

**An Innovative ICT approach to evaluate and enhance delivery of Government of Tamil Nadu
advisory messages to farmers**

Ashok Jhunjunwala

Department of Electrical Engineering
Indian Institute of Technology Madras (IIT Madras)
Chennai, India
ashok@tenet.res.in

Jayalakshmi Umadikar, Suma Prashant

IITM's Rural Technology and Business Incubator
(RTBI)
Chennai, India
jaya@rtbi.in, suma@rtbi.in

ABSTRACT

Over 52% of India's population depends on agriculture but generates merely 13.9% of its Gross Domestic Product (GDP). With fragmented landholdings, the number of independent farmers has risen to 88 million with near-stagnant productivity. Despite the Central and State Governments initiating many reforms in agricultural extension in India, there continue to be serious information gaps between farmers, extension workers and agricultural scientists. In the state of Tamil Nadu, small and marginal farmers have a share of more than 90% of the 8 million total land holdings. And it is these farmers who still find it difficult to access quality information when they need it the most. The Government of Tamil Nadu, with the aim of providing farmers the latest farming and crop-related information using ICT tools, has launched a service to relay agricultural advisories by means of a 'PUSH' voice-message to farmers in five delta districts. A mechanism of gaining feedback on different aspects of this service was embedded in the 'PUSH' messages itself. The paper presents how such a technique adds to the agility of service-delivery and improves the service even while it is being deployed. The results indicate that ICT does have a transformative potential – empowering farmers to convey feedback in real-time and enabling the Government to respond in a timely manner based on the feedback. At a broader level, whether evaluation, feedback and modification can be made part of the ICT service delivery itself, enabling better-targeting and better delivery of services, is discussed.

INTRODUCTION

The contribution of agriculture to the overall Gross Domestic Product (GDP) of India has been falling rapidly and has gone down from 30 percent in 1990-91 to a mere 13.9 per cent in 2012 (State of Indian

Agriculture, 2011-2012). Yet, the agriculture sector remains the backbone of our country as it employs 52% of its workforce. Indian farmers, particularly, small and marginal ones, currently face a variety of challenges – fragmentation of land into small holdings, limited land and water availability, effects of climate change that include but are not limited to new pest and disease outbreaks, new demand and consumption patterns, liberalization of trade as well as a move towards high-value agriculture (Claire J. Glendenning, 2010). Lack of quality information at multiple levels has prevented many of these farmers from increasing their productivity and profitability. Information gaps exist in terms of what and where to buy much-needed inputs, how does one overcome stunted growth and disease outbreak, when and where to sell the produce as well as how and where to get information about financial services, transport and local weather. In the state of Tamil Nadu, small and marginal farmers have a share of more than 90% of the 8 million total land holdings (Department of Evaluation and Applied Research, 2008-2009). And it is these farmers who still find it difficult to access quality information when they need it the most. Experts agree that there is a strong need today to align the information that is being delivered through various extension approaches with the needs of farmers, their existing experience and knowledge base, by personalizing the information that is being delivered to them. Considering that there are around 88 million farmers in India, with 98.5 million holdings (operating an average area of 1.1 hectare) (National Sample Survey Office - Survey Finding - 59th Round), speaking some 20 different languages and many more dialects, dispersed geographically in 630,000 villages (Census Reference Tables - Number of Villages), it is not surprising that extension approaches fail to do so.

In such a scenario, it was conceived that Information and Communication Technology (ICT) could play a significant role in overcoming the current shortcomings in Indian Agricultural Advisory Systems.

(Jhunjhunwala, Umadikar, Prashant, & Canagarajah, 2013) (Chhibber, 2004)

ACCESS TO ICT – THE MOBILE REVOLUTION

Before looking at ICT solutions, it was important to assess what kind of reach ICT had amongst farmers.

