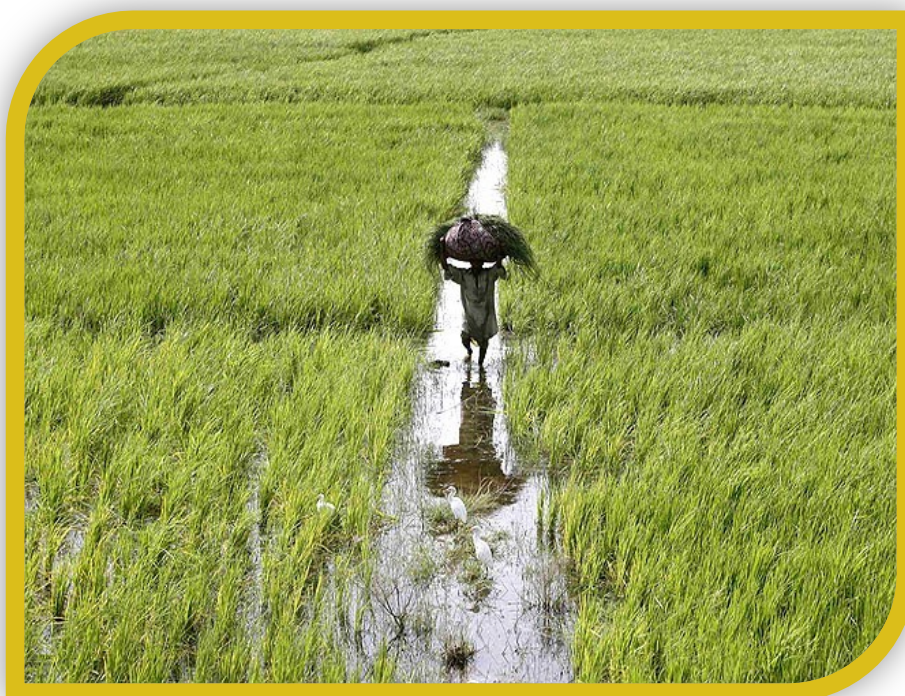


Assessment of Information and Communication Technologies in Pakistan Agricultural Extension



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College of Agriculture and Environmental Sciences
International Programs Office
University of California Davis
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The primary purpose of the assessment was to inform project efforts and build organizational knowledge. The results have been positive in this regard, and we therefore provide the document to others with the aim to inform organizations seeking to employ information and communication technologies in Pakistan agricultural development.

While we have attempted to be as thorough and objective as possible, the information in this report is not based on systematic field surveys; consequently, we refrain from making concrete recommendations. Rather, this report should be viewed as an introduction to information and communication technologies for agricultural development in Afghanistan.

Readers should also be aware that the project landscape as well as the ICT landscape in Pakistan is changing very rapidly. Consequently, the information herein is highly time-sensitive and should be corroborated before utilization. The statements expressed herein are solely that of the authors, and do not necessarily represent the International Programs Office, the College of Agriculture and Environmental Sciences, the University of California Davis, or the United States Department of Agriculture.

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Rationale

This assessment aims to inform organizations seeking to employ information and communication technologies in agricultural development in Pakistan. The information in this report is not based on field surveys; consequently, we refrain from making concrete recommendations. Rather, this report should be viewed as an introduction to information and communication technologies for agricultural development in Pakistan.

Executive Summary

Despite Pakistan's rapidly expanding field of Information Technology, such tools are largely underutilized in bridging communication between farmers and extension support or other technical specialists. Major barriers include unreliable electricity, lack of rural infrastructure, widespread rural illiteracy, gender barriers to ICT tools and education, and poor user-friendly interfacing. From the national level, government organizations have invested in agriculture-focused web portals as a location to display organizational charts and project announcements, but fall short of providing relevant extension information in a way that the majority of agricultural producers (especially small-scale farmers, non-English readers or people of varying education levels) can utilize. In the last year notable improvements have been made, such as AgriPunjab's web reformatting with prominent directing of users to a call-in helpline and links to a variety of extension-like research initiatives, suggesting a self-recognized push to meet user needs. Beyond websites, a handful of ICT for Agriculture programs exist, primarily utilizing mobile cell services. Mobile phone communications, especially when coupled with other ICTs (such as internet TV / YouTube and other social media) are a promising option for agricultural extension, due to cell system access and adoptability. Two-way, user-specific information formats (ex. IVR teleshops or call-in helplines) are key to connect farmers with relevant knowledge at the moment they need crucial problem-solving material. Other approaches include reformatting existing Internet resources for SMS and [satellite or internet] TV delivery in collaboration with well-established stakeholders in various sectors (i.e. Telenor, ZaraiMedia, Pakissan), as well as exploiting social media tools among community groups. The growth of Pakistan's IT sector, in both infrastructure and ability of skilled IT workers and entrepreneurs, presents an opportunity for increasing access to agricultural information by farmers and extension agents in the field through ICTs. Where farmer-accessible ICT tools are used in combination, and services designed

