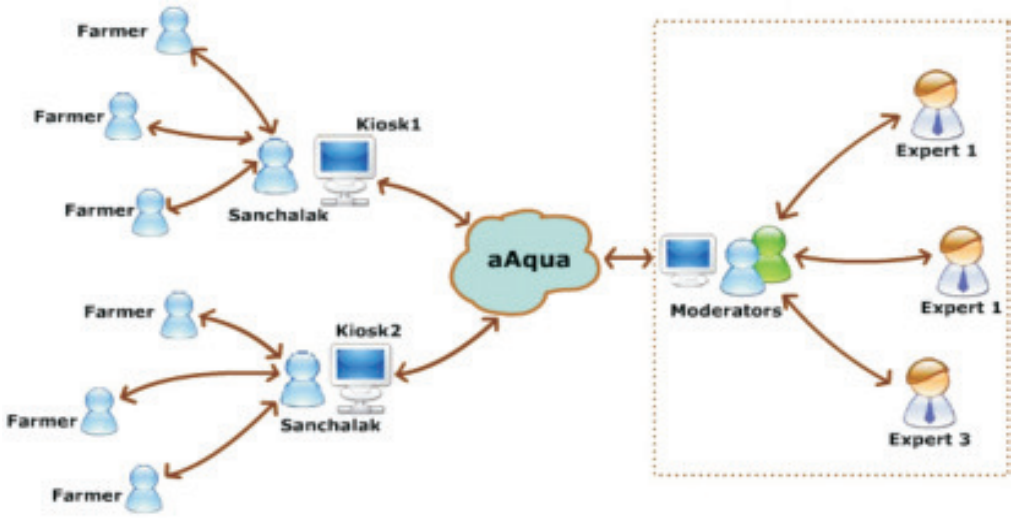

Figure 1 : Flow of information in aAQUA system (Source: Ramamritham *et al.*, 2005)

5.2. Digital Green – Participatory Video for Agricultural Extension

Digital Green (DG) is an ICT based research project for the production and dissemination of locally relevant agricultural through participatory video and mediated instruction. The digital Green farm based video has been interactively designed, deployed and evaluated among the small and marginal

farmers of the Karnataka State of India. The project was initiated by the Microsoft Research, India in collaboration with Green Foundation, an NGO.

Farmer participatory video recordings facilitate the aggregation of scattered information into systematic and comprehensive format with a localized context. The video recordings are made by teachers of agricultural at grassroots level and expert reviewers ensure the accuracy, clarity and completeness of the context and guide the construction of a time and location sensitive video based curriculum. First, awareness meetings on DG services were conducted; interested farmers were identified and new content was recorded. Content was provided by local farmers with the guidance of experts. Selected farmers were deployed for field adoption, and content screenings were used to learn, adopt and innovate better agricultural practices. Community members act as mediators to conduct a minimum of three screening per week during suitable evening hours and mediators act as a facilitators, mediators are paid honorarium up to INR 1, 500 (USD 38) per month and they additionally supported by a full time extension staff either from the government or NGO. The Digital Green one year trial involving 20 villages (1, 470 house holds) in Karnataka, India increased the adoption of certain agricultural practices seven fold over a traditional extension system and ten times more effective per dollar spent (www.digitalgreen.org). DG system was able to multiply the value of a NGO's extension agents by a factor of 10 times per dollar spent (Gandhi *et al.,* 2008).

5.3. e-Arik (e-Agriculture)

The e-Arik (Arik means agriculture in the Adi tribal dialect of Arunachal Pradesh State of North-East India) project was implemented in Arunachal Pradesh, one of the most socio-economically backward states of North-East India. After assessing farmers' information needs, the project experimented single window system for the improved agricultural information and technology delivery by using computer, internet, phone, radio and television. Project provides all time expert consultation on agriculture production, protection and marketing aspects through ICTs. The e-Arik research project staff regularly undertakes field visits to observe crop condition, diagnosis the pest, diseases, and nutrient deficiency, physiological problems, and then field crop condition is digitally documented. To solve complex crop pest, diseases, nutrient deficiency and physiological problems, digital photographs are transmitted through e-mail from e-Arik-village knowledge centre to the farm scientists of Central Agricultural University and recommendations passed on to the farmers. Further, farm scientists undertake need-based field visits and provide expert advice to the farmers. Further, farmers training and demonstrations were conducted by the project staff and or Subject Matter

Specialists of Farm Science Centres, extension personnel from the developmental departments. Project portal (www.earik.in) provides information on crop cultivation, agriculture and rural developmental departments and their schemes, day to day market information and weather conditions, which is also displayed in the village knowledge centre notice board. Further, information on health, education, governance and other information for tribal farmers are available in the project portal. The village agricultural library at the e-Arik-village knowledge centre is having the collection of farm publications, multimedia CDs and daily news papers for the ready reference of the farmers and others. Farm input display unit at the e-Arik-village knowledge centre exhibits bio-fertilizers, organic pesticides and fungicide samples for the familiarization among the farmers. The ICT awareness lectures, regular trainings were conducted for the benefit of village children, students, village school teachers and villagers. The village advisory committee regularly reviews the progress of the project. Innovative approaches such as: farmer to farmer communication, local leadership and self-help approaches are employed for the agricultural technology transfer. The e-Arik pilot project covered 12 tribal villages, 500 registered farm families of East Siang district of Arunachal Pradesh State of North-East India (www.earik.in; Saravanan and Indradevi, 2008).

Figure 2 : Farm Information Dissemination in e-Arik: ICTs for Agricultural Extension Project

5.4. e-Sagu (e-Cultivation)

e-Sagu was a ICT based personalized agro- advisory system in which rather than on site visit of crops the agricultural scientists deliver the advice by getting the crop status in the form of digital photographs and other information. A co-ordinator who was associated with a group of farmers and who possesses agricultural experience and basic data entry skills, visits each designated farm on a weekly basis. The co-ordinator collects the registration information including soil data, water resources and capital availability from the farm and sends the crop details in the form of text and digital photographs through the communication system to agriculture experts. The agricultural experts gave appropriate recommendation with the help of computerized agricultural information system. Agricultural information system contained all the related information such as details of the farmer with corresponding soil and crop information and status of the crop. Also the details of agricultural technology related to various crop such as the level of pest resistance, requirement of water so on. They used research data, soil data, historical data, weather data and other information to generate appropriate recommendation and stored this advice in the system to improve crop productivity. The co-ordinator then explained the advice to the farmer. The feed back regarding the advice was sent along with photographs during the following weeks. The cycle was repeated every week for each farm (www.esagu.in).

A team of agricultural experts worked at the e-Sagu main lab, supported by an agricultural information system. One e-Sagu local centre consists of a few computers and a computer operator and covered a group of about ten villages. Educated and experienced farmers worked as coordinators. Depending on the crop, each coordinator was assigned a fixed number of farmers. He collected the registration details of the farms under him including soil data, water resources and capital availability and sent the information to the main e-Sagu system. Every day the coordinator visited a fixed number of farms and took 4-5 photographs for each farm. A CD was prepared with the photographs and other information and transferred to the main system by a regular courier service. The agricultural experts with diverse backgrounds (entomology, pathology, agronomy *etc.*) at the e-Sagu main lab analyzed the crop situation with respect to soil, weather and other agronomic practices and prepared a farm specific advice. At the local e-Sagu centre, the advice was downloaded electronically through a dial-up Internet connection. The coordinator collected the advice print out and delivered it to the farmer concerned. In this way each farm got the proactive advice at regular intervals

starting from pre-sowing operations to post-harvest precautions (Ramaraju and Krishna Reddy, 2009).

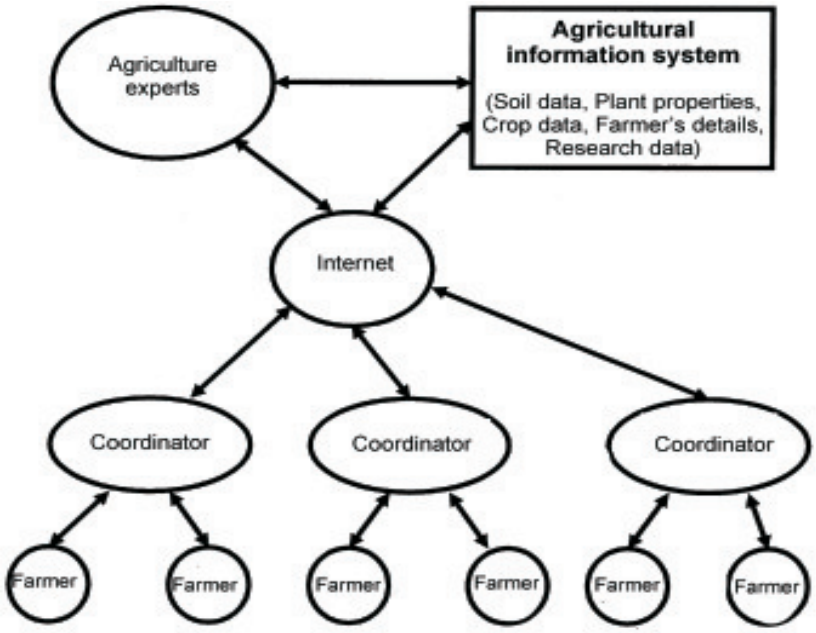

Figure 3 : Agricultural information dissemination system.
(Source: Krishna Reddy and Ankaiah, 2005)

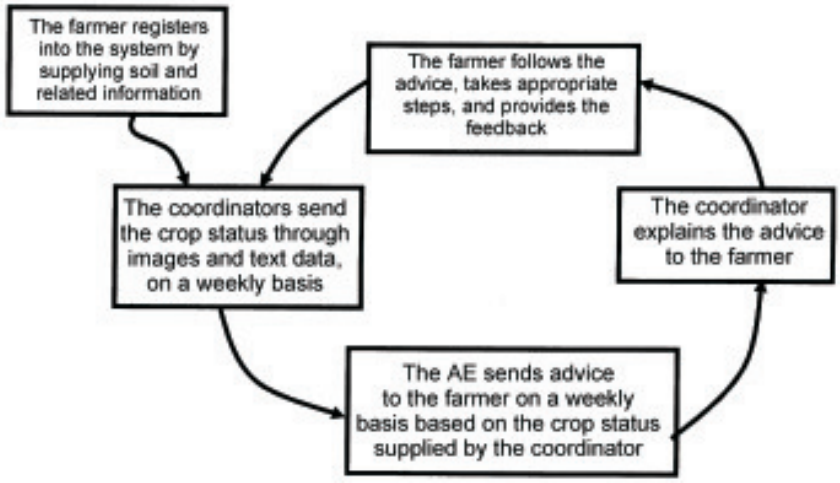

Figure 4 : Depiction of Agricultural Information Dissemination System (AgrIDS) Operation
(Source: Krishna Reddy and Ankaiah, 2005)

The development of e-Sagu was started during Kharif season of 2004. The e-Sagu system was implemented by delivering advisory to 1051 cotton farms in three villages of Warangal district in Andhra Pradesh State of South-India. The experiment was successful. During 2005-06, as a scaled-up experiment, e-Sagu system was implemented for cotton, chilli, rice, groundnut, castor, red-gram and other crops for 4894 farms in 35 villages spread over six districts in Andhra Pradesh State. In addition, the e-Sagu system has evolved to deliver advisory service to fish-farmers. About 160 fish ponds were covered. By the end of 2005-06, there were eight e-Sagu local centres which had delivered 35925 advices covering 30 crops and fish rearing. About 260000 crop photographs and 8918 fish photographs were taken in the process. The average number of photographs taken per observation was five. The farmers are happy with the expert advice as it was helping them to improve input efficiency through the use of integrated pest management (IPM), judicious use of pesticides and fertilizers, *etc.* At the same time benefits accrue through higher yield. As per an impact assessment study carried out by social scientists, benefits accrued to farmers were (in 2004) Rs. 9435/- (USD 240) per hectare with cost benefit ratio of 1:3 and for the year 2005: Rs. 9491/- (USD 240) per hectare with cost-benefit ration of 1:4.1. Fish farmers have also realized significant benefits. In some centres the farmers have paid the subscription fee for the services and they are satisfied with the same. The e-Sagu project has successfully delivered advices for 5, 054 farms (4130 ha) of 3,035 farmers in 38 villages in Andhra Pradesh State of India (Ramaraju and Krishna Reddy, 2009).