In 1994, India had less than ten million phones and was not adding more than 10 million phones a year. A combination of wireless telephony, better signal processing and innovations from Indian telecom

operators changed the picture dramatically (Jhunjhunwala & Ramamurthi, *Wireless in Local Loop: Some Key Issue*, 1995). The costs of telephony were brought down significantly and 2G GSM (Global System for Mobile Communications) and GPRS (General Packet Radio Service) networks mushroomed throughout the country, including a large number of villages. With these networks offering robust voice connectivity and with the prices of mobile handsets also dropping significantly, most farmers can now afford a cell phone. India, today, has over 900 million users with close to 300 million rural subscribers (Telecom Regulatory Authority - Highlights on Telecom Subscription Data). Further, farmers are fairly comfortable with voice telephony, limited data handling (such as SMS), as well as using a camera and sending pictures using MMS (Multimedia Messaging Service).

The other challenge before ICT solutions is that most farmers are either illiterate or semi-literate. Though they are capable of taking and sending pictures, they find it difficult to handle and interpret text/data information. They are most comfortable when the rest of the communication takes place in the local language, using voice. It is imperative therefore, that any agricultural advisory provider takes these realities into account.

This paper will demonstrate the power of two-way voice services over mobile phones today, which when combined with innovative methods, can serve to deliver information as well as seek feedback. We will do this in the context of the efforts of the Department of Agriculture, Government of Tamil Nadu to deliver agricultural advisory voice messages directly to the mobile phones of farmers of five delta districts through a 'PUSH'¹ mechanism. The next section will present an overview of some of the current services delivering agricultural advisory messages to farmers after which we present the background to our work followed by the research methodology and summary of findings. We discuss extensively the potential and challenges of using voice technology to obtain and implement feedback, and finally we present the conclusion.

OVERVIEW OF MOBILE AGRICULTURAL ADVISORY SERVICES

¹ Typically, a user will 'PULL' in information as and when needed from information providers. In contrast, a new 'PUSH' approach depends on the service provider (Government and non-Government) pushing information to the user without a specific request for each item, after the user has registered with the provider and indicated willingness to receive such information.

In India, mobile phone users have increased from fewer than 37 million users in 2001, to over 900 million users in 2012 with close to 300 million rural subscribers (Telecom Regulatory Authority - Highlights on Telecom Subscription Data). As mentioned earlier, farmers can now afford a cell-phone and are comfortable communicating over the phone in their local language. The potential of mobile technology in serving the more vulnerable, less-empowered and often dispersed users, has been extensively discussed (Sharma, May 2010) (Thompson, August 2008) (Hellstrom, 2009) (India: The Impact of Mobile Phones, 2009). In recent years, it has also been recognized that mobile technology makes it possible to deliver timely, relevant, and quality information to farmers with fewer resources than any traditional service. Some agricultural advisory services that have tried to capitalize on the mobile boom are –

- **Reuters Market Light (RML)** (Reuters Market Light) (Thomson Reuters: Removing Barriers to Growth in Agriculture, 2011): Reuters Market Light (RML) promoted by Thomson Reuters was initiated in 2006. It provides highly customized and localized agricultural information services via mobile phone based Short Message Service (SMS) primarily for RML subscribed farmers, in 8 local languages.
- **Nokia Life Tools** (IBS Center for Management Research, 2009): Nokia Life Tool was launched by Nokia India Private Limited in 2009, in Maharashtra, later expanding to provide agricultural information through SMS, to customers in 18 Indian states, covering 11 Indian languages - English, Hindi, Oriya, Gujarati, Bengali, Marathi, Punjabi, Telugu, Tamil, Kannada and Malayalam. The services are subscription oriented, where one pays a monthly fee and some are chargeable on a per download/request basis.
- **Intuit Fasal** (Intuit Fasal) (Improving Earning Capacity of Farmers: Case of Fasal by Intuit Labs, 2012): Intuit Fasal, started in the year 2009, aims to deliver personalized messages through SMS in the local language to farmers. Currently operational in Gujarat, Andhra Pradesh and Karnataka, the service allows farmers to contact a toll free number and register their profile. Based on this profile, the service attempts to deliver personalized market information to the farmer in an effort to directly connect him/her to a buyer/agent/institution.

(A quick point to be made here is that the above mentioned services use SMS as a medium of information delivery; it remains to be seen how these services will reach out to the largely illiterate or semi-literate farmers.)