with the user-experience in mind, stakeholders and collaborators will achieve higher adoption rates and ultimately improved chance of long-term success.

Opportunities and Challenges

The rise of Pakistan's IT industry is paving the way for ICT opportunities across the country. As electronic infrastructure advances into rural areas more farmers will be able to access information that fits their needs, rather than relying on biased marketing or top down dissipation of standard practices. ICTs hold a unique advantage in the spread of information because they connect people in rural areas and across difficult geographic terrain.

Major challenges to ICT in agricultural extension include poor IT infrastructure (especially in rural areas), limited energy availability, gender barriers in adopting and accessing technologies, language and literacy barriers, top-down one-way distribution of information, and the costs associated with acquiring ICT tools. Most current ICT initiatives act as delivery services for agricultural information but are not engaging in two-way communication with farmers. Rather, they serve as platforms for aggregated data that is difficult to navigate and digest. In many cases websites host general instructional pamphlets with limited applicability to specific regions or particular problems and needs. Additionally, ICT programs often overlook accessibility to and needs of women as farmers and food suppliers. Services that require literacy skills, or are not available at the household level, bypass large segments of the farming population, including women, the illiterate, and very poor families. To address these challenges, ICT programs must first recognize barriers of the target user and seek out means to bridge the accessibility gap and meet farmers' needs.

Background

Agricultural Production

Agriculture is referred to as the backbone of Pakistan's economy (Siraj 2012); it is the single largest sector employing over two-fifths of the country's total workforce and contributing one-fourth of the GDP (CIA World Factbook 2016). Main agricultural products include cotton, wheat, rice, sugarcane, fruits, vegetables, milk, beef, mutton, and eggs (ibid).

There are 6.6 million farming households in Pakistan, 86% of which are classified as small farmers and 14% considered large farms having the best access to land and water (Amjad

2010). One third of the rural population consists of farmers owning less than 2 hectares or are landless (Siraj 2012), generating income through livestock or service to other farmers.

Cultivable land totals 21 million hectares of Pakistan's total area (80 million ha), of which nearly 16 million hectares (77%) have established irrigation. This is generally limited to the Indus Plain, where the River Indus and its tributaries are the main source of irrigation water. Despite a number of interventions, salinity and water-logging problems persist, resulting in an annual loss of 40,000 hectares of irrigated land (Alam & Khan 1999). Punjab is the dominant agricultural region in Pakistan, spanning a quarter of the country's total area and comprising 57% of the total cultivated land (Siraj 2012). This is also an advantageous growing region due to high soil fertility and well-developed irrigation systems. In general, there is considerable room for productivity growth and development of yield potential in Pakistan (ibid).

Gender

In addition to household and childcare duties, women in Pakistan provide about 50% of agricultural labor (Amin et al. 2009). Women are the principal family members responsible for major agricultural tasks such as rice and cotton production, as well as pulses and vegetables (Mumtaz 1993, cited in FAO Report), with cotton picking being exclusively woman's work (ibid). Female participation increase is in direct proportion to farm size, as small farmers are less able to afford hired labor and thus rely more heavily on family labor (Rais et al 2013), promoting polygynous marriages in some ethnic groups in order to meet required farm and household labor demands (PARC 1998, cited in FAO Report). Further, as more male heads of household migrate to cities in search of work, women's role in the management of farms may be increasing (Rais et al 2013). Women play a key role in livestock production and herding (Ishaq 1998; Hassan 2008), food conservation (Hassan 2008), and participate in natural resource management activities with an indirect impact on agriculture, such as harvesting of firewood (ibid). However, women's role in agriculture remains primarily limited to non-commercial production operations (ibid). They rarely travel to the main markets to buy inputs or negotiate rates (Jamali 2009) and consequently women are not directly involved in farm-related decision making, nor are extension services targeted to them (ibid). Some thus consider women to be the "invisible farmers," putting them at a disadvantage when it comes to receiving information related to increasing production or pesticide safety (Rais et al. 2013; Hassan 2008).