5.5. KISSAN- Karshaka Information Systems Services and Networking

KISSAN is an innovative project by the Department of Agriculture, Government of Kerala. The mission of this project is to develop and deploy Information Systems, Network, Processes and Services for Agriculture in ways that lead to (i) amelioration of farmers' distress and enhance their welfare, (ii) increased farm productivity and (iii) better returns for farm produce and derived products.

The objective is to provide an effective knowledge management and smart information dissemination system that provides linkage among farmers, public research institutions, administrative and private entrepreneurs to share the information and knowledge. The KISSAN project is having a dedicated content processing and dissemination system. This involves the collection, analysis, classification, process various information from different sources. The project will establish an agriculture data center, which will cater for all

the needs. High-end servers and other data processing equipments will back up the data center. All the information will be processed and disseminated through this data center. The project portal also provides Post Query for Expert Answers, Crop Information, GIS Based Agri Advisory, Farming Practices, Fertilizers & Pesticides, Kerala Agri Directory and Discussion Forum (http://www.kissankerala.net/kissan/kissancontents/about.jsp).

5.6. Lifelines India- Soochna Se Samadhan (Solutions through Information)

SOOCHNA SE SAMADHAN is an initiative to use the power of voice as the primary means of information dissemination. It facilitates the exchange of critical and timely information among marginalised communities so that it helps in improving their quality of life. It aims to provide connectivity, content and capability *via* a phone-based service. Specifically it will provide grassroots communities with access to a wide information and knowledge pool.

OneWorld South Asia (OWSA) with support from British Telecom and CISCO systems are piloting the service in North India in partnership with other civil society organizations. British Telecom and CISCO Systems have supported the initiative as a part of their Corporate Social Responsibility programme which assumes that access to information and communication technologies (ICTs) can improve people's lives and open doors to education, jobs, entertainment and interactions. The technology solution development has been supported by Tech Mahindra and WIPRO.

The benefactor calls a designated number using a land line/mobile telephone. The call first reaches the Interactive Voice Response System (IVRS) where she/he registers the query with the help of a voice menu. The query is stored as a voice clip in a database server. The knowledge worker (KW) logs in to the application through a web interface, views all the calls that are waiting for attention, and searches the FAQ database for the answers. If the KW finds the answer, it is retrieved and stored in the IVRS. If the answer is not found, the KW forwards the question to the subject matter experts. Once a response is received from any of the subject matter experts, the application alerts the KW, who examines the response and if appropriate, stores the answer in the database and makes it available for future queries. Voice Clip of the answer is played back to the benefactor when they call back.

The information can also be retrieved in text format from the Information Centre near the village. The farmers can send pictures along with their questions, and also voice clips to clarify on the issue (SOOCHNA SE SAMADHAN, 2009).

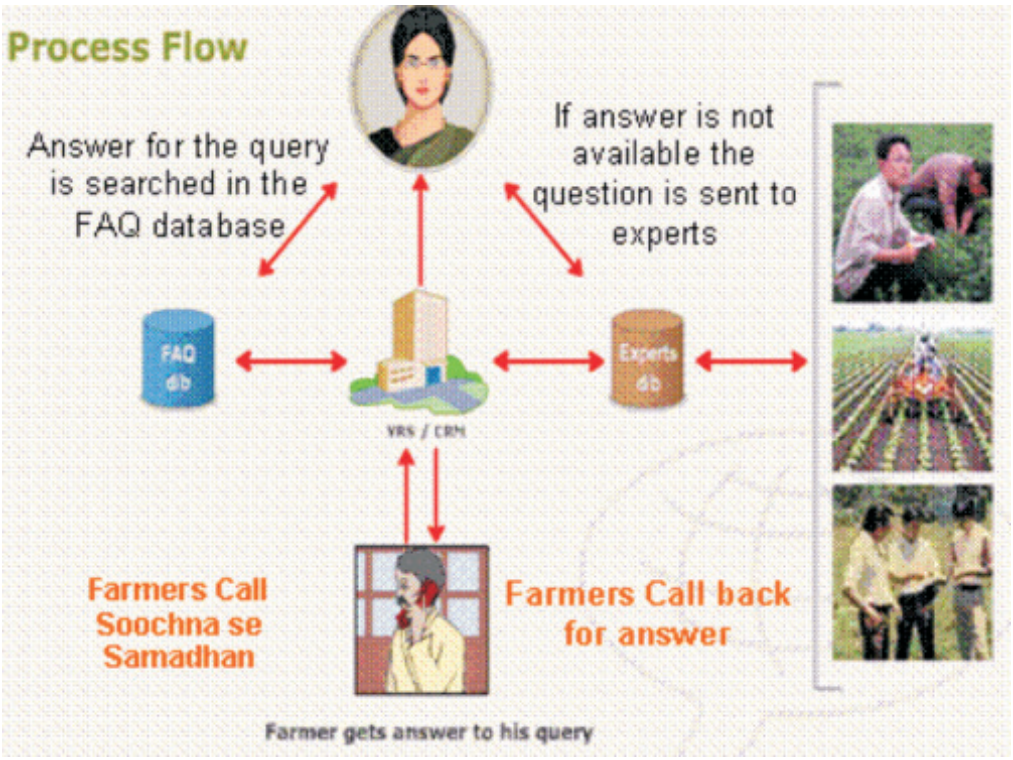

Figure 5 : Information Dissémination Pattern in Lifelines India
(Source*:* www.solutionexchange-un.net.in/decn/cr/res05110601.doc)

Lifelines India which was launched in 2006 as an information delivery service at the grassroots was started in 700 villages in north and central India (Lall and Sahi, 2009), in partnership with Indian Society of Agribusiness Professionals and TARAhaat. Local volunteers will facilitate the use of the service by the farmers. The farmers can also visit the nearest information centre to access the offline database in local language, listen to the audio clips and also to send pictures of affected crops.

5.7. VASAT - VIRTUAL ACADEMY FOR THE SEMI-ARID TROPICS

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) at Hyderabad, India has initiated the Virtual Academy for the Semi-Arid Tropics (VASAT), as a technology mediated extension and knowledge sharing programme (Navarro and Balaji, 2003; http://vasat.icrisat.org). As part of the VASAT activities, two field projects (one in India and another in Niger) involving the participation of rural community

based organisations were launched in 2004. In Addakal region (South Central India), the VASAT project involved a local community based organisation, Adarasha Women's Welfare Organisation. In the experiment, a module prepared by ICRISAT experts was rendered into local language and the info-mediaries (volunteers from community based organisation) were administered the granules, which helped the volunteers to 'refine" farmers' queries before passing them onto experts. The video-conferencing and online forums in support of agricultural related questions and answers processes and also GIS derived tools were successfully experimented for micro-level drought preparedness among small and marginal farmers in drought-prone rainfed area (Balaji *et al.*, 2007).

5.8. Touch Screen Kiosk

The touch screen kiosk with information on cattle health was tried and tested under a United Kingdom Department of International Development (DFID) - Animal Health Programme (AHP) supported project on dissemination of animal health knowledge for development of landless dairy cattle owners in the peri-urban regions of Pondicherry, India (2002- 2004) by the Rajiv Gandhi College of Veterinary and Animal Sciences, Pondicherry, India in collaboration with the University of Reading, UK. The kiosks were installed in the veterinary centre and veterinary dispensary. The cattle owners bring their animals to the veterinary dispensary for treatment or Artificial Insemination (AI) and register the case. After that they will wait for their turn to come for service delivery. That waiting time is utilized for getting information from the kiosk (Ramkumar and Rao, 2004).

5.9. e-Extension (e-Soil Health Card Programme)

The Department of Agriculture, Gujarat State, India initiated office automation, networking and e-communication among department staff, digital data bank generation, management, storing and retrieving computerisation of farmer centric applications, web site, e-soil health card scheme. The crop estimation survey, online management and monitoring of Government schemes, online farmer accident insurance scheme applications and status, crop wise sowing area, crop and weather condition data will be entered online and state level weekly reports are generated automatically. It also provides online monitoring of individual beneficiary schemes and extension programmes (Krishi mahotsav) and online applications for natural calamity, *etc.* The e-Soil Health Card Programme, an e-Agricultural extension service programme, is one of the ambitious programmes which aims to analyse the soil of all the villages of the state and proposes to provide online guidance

to farmers on their soil health condition, fertilizer usage and alternate cropping pattern (www.agri.gujarat.gov.in; www.shc.gujarat.gov.in).

6. VILLAGE KNOWLEDGE CENTRES

6.1. MSSRF - Village Knowledge Centres (VKCs)

The Village Knowledge Centre programme was started in 1998 in the Union Territory of Pondicherry in South India by the M S Swaminathan Research Foundation (MSSRF) in the east coast of South India with the generous support of IDRC and CIDA. In order to ensure access to all, the VKCs are located in public buildings (Panchayats, SHG building, Community Hall, School, Farmers and Fishermen Associations, Women Self-Help Groups, Community Based Organization, *etc*.). The information content is developed in close interaction with the local people in a bottom-up manner. VKCs are connected with hub centres through a hybrid wired and wireless network. The VKCs provide information on agriculture, health, employment, weather, education, government entitlements, microenterprises training, *etc*. In each case, the community or local partner provides an accessible rent-free building, electricity and volunteers. In turn, the project provides all the needed equipment, training and helps in collecting data. Gender concerns are central to the project. More than half of the volunteers are women. This has positively reflected in the increase of the number of women users.

6.2. ISRO -Village Resource Centres (VRCs)

Indian Satellite Research Organization (ISRO) has initiated the VRC concept *i.e.*, setting up of the Village Resource Centres (VRCs) with a view to integrating its capabilities in satellite communications and satellite based earth observations to disseminate a variety of services emanating from the space systems and other IT tools to address the changing and critical needs of rural communities (VRC-WP, 2006). Village Resource Centres will become single window delivery mechanism for tele-medicine, tele-education, natural resources data, agriculture advisories, land & water resources advisories, interactive farmers' advisories, e-governance services and weather advisories. It will also be involved in capacity building of the community to enhance its awareness and knowledge levels. The VRCs will provide information on health, education, nutrition, gender issues, legal services and women empowerment.