- **IFFCO Kisan Sanchar Limited** (IFFCO Kisan Sanchar Limited) (Narula, Sikka, Singh, & Chawla, June 2012): Started in the year 2007, IFFCO Kisan Sanchar Limited offers the following services to farmers from 18 states–
 - 5 free voice messages every day on areas of interest to rural subscribers. Messages are prepared by subject matter experts; Content Managers trim it down to one minute lengths; Panel of eminent scientists monitor the quality
 - Dedicated helpline for query resolution by Experts-Conference Calling available
- **Avaaj Otalo** (Patel, Savani, Klemmer, & Parikh, 2012) : Avaaj Otalo is a service for farmers to access relevant and timely agricultural information over the phone. This service was designed in the summer of 2008 as collaboration between UC Berkeley School of Information, Stanford HCI Group, IBM India Research Laboratory and Development Support Center (DSC), an NGO in Gujarat, India. By dialling a phone number and navigating through simple audio prompts, farmers can record, browse, and respond to agricultural questions and answers.
- **mKrishi** (mKrishi: A Rural Service Delivery Platform) (Tata Consultancy Services: Providing Advisory Services to Indian Farmers, 2012): mKrishi is a mobile platform, launched in 2009, that allows a farmer to send queries in the form of text, voice or images to the system; the expert will analyse the query based on the farmer profile and the advice/information is delivered to the farmer's mobile. Since then, 12 additional mKrishi pilot projects have been introduced in the Indian states of Punjab, Uttar Pradesh, Maharashtra, Gujarat, Andhra Pradesh, Tamil Nadu and Rajasthan. Today, mKrishi serves about 10,000 farmers in all markets.
- **ITC's Namma Sandesh** (ITC launches interactive mobile telephony for tobacco farmers, 2012): ITC has recently launched '*Namma Sandesh*' – an interactive mobile telephony based communication service to tobacco and ragi farmers for provision of crop advisory on best agronomy practises, market prices, weather forecast and local news to farmers. Started on a pilot

basis in Mysore district of Karnataka, the voice messages are in Kannada and are personalised to each farmer – only messages specific to the farmer's crop cycle reach him/her.

The success of advisory voice messages, which are delivered as a result of farmers subscribing to the system or in response to a specific request for information, is easy to gauge depending on the number of subscriptions, queries or requests. For systems deploying the 'PUSH' mechanism to deliver personalised messages to farmers, delivery reports can be a trifle deluding and there is no easy way of understanding if messages are reaching the intended beneficiaries or if the information is truly useful.

So how does one gauge the success of these services? Can ICT itself be used to gain feedback on the usefulness of the service regularly and make the advisories more relevant? The paper addresses this question – as a solution, a system that not only delivered advisory voice messages but also incorporated a real-time feedback mechanism, was developed.

BACKGROUND OF STUDY

The Government of Tamil Nadu has undertaken a programme to partially fill the existing information gaps for farmers by using ICT tools (Department of Agriculture, 2012). The pilot project of relaying agricultural advisories by means of a 'PUSH' voice-message system to the mobile phones of farmers in five delta districts (Thanjavur, Thiruvarur, Thiruchirapalli, Nagapattinam and Cuddalore) was started in August 2012 and presently covers around 0.2 million farmers. The Cauvery Delta Zone in the state of Tamil Nadu is a major rice producing zone in the country and the above mentioned districts cover a large fraction of the delta zone (Agro Climatic Zone Profile, 2009). The Agriculture Department naturally thought it fit to start relaying advisories to the districts where the rice productivity matters most to the state.

The Department first conducted a baseline survey of all farmers in Tamil Nadu over 2010-11 as part of their Farm Crop Management System (FCMS). This comprehensive baseline survey was intended to cover regional details, personal details, mobile details, bank details, land details, details about farmer group memberships, farm animals, farm equipment, plantation crops, wells, micro-irrigation, fodder crops grown, and other activities such as beekeeping, sericulture, fisheries and agroforestry. It also endeavoured to obtain information regarding facilities available to farmers and what their requirements

were – such as credit facilities, inputs availability, farm equipment and also market information. This data was then used to classify farmers and understand the requirements for specific sets of farmers.