Women's differential access to resources extends to information access via technology. Prevailing conservative opinions in Pakistani society believe that the vulgarity on television shows would negatively influence women, and that mobile phones would give women secret access to nefarious influences (such as males) (Siraj 2012). As recently as July 2013, a woman in the Punjab, Pakistan's most populous province and the center of agriculture, was ordered stoned to death by the local tribal court (*panchayat*) for owning a cell phone (Asian Human Rights Commission 2013). For all these reasons, women face a digital divide in Pakistan, especially in rural areas.

However, the usefulness and rapid pace of diffusion of new technology may yet force the relaxation of social taboos. The rapid increase in mobile phones nationwide may soon render landlines obsolete, and some predict that rural women will gain access to cellphones as market penetration expands, thus increasing women's access to mobile-based services and technology (Siraj 2012; GSMA report). Mobile operators such as Mobilink have already begun tailoring products for the "women's market" and are partnering with UNESCO on initiatives to use mobile phones to address illiteracy in young girls and improve basic education programs. They have found that societal suspicion towards technology such as mobile phones can be overcome by engaging parents and local leaders to understand the benefits of the tool without offending cultural norms (GSMA report, cited in Ishaq and Sukhera 2011).

Norms regarding women's access to cell phones are also changing as a response to violence and social unrest escalating in urban areas. More frequent bombings and safety concerns have encouraged parents to give daughters and husbands to give their wives cell phones to use in the event of an attack (Saleem 2013). Exceptions still exist but the general opinion of safety in large cities is having a wide impact on deeply penetrating cultural values that restrict women's access to technology (*ibid*), and may permeate to some degree in rural areas.

Language & Ethnicity

The nation of Pakistan encompasses an extremely ethnically diverse region. It comprises six major ethnic groups, grouped roughly geographically by province, and numerous minority ethnic groups. Punjabi (44.68%, Punjab province), Pashtun/ Pathan (15.42%), Northwest Frontier province, and Sindhi groups (14.1%, Sindh province), form the largest constituencies

(CIA World Factbook 2016). Several northeastern provinces are composed of a mix of ethnic groups with no clear majority.

As would be expected, the linguistic diversity of Pakistan mirrors the ethnic diversity. Major languages include Punjabi (48%), Sindhi (12%), Saraiki (a Punjabi variant, 10%), Pashtu (8%), Urdu (official, 8%), Balochi (3%), Hindko (2%), Brahui (1%), English (official; lingua franca of Pakistani elite and most government ministries), Burushaski and other (8%) (ibid). Addressing the linguistic diversity of the population presents a challenge to agricultural extension efforts attempting to cover large geographic areas.

ICT Landscape

Regulatory Policies and Institutions

Institutions

The government of Pakistan has responded actively to mushrooming new communications technology by sponsoring a robust regulatory framework to keep pace with the rapid changes of the telecommunication industry. We see evidence of this in the plethora of agencies involved in the regulation and oversight of the telecom industry.

Initially, the Ministry of Science and Technology (MoST), with its goal to coordinate, plan and direct scientific and technological programs and projects, was instrumental in launching ICTs in Pakistan. It helped develop the human resources and research necessary for the growth of the sector via new Universities and IT institutes and laid physical infrastructure for internet connectivity throughout the country (Siraj 2012).

Today, the Ministry of Information Technology and Telecommunications (MoITT) is the central government institution involved in planning, coordinating and regulating information technology and telecommunication programs in Pakistan (MoITT 2013). Among the numerous initiatives supported by the MoITT:

- *National ICT R&D Fund*. Funds scholarships in ICT-related disciplines and grants for industrial and academic research in ICT-related fields. (ICTRDF 2013)
- *Electronic Governance Directorate*. Spearheads efforts to use ICT to increase efficiency, accountability, transparency in public service delivery throughout government (EGD 2013).