Village Resource Centres (VRCs) was inaugurated in 2004. Under this VRC programme, most of the MSSRF -VKCs are connected through Indian Space Research Organization's (ISRO) uplink and downlink satellite facilities. The satellite based ISRO-VRCs, aims at digital connectivity to remote villages

for providing multiple services such as tele-medicine, tele-education, interactive farm and fishery advisories, government schemes and entitlements, weather services and remote sensing applications through a single window. Users located at one node of this network can fully interact with others located at another node through video and audio links. Each node can further be expanded using different technologies such as notice boards, pamphlets, public address system, community newspaper, press releases, cable TV, audio/ video conferencing through wireless, telephone, meetings, mobile phone and intranet web site for dissemination of the useful and necessary information. To strengthen the management among VRC, VKCs and strategic partners (data providers, generators, capacity building providers, *etc.*) the Jamsetji Tata National Virtual Academy (NVA) developed a three-tier knowledge network. The main aim is to develop a user-controlled, user-owned and user-managed network, which will help to reach the unreached and include the excluded in terms of information, knowledge and skill empowerment. As on September, 2009, 18 VRCs and 101 VKCs have been set up by National Virtual Academy (NVA), MSSRF in India. For setting up and running of VKCs the MSSRF is working with 127 partners. For providing locale-specific demand driven content and capacity building of rural communities the VRCs and VKCs are working with 315 partners consisting of Government Departments-Agriculture, Animal Husbandry, Fisheries, Education, Rural Development, Health, *etc.*), NGOs, Academic and Research Institutions, Hospitals, *etc.*, (Senthilkumar, 2009).

6.3. Community Information Centres (CICs)

The eight North-Eastern (NE) states of India have traditionally been less developed than the other states due to their geographic remoteness and difficult hilly terrain. The Government of India in 2002, set up 487 Community Information Centres (CICs) at the block level in the eight NE states. They are equipped with computer communication equipments and are internet-enabled. The CICs, besides offering basic services like internet browsing, e-mail and training in computer fundamentals, also provide citizen-centric or government-to-citizen (G2C) services. *e-Suvidha* is a single-window front end for such services and is offered by many CICs. The CIC operators teach the villagers how the internet can help them obtain necessary information regarding farming, agriculture, health, education, *etc.*

6.4. Mission 2007

It was way back in 2003 that the idea was seeded to have a Mission targeting the 60th year of Indian Independence named as Mission 2007 which

would successfully let the concept of the ICT enabling of all the villages of India evolve into a movement. Today after 15th August of 2007 the Grameen Gyaan Abhiyan proudly holds hands with its 400 odd partners across the country with one intention of creating a Knowledge revolution in rural India (Senthilkumar, 2009). The Grameen Gyaan Abhiyan is Rural Knowledge Movement in India which has been working with an aim to achieve ICT enabling of 637 000 villages of India has built a multi stake holder partnership with the different ICT4D models present in India. They include the community based models, the entrepreneurial models, government models, the business models or corporate models, the cooperative models and the combinations of all these models in pairs or more (http://www.mission2007.in).

6.5. Common Service Centres (CSCs) Scheme

Common Service Centres (CSCs) Scheme is the nationwide initiative of Government of India to provide support for establishing 100 000 Common Service Cantres in 600 000 villages of India. CSCs scheme has been started in 2004 with the vision to develop these centres as a front-end delivery points for Government, private and social sector services to rural citizens of India in an integrated manner.

7. WARANA WIRED VILLAGE PROJECT

The project was initiated in 1988 to increase the efficiency and productivity of sugarcane sector and provide a wide range of information and services to 70 villages around Warana. It comprises 25 co-operative societies and a membership of over 20000 farmers with a total turnover of over US $ 130 Million. There are 54 functional village information kiosks which are open from 10 am to 6 pm and frequented by 30 to 100 farmers daily (Patil *et al.,* 2009). An evaluative study after the seven years of implementation indicated that the personalised sugarcane processing information that allowed farmers to obtain information from the co-operative records at their local kiosks was mostly used by the farmers (Veeraraghavan *et al.,* 2009).

8. WEB PORTALS

8.1. AGRISNET

AGRISNET (Agricultural Resources Information System and Networking), a project funded by the Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India. Under this scheme most of the State Governments are established information rich agricultural websites. For example, Sikkim AGRISNET (http://www.sikkimagrisnet.org),

Andhra Pradesh agri-portal, http://www.apagrisnet.gov.in, Uttar Pradesh (UP) Agrisnet Knowledge Portal (http://agriculture.up.nic.in), AGRISNET – Himachal Pradesh (http://203.193.179.168/default.aspx) - Expert Advisory Services (http://www.hp.gov.in/expertadvisory/SignUp.aspx).

AGRISNET projects, pilots for 17 states, have been approved to provide following services; market prices, soil information, crop diseases and management, good practices for horticulture, sericulture, *etc.* Twenty three priority services and processes for reengineering have been identified. Several initiatives have been taken by central government and states such as ASHA in Assam, KISSAN and e-Krishi in Kerala, Krishi Maratha Vahini in Karnataka, *etc.*, aimed at meeting challenges facing the agriculture sector in the country and have met with varying degree of success. As such, to consolidate learning from the past, integrate present diverse and disparate efforts and upscale them to cover the entire country, Agriculture has been included as a Mission Mode Projects (MMP) in National e-Goverence Plan (NeGP) and is to be operationalised by Department of Agriculture and Cooperation (DoA&C). The typical services envisaged in Agriculture as an MMP include: information to farmers on seeds, fertilizers, pesticides, government schemes, soil recommendations, crop management, weather and marketing of agriculture produce. The DoA&C has adopted twin strategy to spearhead implementation of MMP in Agriculture through AGRISNET & two portals AGMARKNET & DACNET. Through the AGMARKNET portal, information on about 300 commodities from 2000 mandis (markets) is made available. The information is updated regularly, directly from the markets. DACNET portal provides subject/ crop specific information from various Directorates under the Department of Agriculture and Cooperation (http://www.mit.gov.in/default.aspx?id=863).

8.2. DACNET – An e-Governance Project of Government of India

DACNET (Department of Agriculture and Co-operation Network) is an e-governance project sanctioned by the Department of Agriculture and Co-operation, Ministry of Agriculture, GoI and executed by the National Informatics Centre (NIC) to facilitate Indian agriculture on-line. It is built using the key criteria such as ease of use, speed of delivery, simplicity of procedure, single window access and affordable services, *etc.*, DACNET has four major components: Network together directorates, regional directorates and field units for Internet and intranet access with the central DACNET resources, establish a local-area network throughout Department of Agriculture field locations, empower employees through specialized system training programs, web-based applications at the directorate, regional

directorate, and field units. Applications under DACNET are Plant Quarantine Information System, Crop Weather Watch, Market Prices Analysis, Bio-fertilizers Informatics Online, Integrated Pest Management Information System, Computerized Registration of Pesticides, Knowledge Management System 'e-Granthalaya' and Farm Machinery Informatics online (www.dacnet.nic.in).

Joint Secretary (IT), DoA&C, GoI, 2009 indicated that under the DACNET scheme, 46 web sites and 39 applications are developed (75 were developed and functional), which include web portals on complete information on 9 crop directorates, extension services, Integrated Nutrient Management, Marketing, Mechanisation and Technology, Economics and statistics (www.agricoop.nic.in/Kharif2009/JS(IT).ppt). Some of the notable applications are: CSMS (Content Schedule Management Program), the Mass Media Portal (http://dacnet.nic.in/csms) for reporting and dissemination of Agriculture Programmes produced by National, regional and Narrowcast Centres of Doordarshan and FM stations (http://navkrishi.nic.in/), SEEDNET (www.seednet.gov.in); Seed management, certification, variety management system, monitoring watershed details (www.dacnet.nic.in/rfs/), district wise crop production (www.dacnet.nic.in/pulses/report.htm) and land use online data entry, pest and diseases monitoring system, online data reporting and monitoring of technology mission on integrated development of horticulture in North-Eastern States of India (http://dacnet.nic.in/techmissionscheme).

8.3. InDG- India Development Gateway Portal

India Development Gateway (InDG) is a nation wide initiative of the Department of Information Technology, Government of India and implemented by Centre for Development of Advanced Computing (C-DAC), that targets specific country needs in the domain of rural and social development. InDG aims to provide credible information products and services in local languages that respond to the real and strategic needs of the rural people especially the farming communities. The use of Content Management System (CMS) enables shared ownership of the portal with various stakeholders. Any authenticated user can upload content to a specified topic in the portal. The content includes various forms such as words, audio and video so as to reach out effectively to rural masses and first level service providers. The information requirements of the rural people are first identified through various mechanisms. Once the information needs are identified, they are mapped to the existing content available with various development stakeholders such as Government, NGOs, Community based organizations and private institutions. The required content is collected, validated by the

respective domain experts, edited for better presentation and published on the site for the end users. If the required content is unavailable, it is generated by an identified agency with expertise in the relevant field. Direct content uploading feature through portal is one of the important features of www.indg.in portal. The Content Management System available in the portal helps the user to directly upload the content into the portal by following simple steps. It saves the time in content flow from content providers and user end. All the registered members will be able to access this facility. Special privileges like 'edit/modify the content' will be given to such partners who validate the content online. The guiding strategies of InDG are three fold. First is to leverage the unique partnership structure to generate information products and services for the unreached in their local languages. InDG banks on consortiums of agencies for content contribution, validation and translation. Building dense networks of partners having expertise in the identified domains and leveraging C-DAC's technology expertise lays InDG's foundation. InDG is following a decentralized content management system for content on the gateway. The content publishing has been distributed and the role of the gateway team is of quality assurance and monitoring. In each of the focus areas the strategic partners of the InDG have managed the content. They are responsible for content generation, development, editing and final publishing on the gateway.

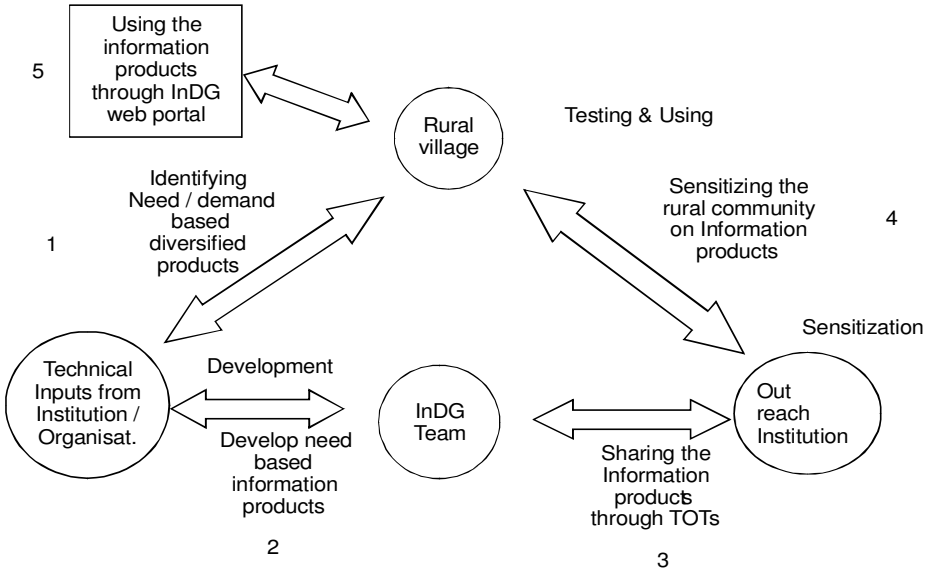

Figure 6 : Information Productization and Implementation Process of InDG

The second is to deliver value added content and services with a set of community building and collaborative tools. Keeping in mind the

developmental needs of the target communities the gateway has both online as well as offline presence. The online mode provides knowledge management services on the thematic areas, collaborative tools and a platform for learning and networking to its target customers. The offline mode will complement the online mode wherever connectivity and other delivery issues are present. In the offline mode the gateway would operate through the network of its partners to provide consulting, research, training and knowledge management services to its target customers.