Based on the categorization, the Department then started relaying voice messages to farmers on a monthly basis, targeted block-wise and depending on the farmer-category. The voice messages were of maximum one minute duration. If the farmer does not pick up the phone at the first attempt, another call is made in an hour; if that too fails, a last attempt is made in the evening between 5 pm and 8 pm. Taking feedback from when the maximum calls get connected, the timings were fine-tuned for each region.

The messages contain information on subjects that are presumed to be relevant to farmers such as -

- Fertilizer application
- Pesticide application
- Pest management
- Disease management
- Best Agricultural practices
- Seed varieties
- Seed treatment
- Weeding
- Government Schemes

Currently, over 3 million messages have been relayed to farmers with an average call connectivity rate of 87%; it was found that 50% of farmers listen to the entire message, whereas others disconnect the call.

The system was initially built only to deliver messages and did not have any mechanism of obtaining feedback from farmers about whether the call was found to be useful. To make the messages truly useful to farmers, it was believed that feedback on the following aspects would be desirable –

- Are the messages timely – do the messages reach the farmers when they need it the most during the crop cycle?

- Are the messages relevant – do the messages contain information that is relevant to farmers or would they like information on other topics?
- Can the messages be more personalized – is there a way in which feedback can be obtained from farmers to understand the crops they are growing and what cropping stage they are at?

Further, if this feedback is to be used to modify the content and delivery of the messages, it had to be obtained and analysed in real-time.

Considering the importance of gaining feedback, an IVR system was introduced into the same system, to seek feedback from farmers in an innovative way – by including questions at the end of the messages so that farmers could provide instant responses; responses that could be recorded, analysed and reported to the Department of Agriculture. The questions are designed to be simple, are in the local language and asked at the end of voice message, which the farmer responds to. This response gives the required feedback to make the next message more relevant.

RESEARCH METHODOLOGY

Prior to implementing feedback using the IVR system, an exploratory study was carried out to understand the time, cost and resources needed to seek feedback from farmers using a more traditional method – manual survey over the phone.

Three districts were chosen for the survey as farmers in these districts had received at least five advisory messages from the Department; the total number of farmers included in the survey was 147,117. Out of this, every 200th farmer was contacted on a random basis; the total number of farmers surveyed was thus 167. A pre-determined questionnaire consisting of 19 questions was administered to them. The survey was administered in the local language, i.e. Tamil, over the phone and was conducted from: September 24, 2012 to October 12, 2012. This meant a total of 3 weeks, with each farmer taking about 10 minutes to respond to the questionnaire.

Some of the key questions included in the questionnaire were -

1. Socio Economic details: Age, gender, education level, total farming experience and number of family members involved in farming.
2. Sources of information: What are the different sources from where farmers currently acquire agricultural information? Options included TV, radio, extension officer, progressive farmers, family members, etc.
3. Implementation of information received by farmers through agricultural advisory voice messages: Had farmers implemented or planned to implement the information relayed through the voice messages?
4. Perceived usefulness of messages: How useful did farmers perceive the information to be? Were they hearing any of the information for the first time?
5. Level of satisfaction with the messages: Were farmers satisfied with various aspects of the message – voice, simplicity and audio quality?
6. Comparison of voice messages with other sources of information: How did farmers compare the information they received through the voice messages relayed by the Department of Agriculture with information they received from other sources mentioned in (2) above?
7. Was the farmer receiving mobile based SMS or Voice messages agricultural related information from any other sources, in addition to the Department of Agriculture, Government of Tamil Nadu?

The number of farmers contacted to get 167 responses was 774. (A majority of the respondents had their phones switched off, some numbers were not valid and some were from a different district or block than that mentioned in the Government database.)