- *National Telecommunication Corporation (NTC)*. Provides IT services to government agencies (NTC 2013).
- *Virtual University*. Pakistan’s first online fully accredited public university offers courses via satellite TV and the Internet. (Virtual University 2013)

In addition to the MoITT, the Ministry of Information & Broadcasting (MoIB) oversees electronic and print media; MoIB duties include regulation of the press (including enforcing compliance with the Media Code) and licensing broadcast media such as television and radio (MoIB 2013).

In 2001 the Government of Pakistan instituted reforms of Agricultural Extension with the name 'Devolution of Power Plan', which is the more advanced form of Decentralization (Saraj 2012). Under this system the Ministry of Food and Agriculture (MiNFA) dissolved; the Ministry of National Food Security and Research (MNFSR) was created to oversee policy and planning with respect to food, agriculture and livestock production (MNFSR website), and all extension activities were transferred to the provincial level. Under the new Ministry framework each province is responsible for managing agriculture and livestock production, research, and information sharing (extension). Provincial governments then contain subordinate agricultural departments or, in the case of Punjab, act as umbrella departments for various agricultural tasks:

Region	Department	Subdepartment
Punjab	Agripunjab	Directorate of Information
		Directorate of Agricultural Information and Extension Services
		Agricultural Marketing and Information Service (AMIS)
Sindh	Agriculture, Supply and Prices Department	
Balochistan	Agriculture and Cooperatives	
Khyber Pakhtunkhwa	Agriculture Department	(note: no information available on gov’t website)
Gilgit Baltistan	Food and Agriculture, Fisheries and Animal Husbandry Department	
Azad Jammu and Kashmir	Agriculture, Animal Husbandry and Food	

Policies

The following legislation governs the structure and behavior of media markets such as mobile phones, internet, radio, and television, as well as content.

- *Public Broadcasting Corporation Act (1973)*. Created and regulates the national Public Broadcasting Corporation. The PBC is charged with broadcasting programs that disseminate “reliable and trusted” information, education, and entertainment, and that promote Islamic ideology, national unity and principles of democracy, freedom, equality, and social justice.
- *Land Reform Policies*:
 - *West Pakistan Land Reform Law (1959)*. Under Ayub Khan, caps individual land ownerships to 500 acres irrigated or 1000 acres unirrigated land, or a maximum of 36,000 Produce Index Units (PIU), whichever was greater. Regulation contained provisions which provided for security of tenants as well as for preventing the subdivision of land holdings.
 - *Land Reforms Regulation (1972)*. Under Zulfikar Ali Butto, voids the transfer of any land and the creation of any right or interest in or encumbrance on any land exceeding an area of more than 150 acres of irrigated land or 300 acres of unirrigated land, or an area equivalent to 15,000 PIU of land, whichever was greater. Regulation provided for excess land to be surrendered and utilized for the benefit of tenants shown to be in the process of cultivating it.
 - *Land Reforms Act (1977)*. Places limits on individual land holdings to 100 acres of irrigated land or 200 acres of unirrigated land, or a maximum of 8,000 PIU, whichever was greater.
 - *Qazalbash Waqf v. Chief Land Commissioner, Punjab and others (1977-1989)*. Repeal of landholder limits following Zulfikar Ali Butto’s removal of office by Muhammad Zia ul Haq; Land Reform Laws of 1972 and 1977 declared un-Islamic and repealed.
- *Telecommunication Act (1996, expired end of 2002)*. Though replaced by PEMRA (see next bullet), the Telecomm Act of 1996 formed two autonomous bodies that continue to exert influence today: the Frequency Allocation Board (FAB) and Pakistan Telecommunication Authority (PTA).

- *Frequency Allocation Board* - Allocates radio frequencies and manages Pakistan's radio spectrum
- *Pakistan Telecommunication Authority* - Responsible for consumer advocacy and protection, ensuring fair competition among the operators, issuing new licenses and overseeing tariff rates.
- *PEMRA (2002)*. Licenses broadcasters and Distribution Service Operators under section 19 of the Pakistan Electronic Media Regulatory Authority, Ordinance, 2002.
- *Telecommunication De-Regulation Policy (2003)*. Attempted to strategically improve telecommunication infrastructure and service options by encouraging foreign and private investments in the telecommunication industry and increasing competition.
- *18th Amendment to the Constitution (2010)*. Decentralization of the federal government that gives provincial governments greater autonomy under the constitution. As part of this substantial restructuring, Northwest Frontier Province (NWFP) controversially renamed Khyber-Pakhtunkhwa.
- *Electronic Media Code of Conduct and Code of Conduct for Media Broadcasters*. Regulates broadcast content on entities licensed by PEMRA (TV, radio, and the Internet) (MoIB 2013).