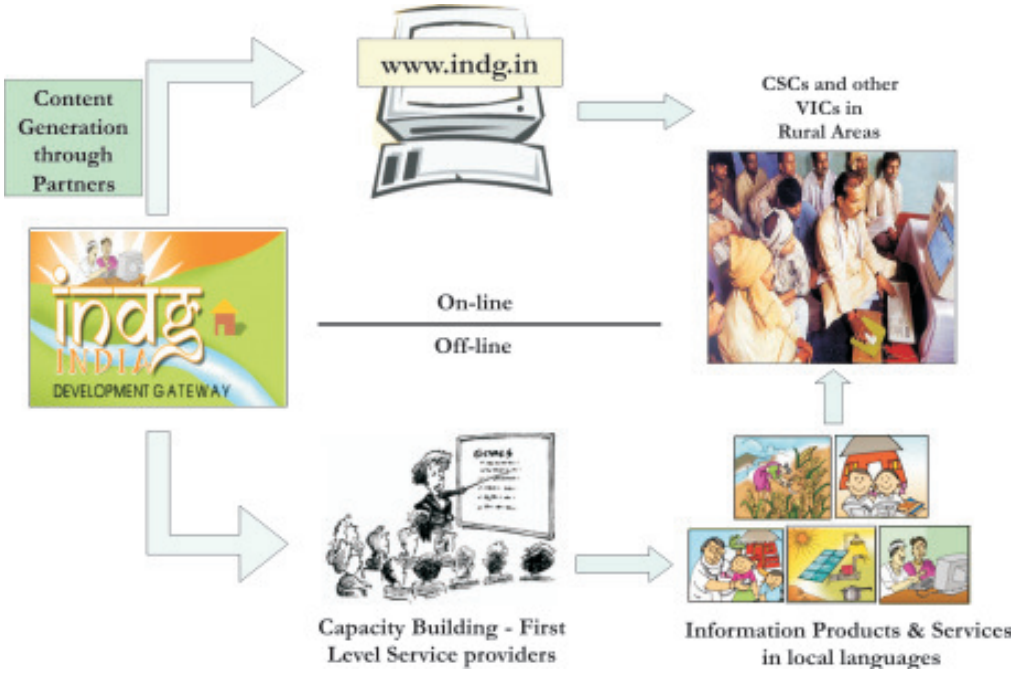

Figure 7 : Online and Offline Initiatives by India Development Gateway

The third is to develop a revenue model that ensures the financial and social sustainability of the project beyond the stipulated project period. The business model hopes to generate revenue from those users who can afford to pay for the services of the InDG portal. The services include priced information products, consultancies, membership fee and advertisements, paid trainings/ workshops and fund raising from donors (Kathiresan, 2007; Vijayalakshmi, 2008; Kathiresan *et al.*, 2009).

8.4. DEAL - Digital Ecosystem for Agriculture and Livelihood

DEAL is an ontology driven digital info mediation architecture; different user groups and expert groups will co-create content through knowledge

exchange and dynamic aggregation which will be enabled for delivery over multiple media. This will allow different e service in this domain to exchange knowledge objects according to a commonly agreed ontology (www.dealindia.org). DEAL is a research project which focuses on developing an Ontology Server (OS) in the Indian agriculture and rural livelihood (ARL) domain (IARL). The agenda here is to build an action oriented vehicle to provide consistent usable access to information for the rural Community searching for knowledge, as well as to assist those whose interaction (*e.g.* Farm Science Centres (Krishi Vigyan Kendra-KVK) scientists and farmers) to create new knowledge. Firstly, the project now attempts to build the OS for IARL as a reference tool that can structure and standardize agricultural terminology in multiple Indian languages for use by different systems. This ontology will contain terms, the definition of those terms and the specification of relationships among those terms. It will start with a Thesaurus, the conversion of the Agrovoc hosted by the Food and Agriculture Organization of the United Nations in Hindi and later in other Indian language. But the aim is to work in parallel on enhancement to the Thesaurus, so that the system can provide the basic relationships inherent in the thesaurus. It will aim to capture and structure the knowledge in the ARL domain (Chatterjee and Prabhakar, 2009).

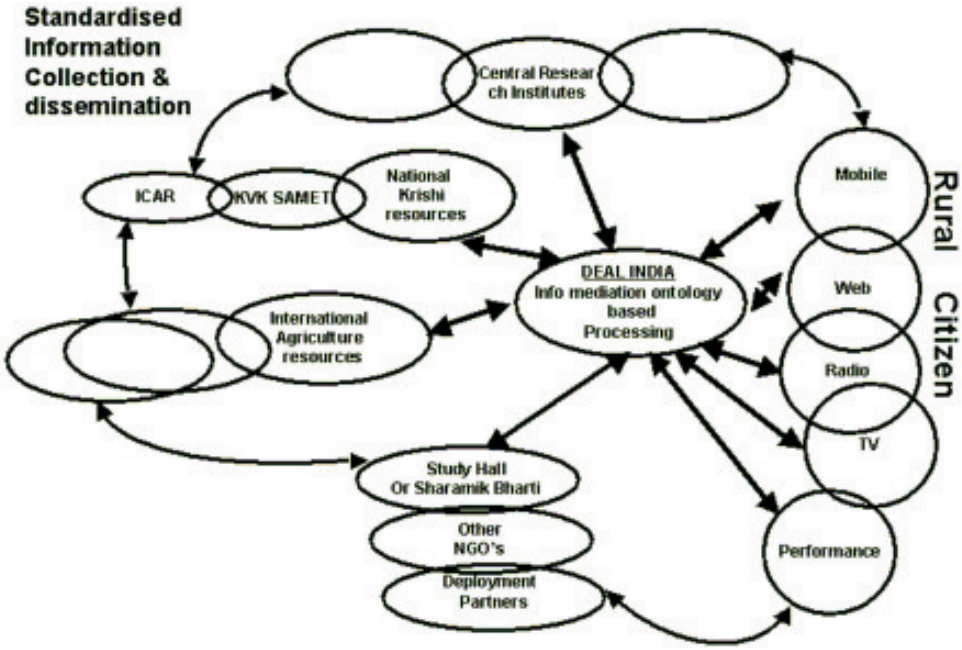

Figure 8 : Conceptual Architecture of Knowledge-Net of the DEAL (Chatterjee and Prabhakar, 2009)

The DEAL (Digital Ecosystem for Agriculture and Livelihood) project is a step towards addressing these issues by assembling a technology enhanced agricultural extension intervention in a Digital Ecosystem (DE) framework. Conceived by Indian Institute of Technology, Kanpur (IIT-K) and funded by Media Lab Asia. DEAL is an ICT enhanced network built on an existing framework of tele-centres in rural institutes, village schools, village level agriculture extension centres and other deployment partners. The project aims to create a digital knowledge base by involving the various actors in the existing system in the content creation process and making this knowledge accessible to farmers and other agricultural practitioners. The entire process of content creation and dissemination is capable of self generation, node independence and self-sustainability using an electronic medium. The moderating node in this system is IIT- Kanpur- providing the collaboration and collation technology platform, skills and resources to assist knowledge flows through the network. The presence of Government agencies helps to build trust in the network. The agricultural experts and educational institutions are responsible for verification of content generated.

Unlike conventional ICT interventions, which adopt either a top-down or bottom-up approach, DEAL focuses on increasing ties between members in the same layer, while also building links across the different layers. DEAL had provided a platform for different KVKs to share their extension experiences with each other through hosting a website for each of them. Horizontal ties between farmers from disperse geographical areas are enhanced through the use of the kissan blog for sharing agricultural experiences. This is a distinguishing feature of a digital ecosystem as creating these ties lead to shared norms and values which make ICT interventions successful. In the case of DEAL, this would fulfil the goal of sustained and voluntary content co-creation (Rajagopalan and Sarkar, 2007).

8.5. iKisan

iKisan is a comprehensive Agricultural Portal initiated by the Nagarjuna Fertilizers and Chemicals Ltd., in South India. iKisan is addressing the Information, Knowledge and Business requirements of various players in the Agriculture arena *viz.*, Farmers, Trade channel partners and Agri Input/ Output companies. Leveraging Information Technology and extensive field presence, Ikisan is positioned as an Information/ Knowledge exchange. Agriculture information; Crop Specific, Package of Practices of crops, Animal Husbandry, Aromatic and Medicinal Plants, Agricultural Machinery, Allied Agriculture, Sprayers, Rural Credit, Insurance iKisan crop solutions; farmers have a critical need to get timely solutions for protecting and nurturing their

crops to get best yields. Addressing this key need, iKisan has developed easy-to-use diagnostic packages for different crops which will be provided on demand. Further, it also provides local agri news, weather and market information to the farmers (http://www.ikisan.com).

8.6. e-Krishi

The e-Krishi project, Market driven Agricultural Initiative through IT enabled Agri Business Centres in Kerala, addresses the existing gap in agriculture information flow and transaction management. The project envisages facilitating and enabling farmers and other Stakeholders through Agri Business Centres to interact with Agricultural Service Providers in the Private, Government and Non Government sectors. The project provides a web based solution enabling the small and medium farmers as well as owners of large landholdings. Piloting was done in Malappuram with the participation of the existing Akshaya e-Kendra Entrepreneurs. The facilities and resources of Akshaya e-Kendras in terms of computers, printers, scanners, cameras, *etc.* and intranet/internet connectivity, already established throughout Malappuram District of Kerala (about 550 e-Kendras), can be leveraged to reach the masses of farming community and other stakeholders in Agriculture sector (http://www.e-krishi.org). The e-Krishi portal also provides Farm Advisory Services (Crop Information, Fertiliser Recommendation, Planting Material Availability, Fertilizers and Pesticides, Weather Information), Agri-Market Information (Vegetable and Fruit Price, Daily Market Price, Market Analysis Report and Commodity Exchange), Resource Library: e-Krishi Eco-System, e-Krishi information centres, Photo Gallery, Model e-Krishi Project, KISSAN Video Channel. Further, e-Krishi news and online expert advisory, trade login and call centre support are the special features of the e-Krishi web portal (http://www.e-krishi.org).

8.7. ASHA

The ASHA project was launched by Assam Small Farmers Consortium (ASFC) to provide ICT based agribusiness services through 219 Community Information Centres using portal www.assamagribusiness.nic.in, since 2005. The project attempted to address the issues of farmers' access to technology, government endeavour (schemes), institutions, markets, resources and services to tackle poverty and poor growth through agriculture medium in Assam. Assam Small Farmers' Agribusiness Consortium (Assam SFAC) undertook the mission of providing access to technology, government endeavor, markets, institutions and services to farmers Media using ICT with relevant and need based Content under a brand name ASHA meaning Hope. ASHA services

are made available through the Community Information Centres (CICs) located in 219 Community Rural Development Blocks of the state where farmers can access technology, Institutions, Government schemes, Markets and Services without barriers at his convenience either over telephone or through walk in and engage with them.

8.8. IFFCO- Agri-Portal

The Indian Farmers Fertiliser Cooperative (IFFCO) is one of the World's largest manufacturers of fertiliser. The IFFCO's agri-portal'-Sixteen states have been covered with information of relevance to farmers in local languages and can be accessed through IFFCO's website www.iffco.nic.in. User-friendly intuitive graphic based navigation is provided to facilitate viewing in touch screen environment. IFFCO has also installed about 100 Farmers Information Kiosks in 16 states. Training programmes and farmers meetings are conducted to encourage farmers to use the facilities provided in farmers' information kiosks (Patil *et al.*, 2009).