Following this, a more innovative attempt was made to gain an understanding of whether farmers found the information contained in the message useful. In the month of October, two messages containing information on Government schemes were to be relayed to farmers by the Department of Agriculture. The duration of the first message was of 40 seconds and it was decided to deliver this message to all farmers with a feedback question inserted at the end. The question was asked in Tamil, through an IVR prompt and the response recorded by requesting users to select specific keys on their Dual-Tone-Multi-Frequency (DTMF) keypads.

The message along with the question asked was as follows –

Farmers can get free paddy seedlings through community nurseries and also get 25% subsidy on fertilizers; to know how to avail these facilities, they can get in touch with officials of the nearest block agricultural extension centre.

Was the information contained in the message useful to you? Press '1' for Yes and '2' for No

This message along with the question was relayed to 130,421 farmers from five districts over five days beginning 24 September, 2012 to 28 September, 2012, with 80338 farmers having heard the entire message.

SUMMARY OF FINDINGS

Delivering advisory voice messages to farmers using mobile technology had certainly proved to be more cost-effective than other traditional advisory method. Further, obtaining feedback by integrating it with the ICT service itself, also meant less time, less costs, less resources and far greater reach.

1. In the traditional survey method, the resource person could contact only 774 persons in 3 weeks and get survey responses from 167. In contrast, using the second evaluation method, 130,421 farmers could be contacted in 5 days and 4216 responses were recorded.
2. Though 80338 farmers heard the message and the question at the end of it, 76123 farmers did not provide any response. It is possible that there needs to be greater clarity in communicating how the DTMF response is to be registered or that farmers were not comfortable with the DTMF options at all. **However, out of the 4216 farmers who did respond, 3841 (91%) responded 'Yes' (The information was useful) while 375 said 'No.**
3. In the traditional method, a resource had to manually enter the data into an online form or excel sheet while speaking to farmers, increasing the chances of errors in data entry during the phone survey. Since the responses in the IVRS feedback method were recorded directly by the system, they are likely to be error free.

4. A comparison of the costs² of administering a phone feedback survey versus that of administering it through the IVR system is also very illuminating.
- Cost of administering the survey and data entry: INR. 12000 (time of the resource administering the survey)
 - Cost of phone calls: INR.1 per minute (10 minutes for each survey) to 774 farmers – INR. 7740

Total costs involved in conducting the manual phone survey: INR. 19740.

When the feedback question was included at the end of the message, no additional costs were incurred to actually administer the question through IVRS. The only time spent was in report generation, the cost of which was INR. 1250. (As we have mentioned, the question was inserted at the end of the message so that no extra costs were borne for the time being, other than that of actually relaying the message; cost of relaying all the messages were being borne by the Department of Agriculture).

Total cost involved in conducting the survey through IVRS: INR. 1250

5. The traditional phone survey provides an opportunity for gathering more comprehensive feedback and it is true that only one feedback question could be included in the message during the relay through IVRS. Yet, we believe our findings are sufficient proof of the potential of using IVRS to obtain feedback and aid in improving delivery of services.

INNOVATIVE NATURE OF IVRS TO OBTAIN AND IMPLEMENT FEEDBACK:

A. POTENTIAL

The savings in cost, time and the availability of error free data are some of the very obvious advantages of using the IVRS feedback method. The study also revealed the tremendous potential of this method as can be seen from some of the aspects listed below -