Electricity Services

The two main suppliers generating and transmitting electricity in Pakistan are the Water and Power Development Authority (WAPDA)¹ covering regions statewide (except Karachi), and the Karachi Electric Supply Corporation (now K-Electric) for the city of Karachi and its surrounding areas (OSEC 2011). Installed capacities between these two public companies total 12,903 MW and 2,359 MW (NEPRA 2015), respectively, though shut downs due to maintenance and forced outages, coupled with inefficient transformer performance and limited transmission lines reduce dependability to 20-90% with frequent tripping (ibid).

Additionally, there are around 20 IPPs (Independent Power Producers) that contribute significant electricity generation (8949 MW, source: NEPRA 2015) and PAEC (Pakistan Atomic

¹ In 2007 WAPDA was bifurcated into 2 entities: WAPDA and Pakistan Electric Power Company (PEPCO). WAPDA is responsible for water and hydropower development whereas PEPCO is vested with the responsibility of thermal power generation, transmission, distribution and billing. Figures shown include thermal energy supplied by PEPCO.

Energy Commission) generating 1117 MW in nuclear power² (WNA 2016; NEPRA 2015). Solar and wind energy contribute 356 MW (NEPRA 2015).

However, production remains below consumption needs, and even those with access to an electrical source experience frequent blackouts, or load-shedding, 10 or more hours per day (EIU 2015; The Economist 2014; Santana 2013). A necessity for all forms of communication technology, electricity shortages are stunting all facets of daily life, even beyond the promotion and expansion of ICTs. Shortfall estimates range between 3,500 to 6,000 megawatts, or up to one-third the total demand (Santana 2013)³, and have spurred public protests, illegal connections, and a refusal by consumers to pay for intermittent service. Electricity shortages are a major political issue, weighing heavily in elections (AFP 2016; The Economist 2014).

The main cause of the energy shortfall snowballs from bad bill-collecting, leaving utility companies short of funds to pay for the oil that powers much of the production, which in turn means the state oil company can't buy enough oil on international markets (The Economist 2014; Hussain 2013), forcing the electricity generators to shut down or run at low capacity. Citizens who cannot afford the inflated electricity rates tap illegally into the grid, further burdening the supply, as well as provincial and federal agencies, who are the largest consumers, who often neglect to pay their bills (M.S. 2012).

Radio Services

The Pakistan Broadcasting Corporation operates the state-owned radio network, Radio Pakistan, that provides news, education and entertainment via more than 40 stations transmitting over FM, AM and shortwave frequencies (CIA Factbook 2016). Radio Pakistan broadcasts domestically in 23 state-approved languages and provides external service in 13 languages (ibid). In addition, PBC licenses over 100 privately-owned radio stations (ibid), however the PBC restricts news broadcasting to state run media (Murthy 2010), limiting programming on these private stations to music, talk shows, and “light” news (traffic and weather). Other outlets

² The Chasma III reactor, a collaboration between the Pakistan Atomic Energy Commission (PAEC) and China National Nuclear Corporation (CNNC) and funded as part of the China-Pakistan Economic Corridor (CPEC) program, went online in 2016, adding 340 MW to the national grid (AFP 2016). Energy analysts and critics point out, however, that the nuclear plant is an overoptimistic solution, as rapidly increasing consumer demand is expected to surpass new generation capacity in the coming years (EIU 2015).

³ From NEPRA 2015: “Reportedly, the load shedding duration has been reduced from 12 hours in 2013 to 6 hours in 2015 in the urban areas. Similarly, load shedding in the industrial sector has been reduced from 12 hours to 4 hours over the same period.”

for radio programming include international news channels such as BBC and VOA and illegal, unregulated militant broadcasts (ibid).

Unlike cable and satellite television service, radio penetration and accessibility is high in rural and impoverished areas of Pakistan, however the extent of access to radio versus other forms of ICT (such as TV or cable and satellite TV) depends on the region. Several studies have estimated radio ownership among small farmers to be around 67% (Abbas et al. 2003) to 77% (Khan 1994)⁴. In a 2008 survey of media access in rural regions across four states, BBC found that the extent of access to radio ranged from 47% (Punjab) to 91% (Sindh) (Murthy 2010). In some areas, such as the Northwest Frontier Province (NWFP) and Punjab provinces, the number of farmers with access to a TV actually exceeds those with access to a radio, while in others (Sindh) radio access rivals that of TV (91% and 94% able to access radios and TVs, respectively). However, in rural Baluchistan, radio is more accessible to the population than TV (74% compared with 65% having TV access). In all cases, satellite TV/ cable is much less accessible to rural inhabitants than radio and TV information sources (ibid).