8.9. Agriwatch Portal

The agriwatch.com is the largest agribusiness portal in India and enables access to a large amount of agribusiness related information covering more than 15 sub sectors within the Agricultural and Food Industry. The daily, weekly and fortnightly Agriwatch Trade Research Reports are published (Patil *et al,* 2009).

8.10. iShakti

The iShakti information 'kiosk' is implemented by the Hindustan Unilever Limited, operated and hosted by the Shakti Entrepreneur. It provides a web-portal with content relevant to the rural audience. Local users can access information on categories including education, employment, agriculture, health, e-governance, personal care, and entertainment. They can post queries on these subjects to local experts who respond within 48 hours. Rural telephone connections are often unreliable, preventing routine Internet use. iShakti uses highly efficient and robust synchronisation to allow new content to be delivered to an autonomous village-based PC. This enables IT-based information and services to be delivered to regions where this was previously difficult or impossible (http://www.stockholmchallenge.se/data/ishakti_bridging_digital_)

9. ICTs FOR MARKET INFORMATION AND AGRI-BUSINESS

9.1. AGMARKNET

The project is about empowering farming community with the knowledge of latest commodity prices and arrivals information through innovative usage of ICT by networking agricultural produce wholesale markets in the country. It was initiated with the objectives of Networking 2800 major agricultural produce wholesale markets; imparting computer awareness and application usage training to about 5000 market personnel; dissemination of daily commodity prices and arrivals information in major Indian languages. In order to bring the farmers in a better bargaining position and to promote a culture of good agricultural marketing practices in the country, Directorate of Marketing and Inspection (DMI), Ministry of Agriculture, Government of India has embarked upon an ICT Project: NICNET based Agricultural Marketing Information System Network (AGMARKNET) as part of the Central Sector Scheme : "Marketing Research and Information Network" . The project, launched during later part of Ninth Plan Period (1997-2002), involves progressively linking all the agricultural produce wholesale markets, State Agricultural Marketing Boards/ Directorates and DMI offices for effective exchange of market information. National Informatics Centre (NIC) is executing the project on turnkey basis.

Project components include installation of basic ICT infrastructure at markets and their networking, capacity building, application development to facilitate creation of market level database as well as a national database on daily commodity arrivals and prices and a portal to gradually serve as a single window facility for disseminating all information pertaining to agricultural marketing. Presently, more than 1000 markets from different parts of the country are reporting data regularly to the portal. Functional days of markets being different, more than 300 markets are sharing information on daily basis for the use of public at large (Source: http://www.stockholmchallenge.se/data/agmarknet).

9.2. e-KRISHI VIPANAN

e-Krishi Vipanan project is the e-Agriculture Marketing project of Government Madhya Pradesh, India, conceived and executed for the benefit of farmers and traders. The project is executed by Madhya Pradesh Agricultural Marketing Board, Government of Madhya Pradesh and Madhya Pradesh Agency for Promotion of Information Technology (MAP-IT), on build, own and operate basis with a Consortium of vendors on Public -Private - Participation model to make operations effective and transparent by collecting

and disseminating real time information, on-line and help the concerned stake holders in effective decision making, which will eventually lead to grainless mandis.

9.3. ITC-e-Choupal

ITC's Agri Business Division, one of India's largest exporters of agricultural commodities, has conceived e-Choupal as a more efficient supply chain aimed at delivering value to its customers around the world on a sustainable basis. The e-Choupal model has been specifically designed to tackle the challenges posed by the unique features of Indian agriculture, characterised by fragmented farms, weak infrastructure and the involvement of numerous intermediaries, among others. 'e-Choupal' also unshackles the potential of Indian farmer who has been trapped in a vicious cycle of low risk taking ability - low investment - low productivity - weak market orientation - low value addition - low margin - low risk taking ability. This made him and Indian agribusiness sector globally uncompetitive, despite rich and abundant natural resources. Such a market-led business model can enhance the competitiveness of Indian agriculture and trigger a virtuous cycle of higher productivity, higher income, enlarged capacity for farmer risk management, larger investments, higher quality and productivity.

Appreciating the imperative of intermediaries in the Indian context, 'e-Choupal' leverages Information Technology to virtually cluster all the value chain participants, delivering the same benefits as vertical integration. 'e-Choupal' makes use of the physical transmission capabilities of current intermediaries – aggregation, logistics, counter-party risk and bridge financing -while disinter mediating them from the chain of information flow and market signals. With a judicious blend of click and mortar capabilities, village internet kiosks managed by farmers – called sanchalaks – themselves, enable the agricultural community access ready information in their local language on the weather and market prices, disseminate knowledge on scientific farm practices and risk management, facilitate the sale of farm inputs and purchase farm produce from the farmers' doorsteps.

Real-time information and customised knowledge provided by 'e-Choupal' enhance the ability of farmers to take decisions and align their farm output with market demand and secure quality and productivity. The aggregation of the demand for farm inputs from individual farmers gives them access to high quality inputs from established and reputed manufacturers at fair prices. As a direct marketing channel, virtually linked to the 'mandi' system for price discovery, 'e-Choupal' eliminates wasteful intermediation and multiple handling. Thereby it significantly reduces transaction costs.

'e-Choupal' ensures world-class quality in delivering all these goods & services through several product / service specific partnerships with the leaders in the respective fields, in addition to ITC's own expertise. While the farmers benefit through enhanced farm productivity and higher farm gate prices, ITC benefits from the lower net cost of procurement (despite offering better prices to the farmer) having eliminated costs in the supply chain that do not add value.

Launched in June 2000, "e-Choupal" has already become the largest initiative among all Internet-based interventions in rural India. "e-Choupal" services today reach out to more than 4 million farmers growing a range of crops - soyabean, coffee, wheat, rice, pulses, shrimp - in over 40,000 villages through 6450 kiosks across 8 states (Madhya Pradesh, Karnataka, Andhra Pradesh, Uttar Pradesh, Maharashtra, Rajasthan, Uttaranchal and Tamil Nadu). The problems encountered while setting up and managing these 'e-Choupals' are primarily of infrastructural inadequacies, including power supply, telecom connectivity and bandwidth, apart from the challenge of imparting skills to the first time internet users in remote and inaccessible areas of rural India (Sourse: http://www.echoupal.com).

9.4. EID Parry- Indiagriline

EID Parry- Indiagriline is an attempt to catalyse e-commerce in rural agricultural and non-farm products and provide economic well being to rural areas initiated by EID Parry. Indiagriline provides a network of partnerships which bring commerce, technology and value added information to help expand the choices of rural India and make farming and SME activities a profitable business (http://www.indiagriline.com/english/corp/index.html). Recognizing the significance of information and communication technology (ICT) as a powerful tool for bridging the infrastructure gaps in rural India, EID Parry regarded the Internet as the next logical medium for delivering its farm extension services. Indiagriline is an effort to provide an end-to-end solution addressing the needs of the farming community in South India. EID Parry launched this project in early 2001 by setting up Internet kiosks in 16 villages around its sugar factory in Nellikuppam, Tamilnadu State. These kiosks were called Parry's Corners, and were intended to be business hubs of their respective villages-a one-stop shop that acted as a storefront for buying farm inputs, a market for selling goods, and an Internet café for communication and information services. The strategic goal of the Murugappa Group was to ultimately develop the following capabilities: Distribution infrastructure— this infrastructure would be capable of supporting bidirectional distribution of products and services into and out of rural India. Therefore, developing a

low-cost channel for rural distribution was a key goal; and Trading infrastructure — this would serve as the foundation to a platform for trading agricultural commodities and rural industry manufactured goods. Towards achieving these ends, EID Parry forged and facilitated partnerships among a wide range of organizations, including Tamil Nadu Agriculture University (TNAU) and its research stations, Tamil Nadu University for Veterinary and Animal Sciences (TANUVAS), National Horticulture Board, AMM Foundation, and Murugappa Chettiar Research Center, to create the agriportal Indiagriline.

www.indiagriline.com was developed by using in-house expertise. It fashioned a franchise-based business model to meet the demand for information and connectivity. These kiosks are owned and operated by franchisees trained to operate the system. Although EID Parry covers the cost of establishing the infrastructure for voice and data connectivity, the franchisee also contributes his portion and attends to the operational expenditure of the kiosk. This cooperative relationship builds a win-win situation for both parties involved. Each Kiosk has a corDECT wall set, a PC, printer, telephone, furniture and a power source with a back up. The franchisees can leverage the EID Parry brand name to attract customers to their location for selling products or services. They also benefit from a wealth of knowledge transferred to them by EID Parry on how to successfully manage and operate the Parry's Corners. EID Parry also offers assistance in financing the franchisees through arrangements with third-party lending institutions such as Indian Bank. In a rural setting where literacy rates are low, fear and resistance to technology are high, however, this facility is slowly changing the life of the farmers, who, instead of travelling to the company or other places to get their business done, now walks into the neighbourhood for information.

Farmers can gather information directly from the kiosk or communicate with an agronomist to get specific, customized advice *via* e-mail. The typical turnaround time is a day. Services such as crop diagnostics actually can be performed remotely. The franchisee can use the digital camera to take a picture of the crop to be inspected and e-mail the image to the agronomist. The agronomist then will be able to follow up with his diagnosis. All this can be done without the farmers leaving the village (http://www.eidparry.com/casestudy.asp).

10. TELEPHONE/ MOBILE TELEPHONY

10.1. Farmer Call Centre (Kissan Call Centre)

The Department of Agriculture & Cooperation (DoA&C), Ministry of Agriculture, Govt. of India launched Farmer Call Centres on January 21, 2004

across the country to deliver extension services to the farming community. The purpose of these call centres is to respond to issues raised by farmers, instantly, in the local language. There are call centres for every state which are expected to handle traffic from any part of the country. Queries related to agriculture and allied sectors are being addressed through these call centres. The Farmer Call Centre is a synthesis of two hitherto separate technologies namely, the Information and Communication Technology (ICT) and the Agricultural Technology. Both have their specialized domains and work cultures. To optimally utilize the strengths of both these systems, it was proposed to take full advantage of professionally managed Call Centre mechanism and dovetail it with the specialized Subject Matter Specialists knowledge of Agricultural Scientists and Extension Officers, so as to facilitate its reach to the farming community. It is accordingly proposed to make use of existing specialized infrastructure of Call Centres (which are normally industry-driven and serve to high-end and many a times, mission critical service sector) and make this communication backbone available to the Subject Matter Specialists of Agriculture, Horticulture, Animal Husbandry, Marketing and other related areas. The Farmer Call Centre consists of three levels – namely Level-I (the basic Call Centre interface, with high quality bandwidth and local language proficient Agriculture Graduate), Level-II (Subject Matter Specialists on concerned important crops and enterprises, connected through good bandwidth telecom and computer connectivity) and Level-III (the Management Group to ensure ultimate answering and resolution of all the farmers' queries which are not resolved at Level-II, connected on off line mode).