² All costs are given in Indian Rupees (INR). 1 USD = INR 54 approximately

- **Customized Questions:** The questions can be customized to obtain feedback on the aspects that are most relevant to the Department. For example, the question could be about whether the information is indeed useful to the farmers, if it is reaching farmers in time or whether they would like information on any other issue.
- **Better Targeting:** The study revealed that data collected from farmers during the baseline survey had some errors in them or had changed over the last couple of years. The feedback technique can serve as an excellent mode of data cleansing as well as data updating. This will help the Department understand if the beneficiaries are indeed farmers, has there been a change in the category they belong to and how best can messages be personalized for them.
- **More Relevance:** Since the responses received from farmers can be immediately recorded and analyzed, the feedback thus received can be utilized faster for better targeting of messages. For example, if the Department of Agriculture is made aware of the fact that farmers in a certain block have already finished transplanting their paddy saplings and they are no longer in the nursery stages, rather than continue with relay of nursery related messages, an immediate switch can be made to messages that contain information about the main field stage.
- **Communication in Local Language:** In what is a significant feature, gathering feedback through the mobile ensures that farmers – most of whom are semi-literate or illiterate – are free to communicate through a medium that they are most comfortable with viz., voice conversations in the local language over a mobile. Rather than depend on intermediaries who could misrepresent them, farmers are provided a tool to directly give feedback to the Department.
- **Extending Reach:** As mentioned before, three attempts are made to relay the message (and the feedback question it carries) to farmers. Through field interactions, it has been observed that farmers are available on their mobile phones either early in the morning or later in the evening. Based on call reports, the timing of the message (plus feedback question) relay can be fine-tuned so that a large fraction of farmers can be reached.
- **Scalability:** In a country like India where there are different languages, voice technology is a powerful tool that can be used to scale the proposed system across the different states very

quickly. If the system proves its benefits in the State, it will not take long for it to be replicated in other States as well.

B. CHALLENGES

It is also important to be aware of the technological challenges facing such a feedback technique. Though the feedback question was relayed to over 80,000 farmers, only about 4000 could actually respond by pressing the right keys. Mention must be made here that farmers were not provided any training or sensitization about this new mode of gathering feedback. The next aspect of study will be to understand if farmers are comfortable using the DTMF options, if additional marketing or sensitization efforts will help or if using an **Automatic Speech Recognition (ASR)** system in the local language, might work better.

CONCLUSION:

In all the efforts mentioned earlier, we have seen both Government and non-Government organizations harnessing ICT, in particular mobile telephony, to deliver messages to farmers. However, in these cases, farmers have either opted in for the service or it is a pre-defined and targeted service delivery; by a Government entity or Contract Farming entity. We have, so far, not seen an effort similar to what has been attempted in this study – to use ICT to ‘PUSH’ informational messages to a large scale of farmers as well to continuously customize delivery based on the feedback obtained directly from farmers. In fact, a very effective way of determining the success of ‘PUSH’ services is by integrating these feedback mechanisms within the system so that the end-users have the power to immediately convey feedback to the organizations and organizations can act in time to respond to that feedback.

This study clearly shows that ICT through innovative use of mobile technology can help in implementing the feedback, through what we believe is a unique and so far, under-utilized approach; not to mention dramatically reduce the time and costs involved in carrying out such feedback efforts. Recognizing this potential and making it a part of the Government ICT schemes as they are being conceived and operated will go a long way in increasing the productivity and effectiveness of these schemes.

Though initial attempts have shown that some farmers have not provided any feedback due to varying reasons, one must note that there were no specific marketing efforts or training that was provided to the farmers introducing the innovative channel using which their feedback was to be obtained. As we go forward one can certainly envision that the farmers will get acclimatized to this innovative method of feedback gathering and even welcome it, after they witness the change such an approach will bring to the farming community.

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REFERENCES:

(n.d.). Retrieved from IFFCO Kisan Sanchar Limited: <http://www.iksl.in/>

(2008-2009). Retrieved from Department of Evaluation and Applied Research:

<http://www.tn.gov.in/dear/4.%20Agriculture.pdf>

Agro Climatic Zone Profile. (2009). Retrieved from Planning Commission, Government of India:

http://planningcommission.nic.in/reports/sereport/ser/7vgtn/v3_ch3.pdf

Census Reference Tables - Number of Villages. (n.d.). Retrieved from Office of the Registrar General and Census Commissioner, Ministry of Home Affairs, Government of India:

http://censusindia.gov.in/Census_Data_2001/Census_data_finder/A_Series/Number_of_Village.htm

Chhibber, N. (2004). Enhancing Developmental Opportunities by Promoting ICT Use: Vision for Rural India. *I-Ways: The Journal of E-Government Policy and Regulation*, Volume 27, Numbers 3-4/2004, Pgs. 190-196.

Claire J. Glendenning, S. B.-O. (2010). *Review of Agricultural Extension in India: Are Farmers' Information Needs Being Met?* International Food Policy Research Institute.