10.2. SMS Broadcast Service by KVK

The Farm Science Centre (Krishi Viigyan Kendra -KVK), Babhaleshwar, India has pioneered in the IT enabled service aiding instant messaging from Farm Science Centre to individual farmers for extending Agricultural information through SMS alerts. The service comprises sending Short Message Service alerts on cellular phones registered at Farm Science Centres by individual farmers. Weekly SMS alerts are issued on various agricultural developments like weather forecast, disease forecast and market information. The service is also being used as a medium to send information on important trainings and other programmes to the members of the Farmers Clubs and SHG network under the Farm Science Centre. The service is an important milestone in reaching out to millions of farmers at a stroke of a mouse click and enables the farmer to have information access and derive the fruits of technological prowess and face the challenge of an upcoming free market.

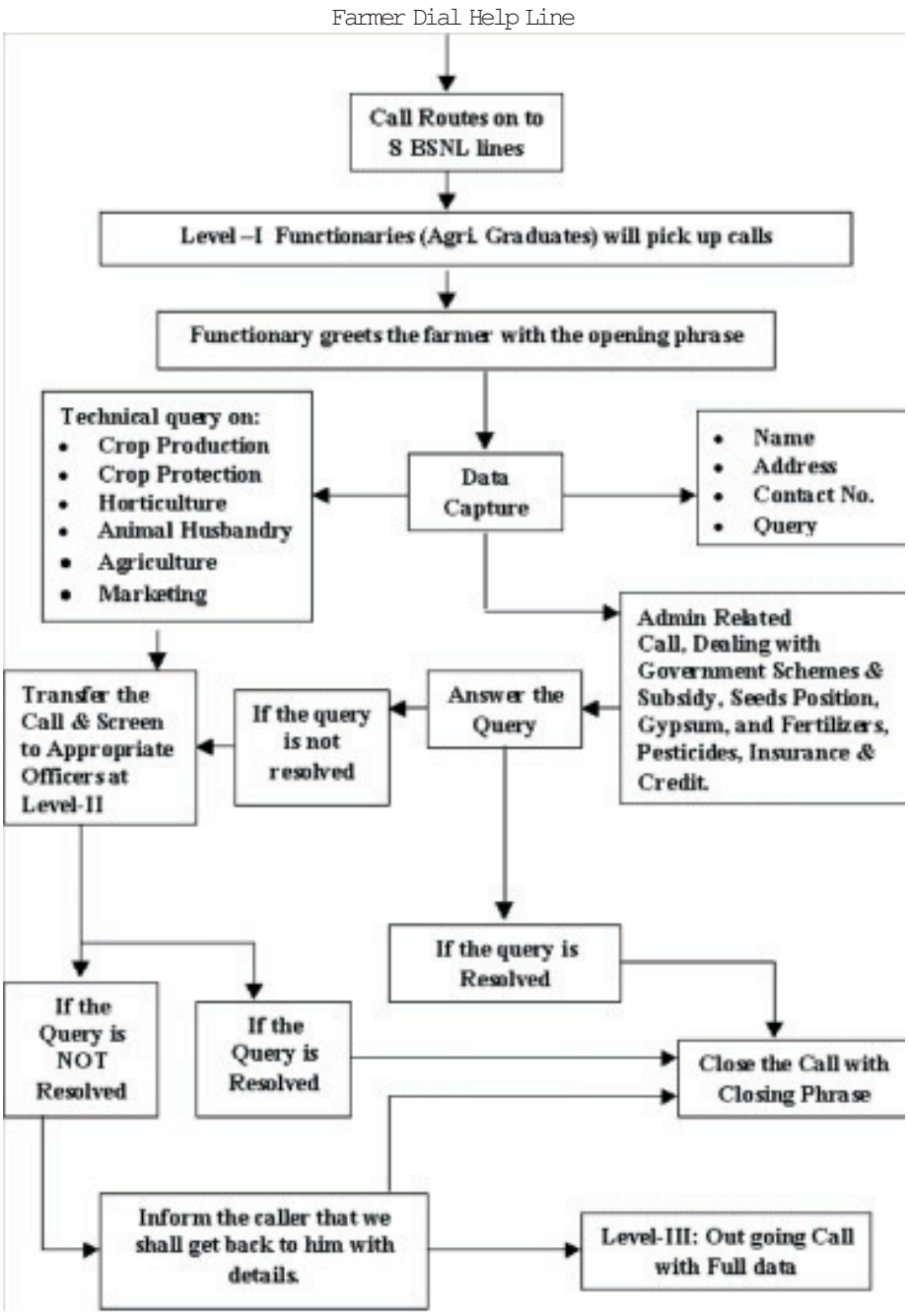

Figure 9 : Schematic Representation of Farmers Call Centre Operational Mechanism
(Source: http://www.manage.gov.in/kisan/Operational_mechanism.htm)

The service is a boon for hundreds and thousands of farmers around the Farm Science Centre within Ahmednagar District. There are currently 241 registered farmers availing this service on payment basis from Farm Science Centre, Babhaleshwar. All registered farmers who are having cellular mobile handsets supporting all major GSM/CDMA networks compatible for Devnagari Unicode fonts within the country can receive the SMSs from Farm Science Centre without incurring any cost. The Farm Science Centre bears all costs of sending the SMS across all the registered farmers having cell phones. In continuation with the efforts of the Farm Science Centre in dissemination of agriculture technological information, the Farm Science Centre have further started the Marathi based SMS text delivery for the cellular handsets users within the District. The vernacular delivery module was commissioned during 2008. The service has been well appreciated by the farmers who have said such a service by the Farm Science Centre is just in the nick of time when farmers have their crops ready for market. The number of farmers coming to the Farm Science Centre is growing day by day and the Farm Science Centre expects to add another couple of hundred farmers by the end of this year (http://www.kvk.pravara.com).

11. ICT INITIATIVES OF CHAMBAL FERTILIZERS AND CHEMICALS LIMITED

Chambal Fertilisers and Chemicals Limited is one of the largest private sector fertiliser producers in India. A dedicated farmer website uttamkrishi.com, farmer helpline- Hello Uttam and mailers such as 'Chambal ki Chitthi' (Letter from Chambal) are important channels to share information with farmers. The web, phone and mobile based extension services such as; Uttamkrishi.com, Hello Uttam and *Via* SMS are offered to the farmers (http://chambalfertilisers.in).

11.1. Farmers' Website – uttamkrishi.com

Chambal set up uttamkrishi.com a website for farmers in the year 2001. It has a bottom-up approach to farming solutions as the website has been designed region wise to address the local issues. Broad information on crops and agronomy has been posted. Farmers can access it free and post queries that are answered by experts.

11.2. Farmers' Helpline – Hello Uttam

Telephonic help lines called "Hello Uttam" have been set-up. Farmers can raise issues over phone by calling one of the local numbers of "Hello Uttam" helpline. Information about the help line is widely circulated; and for

areas where the help line is not operational, the farmers are urged to seek clarity from Department of Agriculture, Govt. of India's Farmers' Call Centre facility.

11.3. Mailers and AVs

Chambal is particular on proper dissemination of information. For that it has a quarterly mailer "Chambal ki Chitthi" that is hand-delivered to every Uttam Bandhan farmer. It contains valuable farm related information on activities pertaining to that quarter. Handouts, leaflets, farm calendar, farmer diary, *etc.,* are distributed extensively. It arranges radio talks, AVs and programmes on Doordarshan for the information of the farmers (http://chambalfertilisers.in/cfcl.asp).

12. ICT INITIATIVES OF NGO

12.1. DHAN Foundation

Development of Humane Action (DHAN) Foundation, a professional development organisation, was initiated on October 2, 1997. DHAN Foundation has taken up Information Technology for poor as a new theme with the following objectives: making information technology accessible to poor by developing relevant schemes through research and pilot activities and collaborating with research and academic institutions on e-governance and computer education at schools in rural areas. As part of the programme, internet kiosks in the rural areas as well as urban slums are set up through which services such as computer education, e-mail, ePost, agricultural market intelligence, *etc*., are rendered (http://www.dhan.org/themes/itforpoor.php).

12.2. ISAP - Indian Society of Agribusiness Professionals

12.2.1. ISAP- Community Technology Learning Centres (CTLCs)

Indian Society of Agribusiness Professionals (ISAP), a non-governmental professional society- with support of Microsoft - Unlimited Potential Programme has established 'Community Technology Learning Centres (CTLCs)' in remote villages of Maharashtra to provide IT training to 450 00 farmers and unemployed youth. Under two-year programme, ISAP would be setting up 250 CTLCs at village level for imparting IT training to rural community and increase their income earning potential.

ISAP is working on online weekly price monitoring system of herbal and medicinal plants with the funding support of National Medicinal Plant Board. ISAP gathers and manages authentic data about the weekly price and demand for 101 medicinal plants from 50-marketing centers in different states of the

country. These data are weekly upgraded on the basis of prices and quantity offered for different medicinal plants (ISAP, 2008).

12.2.2. ISAP- Query Redress Services (QRS)

Transfer of technical and scientific knowledge to the farmers is one of the primary functions of ISAP. QRS enables ISAP to provide solutions to farmer's queries pertaining to agricultural practices, problems, productivity improvement, scientific farming and improved technology for production to farming community. ISAP is running a query redress services (QRS) funded by One World South Asia (OWSA). The queries are received *via* electronic mail, by post and through telephone and responded within 24 hours. Currently ISAP receives more than 300 queries per day from farmers of Himachal Pradesh, Madhya Pradesh and Uttar Pradesh farmers, where it runs this service (ISAP, 2008).

12.2.3. ISAP- Community Radio Stations (CRS)

Timely availability of reliable information is the key to achieve sustainable food production and mitigate risks. Toward this community radio stations will act as an effective tool of communication and create platform to share experiences, perspectives and innovations to increase yield and reduce labour. ISAP has been identified as one of seven organizations in the country to establish community radio station (ISAP, 2008).

13. EXPERT SYSTEMS, DECISION SUPPORT SYSTEMS, CDs AND OTHERS

13.1. Agricultural Decision Support System by Agro-Climate Planning and Information Bank (APIB)

A pilot project to create "Single Window Agricultural Knowledge Base" was initiated at Regional Remote Sensing Centre, ISRO, Bangalore, India during mid 1990's. As a part of project, user needs assessment, spatial data and non-spatial data were collected. Based on the information collected, 17 agricultural decision support modules were developed and deployed in the selected three district level offices of the Department of Agriculture and Horticulture for field testing in three districts of Karnataka State of India. However, case study revealed that there was a lack of conceptual inadequacy and lack of skill to use modules among the extension officials, infrastructure inadequacy to deploy larger area and hence the modules were not used as expected (Saravanan, 2002).

13.2. Expert System on Pests and Diseases of Major Crops in Andhra Pradesh

Software has been developed with user-friendly menus using VB.net a relational database management system for information retrieval, and it has been used as a diagnostic tool to speed up decision making in identification and recommendation of control strategies of major pests and diseases on the spot. This is the most effective extension tool to take the technology from the scientists to the farmers directly without any dilution of the content which normally creeps in because of the number of the agencies in normal technology transfer systems. Using this system, farmers, scientists, extension workers and researchers can identify the pest or diseases within a short time and effective decision making can be taken up to manage the problem. This software has the unique provision to store the data by embedding the picture in the database itself. It can play a vital role in the maintenance and monitoring complete details of the pests and diseases (Ravishankar *et al.,* 2006).

13.3. Pesticide Advisor (Verson 2005.1.0): An Expert System for Judicious use of Pesticides for Management of Pests

The pesticide advisor software works as a simple interactive decision making tool providing a choice of recommended curative as well as preventive pesticides as per the recommendations of the central insecticide board and registration committee, Government of India to manage key pests, in major crops. The different modules, which are in the software, are as follows; pesticides complete details, pesticides recommendation, pesticide selection criteria, field use rating, pesticides quantity calculator, pesticide delivery system, data on bio-pesticides, safety measures, pesticide manufacturers, pesticides scenario and pesticides general information (Amerika Singh *et al*., 2006).

13.4. Vasundhara: Software for Soil and Water Test Based Nutrient Recommendations by KVK Ahmednagar, Maharashtra

The KVK has successfully demonstrated the use of ICT in disseminating improved agricultural technologies in rural areas under its Cyber Extension Programme. The KVK pioneered the pest and disease forewarning through its SMS based alert system to the registered users. A number of technology CDs has been developed on crops, livestock and other agri-enterprises for use by the farmers. It also developed software called 'Vasundhara' for soil and water test based nutrient recommendations and also released CDs on statistical information and FAQs on farmer's needs and problems. The KVK suggested

providing facilities for automatic weather station, infrastructure for market intelligence, quality assessment and certification (Sajeev, 2009).

13.5. TCS - mKrishi

mKrishi is a mobile-based crop advisory service. The application provides personalized information and expert advice to rural farmers, and runs on Tata Indicom's Code Division Multiple Access through network, and it uses various applications including sensors, camera phones, and Global Positioning System technologies. Through mKrishi, farmers get answers to queries related to agriculture, such as advice on use of fertilizers, pesticides and growth hormones. It also provides up-to-date weather and market information through text messages on cell phones. Services such as assistance with crop insurance, loan services, rural yellow pages and government policy information will be included in a phased manner. The mKrishi application can be customized in farmers' local languages, both text and voice. Currently the application runs as pilot project in four villages and few hundreds of farmers each holding an average of three to four hectors of land. The service includes weather and soil sensors for these villages (www.tcs.com; http://satellite.tmcnet.com/topics/satellite/articles/41495-tcs-mkrishi-earns-wall-street-journal-it-award.htm; Pande and Arve, 2009).

13.6. Digital Data Banks - Agricultural Planning and Information Bank (APIB)

APIB, an agricultural digital data bank was a joint project developed for the East Khasi Hills District of Meghalaya State of India by the North Eastern Space Applications Centre (NESAC) in collaboration with the Department of Agriculture, Government of Meghalaya, India. It is a single window access to information related to agriculture and allied sectors useful for the farmers, extension personnel and planners. It contains information modules on natural resources, Package of Practices for 25 crops, Soil Crop Suitability, Integrated Plant Protection (12 crops), Varietal Selection (16 crops), Post Harvest Information (8 crops), Agro-meteorological Services, Food Processing, Fertilizers, Farm Machinery & Hand tools, Allied sectors & occupations, Soil conservation and Forestry, Water resources, Micro Credit and Self Help Groups. Natural resources module provides block-wise details of the Land Resource Development Plan (LRDP), current Land Use Practices, Soil Type map, Ground Water Prospective map and Watershed map. Extension officials can also use this module. Package of practices are provided in both standard and comprehensive versions. This module provides the correct version for each of the major crops. Integrated plant protection provides vital and

practical information necessary for pest and disease prevention, control and mitigation. Integrated approach encompassing cultural, mechanical, biological and chemical methods have been considered. Harvest and post harvest module provides crop-wise information on traditional storage devices, such as harvest tips, post harvest handling and processing. Allied sectors gives information on Animal Husbandry, Fisheries, Sericulture and other non farming activities essential for the farmers of this region (http://megapib.nic.in/about_apib.htm).

14. VALUE ADDED SERVICES

14.1. IFFCO Kisan Sanchar Ltd.

Bharti Airtel Limited, India's leading integrated telecommunications services provider, and Indian Farmers Fertiliser Cooperative limited (IFFCO) launched a joint venture company IFFCO Kisan Sanchar Limited (IKSL), that is set to provide a major boost to Indian agriculture and the rural economy at large during 2008. The joint venture company will harness the power of telecom to add value to the farm sector and empower the rural farmer by giving him access to vital information, which will enhance his livelihood and quality of life. Innovative telecom products and services, especially created for the farming community, will enhance their productivity and play a bigger role in India's growth story. The Indian farmer can now look forward to the benefits of mobile telephony and mobile internet through this initiative. Synergizing on IFFCO's presence in about 98 per cent of villages throughout the country, Airtel would use IKSL as a vehicle to make its mobile telecom services reach the rural masses (IFFCO, 2008). IFFCO Kisan Sanchar Ltd. is, therefore, a unique venture to strengthen the Cooperative movement in rural India, to empower the farmers through information, to boost the rural economy, and also to create rural employment. IKSL will offer products and services, specifically designed for farmers, through IFFCO societies in villages across the country. On offer will be affordable mobile handsets bundled with Airtel mobile connection. The farmers will also get access to a unique VAS platform that will broadcast 5 free voice messages on mandi prices, farming techniques, weather forecasts, diary farming, animal husbandry, rural health initiatives and fertiliser availability *etc*. on a daily basis. In addition, the farmer will be able to call a dedicated helpline, manned by experts from various fields, to get answers to their specific queries. This is expected to promote community building within the society and rural community at large (http://www.iffco.nic.in).

14.2. BSNL- Mandi on Mobile Service

Uttar Pradesh State farmers are able to know rates of agriculture commodities in any market in the State on their mobile phones, service was launched by the State-run telecom major Bharat Sanchar Nigam Ltd (BSNL) teamed up with the Uttar Pradesh Agricultural Marketing Board (Mandi Parishad) to launch the 'Mandi on Mobile' service for the farmers (Manoranjan, 2009). The service would be voice-based. To know the rates of over 100 commodities including crops, vegetables and other items, the farmers need to dial specific number from their BSNL cellular phones and follow the voice command subsequently. The service would immensely benefit the farmers, especially those who used to sell their agriculture produce to middlemen at low prices without knowing the market rates (IANS, 2008).

14.3. Nokia Life Tools

Nokia Life Tools is a range of services which includes Agriculture, Education and Entertainment services designed specially for the consumers in small towns and rural areas of the emerging markets. The service provides timely and relevant information customized to the user's location and personal preferences directly on their mobile phones. Nokia Life Tools Agriculture services aim to plug the information gaps and needs of farmers, by providing information on seeds, fertilizers, pesticides, market prices, and weather (temperature, rainfall, wind conditions) *via* their mobile phones. Information on weather, agriculture tips and techniques, as well as market prices are provided to improve farmers' productivity and earnings. Farmers are empowered with tailored and reliable information in synch with the cropping cycles delivered regularly to their mobile phone (http://www.nokia.co.in/explore-services/nokialifetools).

14.4. Fisher Friend Project

QUALCOMM, M. S. Swaminathan Research Foundation (MSSRF), Tata Teleservices and Astute System Technology were collaborated to develop a BREW-based mobile application, which empowers fishing communities in India. Fisher Friend is a mobile application, which is based on QUALCOMM's BREW solution and works on 3G CDMA and WCDMA handsets. The new application allows fishing communities to use ICT and wireless technology to earn their livelihood. Fishermen can send request form from menu-driven client software on the mobile phone. Fishermen can access vital updates on opportunities, risk and market information in their local language. Presently, the application is implemented in the coastal areas of Tamil Nadu, India.

Fisher Friend project aims to be extended in other communities in the coastal belts of India (News-i4d, 2009).

14.5. Rubber Board, India- Market Price by SMS

The Rubber Board provides the update of both national and international rates of natural rubber through SMS throughout the country by the rubber farmers and dealers in India (especially Kerala State of South India) are tracking the prices of the commodity real time by SMS. The growers are helped by a service by the Rubber Board which through SMS updates the farmers with rates in the global as well as domestic markets, which is also displayed in the Rubber board's web portal (www.rubberboard.org.in).

14.6. SMS Service to Farmers by the Department of Agriculture, Haryana State

Farmers of Chandigarh (India) are using mobile phones to sort out agricultural related problems. The Haryana Agriculture Department has introduced short messaging service (SMS) for farmers. The service was available by the agriculture department's Kissan (Farmer) call centre. More than 800 farmers had sent their queries through SMS service and replies had been sent by officials' concerned and agricultural scientists. The free of cost SMS service is available to farmers on mobile number (News-i4d, 2007).

15. ICT INITIATIVES BY THE NATIONAL AGRICULTURAL INNOVATION PROJECT (NAIP), INDIAN COUNCIL OF AGRICULTURAL RESEARCH (ICAR)

The World Bank aided National Agricultural Innovation Project (NAIP) has been conceived to pilot this innovation in conducting agricultural research. The projects which have policy relevance to the ICTs for Agricultural extension are mentioned below and these projects are under progress. Through these pilot projects, the policy recommendations, well-tested models for digital knowledge repository and dissemination of information to the farm stakeholders are expected during the year 2011-12.

15.1. Re-designing the Farmer-Extension-Agricultural Research-Education Continuum in India with ICT-mediated Knowledge Management

Through this project, a consortium of partners from the agricultural research and education sector and ICT for development area will work together

to organise a national pilot project. They will develop new and revived linkages between research and education sectors with agricultural extension, through the use of ICT mediation and contemporary practices in knowledge and information management. The engagement with farmers will be through online as well as offline methods. The emphasis is on providing information support services to the extension personnel and farmers in a seamless fashion. This integration of back-end digital services to generate an access and delivery system for different stakeholders in online and offline modes is at the core of this action-research effort (source: http://www.akmindia.in).

As a part of this pilot project, developing "agropedia" aims to develop a comprehensive digital content framework, platform, and tools in support of agricultural extension and outreach. In other words, it aspires to be a one stop shop for any information, pedagogic or practical knowledge related to extension services in Indian agriculture – an audiovisual encyclopedia, to enchant, educate and transform the process of digital content creation and organization completely (Source: http://agropedia.iitk.ac.in/?q=content/welcome-agropedia-2).