Department of Agriculture, G. o. (2012). *Policy Note*. Retrieved from

<http://www.tn.gov.in/policynotes/pdf/agriculture.pdf>

Hellstrom, J. (2009, April). *Mobile phones for good governance-challenges and way* . Retrieved from

http://www.w3.org/2008/10/MW4D_WS/papers/hellstrom_gov.pdf

IBS Center for Management Research. (2009). *Emerging Markets Strategy: Nokia Life Tools for Rural Markets*.

Improving Earning Capacity of Farmers: Case of Fasal by Intuit Labs. (2012, March). Retrieved from Governance Knowledge Centre, Department of Administrative Reforms and Public Grievances, Government of India: http://indiagovernance.gov.in/files/intuit_fasal_edited_intuit_final.pdf

(2009). *India: The Impact of Mobile Phones*. Vodafone Public Policy Series.

- Intuit Fasal*. (n.d.). Retrieved from <http://fasal.intuit.com/index.html>
- ITC launches interactive mobile telephony for tobacco farmers*. (2012, August 16). Retrieved from eGov magazine enjeGov Magazine- Asia's first magazine on e-Governance:
<http://egov.eletsonline.com/2012/08/itc-launches-interactive-mobile-telephony-for-tobacco-farmers/>
- Jhunjhunwala, A., & Ramamurthi, B. (1995). Wireless in Local Loop: Some Key Issue. *Journal of IETE*, Vol.12, Nos.5&6, pp 309-314.
- Jhunjhunwala, A., Umadikar, J., Prashant, S., & Canagarajah, N. (2013). A New Personalized Agriculture Advisory System. *European Wireless Conference 2013*, (p. 6). Surrey.
- mKrishi: A Rural Service Delivery Platform*. (n.d.). Retrieved from Tata Consultancy Services:
<http://www.tcs.com/offerings/technology-products/mKRISHI/Pages/default.aspx>
- Narula, S. A., Sikka, B., Singh, S., & Chawla, K. (June 2012). Empowering farmers through mobile telephony in India: A Case of IFFCO Kisan Sanchar Limited. *International Food and Agribusiness Management Association(IFAMA): 2010 Annual World Symposium*.
- National Sample Survey Office - Survey Finding - 59th Round*. (n.d.). Retrieved from Ministry of Statistics and Programme Implementation:
http://mospi.nic.in/Mospi_New/Site/inner.aspx?status=4&menu_id=54
- Patel, N., Savani, K., Klemmer, S. R., & Parikh, T. S. (2012). Power to the Peers: Authority of Source Effects for a Voice-based Agricultural Information Service in Rural India. *Proceedings of IEEE Conference on Information and Communication Technologies for Development (ICTD 2012)*.
- Reuters Market Light*. (n.d.). Retrieved from Reuters Market Light:
<http://www.reutersmarketlight.com/index.html>
- Sharma, R. (May 2010). *Use of ICT in improving governance and social accountability with a pro-poor approach: reflections from India*. Centre for Good Governance, Government of Andhra Pradesh. (2011-2012). *State of Indian Agriculture*. Department of Agriculture and Cooperation, Government of India.

Tata Consultancy Services: Providing Advisory Services to Indian Farmers. (2012, April). Retrieved from

Business Call to Action: http://www.businesscalltoaction.org/wp-content/files_mf/tataconsultancyservicescasestudyforweb.pdf

Telecom Regulatory Authority - Highlights on Telecom Subscription Data. (n.d.). Retrieved from

<http://www.trai.gov.in/WriteReadData/WhatsNew/Documents/PR-TSD-Sep2012.pdf>.

Thompson, M. (August 2008). ICT and Development Studies: Towards Development 2.0. *Journal of*

International Development; Special Issue: DSA 2007, Volume 20, Issue 6, pages 821–835.

Thomson Reuters: Removing Barriers to Growth in Agriculture. (2011). Retrieved from Business Call to

Action: http://www.businesscalltoaction.org/wp-content/files_mf/1286830018BCtAREutersMarketLightCaseStudyForWeb.pdf