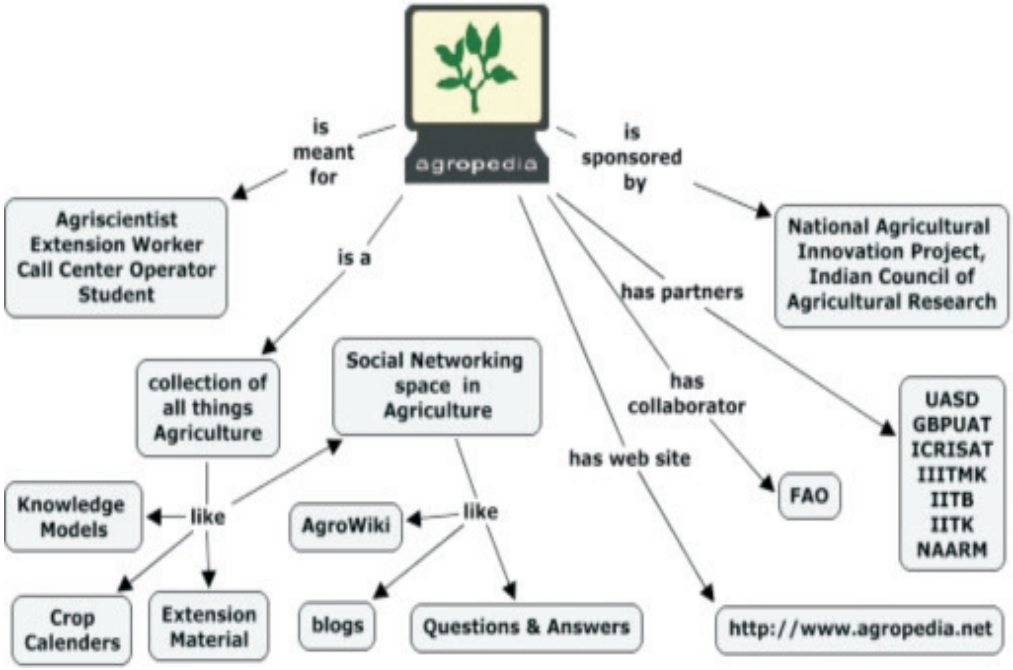

Figure 10 : Schematic Representation of Agropedia– A Comprehensive Digital Content Framework

15.2. Development of a Set of Alternative ICT Models Based on a Study and Analysis of the Major ICT Initiatives in Agriculture in India to Meet the Information Need of the Indian Farmers

The project will study the effectiveness and impacts of the various existing ICT based knowledge dissemination systems for the farmers in India and propose ways to make the systems more effective, with deeper and more extensive impact to fulfil the need of various stakeholders. The project proposes to undertake assessment of the major ICT initiatives in agriculture vis-à-vis the need of the farmer in various agro socio-economic situations and suggest a set of alternative ICT models based on the assessment for the major situations (http://www.naip.icar.org.in/downloads/C30012.pdf). The NAIP's other ICT's for Agriculture intiatives are;

15.3. AGROWEB - Digital Dissemination System for Indian Agricultural Research (ADDSIAR)

15.4. e-Publishing and Knowledge System in Agricultural Research

15.5. Developing a Decision Support System for Agricultural Commodity Market Outlook

15.6. Development and Maintenance of Rice Knowledge Management Portal

15.7. Establishing and Networking of Agricultural Market Intelligence Centres in India

15.8. Decision Support System for Enhancing Productivity in Irrigated Saline Environment using Remote Sensing, Modelling and GIS

15.9. Strengthening of Digital Library and Information Management under NARS (e-GRANTH)

15.10. Mobilizing Mass Media Support for Sharing Agro- Information

(Sourse: http://www.naip.icar.org.in; Yaduraju *et al.,* 2009)

16. IMPACT OF ICT PROJECTS

Systematic and comprehensive impact studies on application of ICTs for agricultural extension are not available. However, Gandhi *et al.,* (2008) indicated that the Digital Green project increased the adoption of certain agriculture practices seven-fold over a classic extension approaches. Digital Green project was shown to be ten times more effective per dollar spent. Further, 85 per cent of adoption of improved technologies achieved as against 11 per cent of adoption by traditional extension methods. Similarly

Krishnareddy and Ankaiah, (2005) reported that deploying e-Sagu prototype increased income of the farmers for the tune of INR. 3075 (63 USD) per ha and also reduced the pesticide usage. Further, their rudimentary estimate of economic advantage indicated that if the e-Sagu prototype used for 1000 farmers, overall net benefit with the proposed ICT based system is INR 100 Million (USD 204800). Saravanan (2008) reported the cost and time indicators comparing traditional extension system and e-Arik (e-agriculture) project, sixteen fold and three fold less time were required to the clientele availing and extension system delivering extension services, respectively. He further reported that 3.4 fold economic benefit as compared to the expenditure of deploying e-agriculture prototype. Interestingly, Ganghi *et al.,* (2009) reported positive social side effects and other qualitative results of Digital Green project on participatory video for agricultural extension.

17. LESSONS FROM ICTs FOR AGRICULTURAL EXTENSION PROJECTS

Keniston (2002) stated that "At least fifty grassroots projects are currently using modern ICT for development in India. Surprisingly, these projects have rarely been studied. No comparisons have been made between them. They are seldom in touch with each other. Lessons learned in one project are not transmitted to others. Appropriate technologies are rarely evaluated. Central questions of financial sustainability, scalability and cost recovery are hardly ever addressed. So, opportunities to learn from the diverse, creative Indian experience so far remain almost entirely wasted". Even after experimenting hundreds of ICT projects for rural development in the last one decade, observations mentioned above are still very much relevant; and also preliminary hypotheses on Grassroots ICT projects in India by Keniston (2002) are yet to be tested fully. However, with the available literature and author's personal experience in implementing e-Arik (e-Agriculture), e-village and e-Kiosk (Touch screen kiosk for farm technology transfer) projects and literature review, the following lessons were drawn.

1. *Pilot Project Syndrome*: Most of the ICT based Agricultural extension projects were implemented as "Pilot Projects"; and after the pilot period, most of the projects are never implemented in larger scale. Efforts for continuance of pilot projects are not taken sincerely by the implementing and also funding (Donor) agencies.

2. *Users Unwilling to Pay:* Most of the ICT for Agricultural extension projects beneficiaries (generally farmers) are not willing to pay for the services they receive. Similar to most developing countries farmers, in India also

most farmers feel that "agricultural advisory services" are welfare activity of the State and National Governments. And hence, they are unwilling to pay for the services.

3. *Small Scale of Operation:* The ICTs for agricultural extension projects were implemented in very limited geographical area and covering few hundreds or at maximum thousands of farmers. Exceptionally, few projects like farmers call centres and e-Soil Health Card Programme covers entire country and Gujarat State, respectively. And few web portals are developed for larger farm stakeholders (AGMARKNET, InDG, e-Krishi). However, continuous updating and maintaining web portals require sufficient resources, which are lacking after few years.

4. *Islands of Learning:* In almost all the projects, the participation of agricultural education, and research institutions appears to be marginal (Balaji *et al.,* 2007). Most of the projects do not have collaboration with other farm research and extension stakeholders. Practical challenges or constraints in implementing the ICT projects are seldom disclosed and shared with others. Learning experience of one project to another project is seldom shared.

5. *Lack of Systematic Evaluation:* Most of the projects never revealed actual evaluation results, Generally they report 'positive' results, and most common difficulties such as; inadequate rural ICT infrastructure (especially frequent power-cuts) and difficulty in content localisation and customisation were indicated. Systematic and objective evaluation or impact of the projects was seldom done. Similar type of projects, with little modification, was implemented in isolated manner. Except few projects, large number of projects evaluation results were never published or communicated.

6. *Knowledge Middle Men with Less Permanency:* Most published projects are from educational/ research institutions, which generally, ignored traditional extension system and extension personnel, those who are serving over a long period in rural India. They implemented time bound ICT projects and hired "facilitators"/ "intermediaries". Once, project completes stated objectives and targets, facilitators also disappear along with the project. In this regard, Digital Green used the services of the public extension personnel. Even, if project winds-up the learning took place among extension personnel will be remain for a longer time and more useful to the farmers. In e-Arik case, public extension personnel are unwilling to collaborate with the ICT project, because of most of the field level extension personnel never used internet and lack of skill in

using other ICTs. However, Subject Matter Specialists from Farm Science Centre (KVK- Krishi Vigyan Kendra) was willingly collaborated with the e-Arik project (Saravanan, 2008).

7. *Information is Not Ultimate :* Along with ICT based advisory services, input supply and testing need to be integrated for the greater impact (Balaji *et al*., 2007). In e-Arik project of North-East India, farmers demanded inputs as per recommendations of the project research fellows.
8. *Virtual Seeing is Not Believing :* The e-Arik (e-Agriculture: ICTs for Agricultural Extension) project was implemented in most backward area of North-East India; experiences indicated that advisory services and information alone were unable to convince the farmers and they demanded field level demonstrations.
9. *Difficulty in Localisation of Content :* Content need to be aggregated from different sources but it needs to be sorted in granular format for rapid adaptation for local use. Localisation and customizability of content are still are not practiced on a significant scale (Balaji *et al*., 2007). If sufficient scientific information is not available, content need to be generated, tested, refined and used for further advisory services through ICTs. Most of the web portals lack relevant content in local language.
10. *Lack of Co-ordination :* In the absence of collective and coordinated efforts by the public-private agricultural research and extension institutions, ICTs have not penetrated satisfactorily in rural India despite time, money and efforts invested so far (Patil *et al*., 2009).
11. *Limited ICT Infrastructure :* Planning Commission of Government of India report (2005) indicated that still 10 per cent of villages yet to get electricity. Further, State wise village electricity coverage varies from 100 per cent (in Punjab State) to 26 per cent (in Jharkhand State). Household wise electricity varies from 94.80 (in Himachal Pradesh State) to 10.30 per cent (in Bihar State). Rural tele density is 9.03 (telephone subscribers per 100 individual). Only 1.2 per cent people have internet access in rural India and rural mobile penetration remains 4.92 per cent. Computer and internet access is difficult task for rural farmers, even though rural tele-centres (Village knowledge centres, village resource centres, common service centres *etc*.,) are taken-up on a massive scale by the national government, developmental institutions and private sector.

18. THE WAY FORWARD

1. *National and State Governments e-Agriculture Policy* **:** National and state e-Agriculture policy need to be formulated. It should explore and outline

the possibilities of leveraging ICT for the Agricultural Extension.

2. *Human Resource Development*: Creating awareness on ICT potentials, ICT using skill and capacity development among the extension personnel of the public and private extension systems and also among farmers and other stakeholders in the extension systems.
3. *Strengthening ICT Infrastructure*: Extension organisations need to be equipped with ICTs.
4. *Localisation and Customisation of Content*: Research, educational institutions and extension systems should continuously strive for the appropriate content localisation and customisation as per the demand of the farmers and other stakeholders.
5. *Integration of ICTs with Public-Private Extension System*: Appropriate ICTs to be identified and deployed in the extension system to complement ongoing extension efforts.
6. *Research and Farm Developmental Institutions Collaboration*: Establishing strong working collaboration among the ICT initiatives of the research and developmental institutions such as; Indian Council of Research (ICAR), National Informatics Centre (NIC), Centre for Development of Advanced Computing (C-DAC) and Ministries of Information Technology & Communications, Agriculture and Co-operation, Rural Development. The leading research and educational institutions in agricultural and information technology should join together to leverage ICT penetration for agricultural extension and they should also guide the other ICT initiatives in rural India.
7. *Convergence of Communication Methods*: For effective agricultural extension service delivery, the convergence of traditional extension communication methods (personal contact methods, print media, radio and TV) and new ICTs are to be appropriately used to reach farm stake holders.

In India, during the last one decade, hundreds of Grassroots ICT projects are implemented. Invariably, agriculture becomes one of the indispensable parts of the project service menu. However, we yet to get substantial results in increase of agricultural production because of deployment of ICTs. Most projects are implemented in smaller geographical area and covering few hundred farmers and hence, drawing generalisations may not appropriate. Much hyped ICT projects are yet to make any break through in agricultural information dissemination. Even though, ICTs are promising to make difference

and also accelerating information access by some farmers, but, most of the ICT practitioners in agriculture are over excited. Author's personal experience shows that "ICTs are not going to supplant traditional extension system and it can play only complementary role". ICTs for agricultural extension projects need to be compared and evaluated objectively. At the same time, experiences are indicating that ICT are going to play greater role in private sector agribusiness, market information and market intelligence. Further, certain type of farm information (*e.g.* Informing government schemes) and online monitoring of the progress of the governmental schemes are proved successful. Hence, it is high time to find out appropriate information to provide through ICTs. As indicated earlier, formulating National and State level e-Agriculture policy, human resource development, strengthening ICT infrastructure, localisation and customisation of appropriate content are to be taken-up to harvest the benefits of ICTs for agricultural extension services provision and agricultural development.

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