The BBC also found that state-owned media outlet Radio Pakistan commands larger audiences among rural and low-income populations than FM or international broadcasts (Murthy 2010). As income increases, listeners shift to privately-owned FM or international news sources. Rural listeners also tend to prefer Radio Pakistan to FM broadcasts, perhaps due to the fact that many FM stations broadcast from urban areas and may have poor signal reach into rural areas. Historically, Radio Pakistan has played a significant role in disseminating agricultural information in rural areas via Farm Broadcast Programs, introduced as early as 1966 (Khan 1994). For example, in remote farming communities of the NWFP, Farm Broadcast Programs such as Karkeela (“farming”) have been acknowledged as particularly influential in awareness raising around agricultural issues.

Factors affecting radio listening

In general, some studies suggest agricultural radio programming could be an effective means of message delivery. Khan (1994) found that agricultural programming was popular among radio listeners (76% of radio listeners listened to the particular agriculture program under

⁴ It is important to note that within the aggregated figures of radio ownership for small farmers, socioeconomic status and land tenure impacts the rate of radio ownership, i.e. those who own their land (“owner cultivators”) have higher percentages of radio ownership compared to tenants (Khan 1994).

study). However, other investigators have found the reach of agricultural programs on radio and television among Pakistani farmers to be closer to 56% (Abbas et al. 2003), and this number declines significantly when considering the proportion of farmers who listen to or watch agricultural programs frequently (14 and 11.1% farmers listened/watched agricultural programs frequently on radio/television, which were comparatively less than the farmers who listened/watched radio/television occasionally for agricultural programs).

Further, Abas (2003) argues that radio listenership of an agricultural program was affected by age and farmer status (producer-owners vs. tenants), with younger and senior farmer participants and tenants less likely to listen regularly to agricultural programming. Less educated and illiterate audiences had high overall listening rates, but listened less regularly than more well-off audience groups (listening was higher in educated classes).

Data gathered on Pakistani farmer information access reinforces the idea that though technology may be widespread, radio and television are not farmers' preferred means of receiving agricultural information. The percentage of farmers (22.8%) who used electronic media as a source of information for agricultural production technologies was relatively lower than extension (26.1%) and fellow farmers (91.1%) (ibid).

The effectiveness of agricultural extension via radio remains unclear. In the survey conducted by Khan (1994), all of the respondents believed the agriculture radio show under study had a positive per acre impact on production, increasing yields in sugarcane and wheat-- however yields were not actually measured to objectively assess the effect on yields. According to Abbas et al. (2003) results, more than 50% of farmers fully understood the messages of sugarcane production technologies broadcast/tecast on radio/television in the study area, yet additional research would be needed to understand why the remaining farmers did not comprehend the message, and whether an alternate form of message delivery could have been more effective. Data also show the effect of farm size on adoption of messages spread via radio and TV: more large farmers adopted the sugarcane production technologies compared with the other farm size groups studied (ibid). Visuals provided by television may be more effective than radio in conveying farming and agricultural messages and technique (Saeed 2013).

Television Services

Pakistan Television Corporation (PTV) operates the state run television network, providing news, education and entertainment programs across 8 channels (CIA Factbook 2016) airing domestically through terrestrial networks and internationally via satellite (ptv.com.pk). While PTV Home is dominated by Urdu language programming, PTV National broadcasts in all languages representing different parts of the country and specific regional stations (AJK TV in Kashmiri and PTV Bolan in Balochi) air coverage in local dialects (ibid). Additionally, private TV broadcasting licenses have been permitted since the media reforms of 2002 (Murthy 2010), and to date over 69 foreign satellite channels are operational (CIA Factbook 2016).

Despite sanctioned expansion of television programming, PTV still leads overall national television popularity (Murthy 2010). Telecommunications infrastructure, lack of financial resources, and language barriers prevent adoption of wider television channels, leaving people in rural areas access to programming from the one state operator (ibid).

Television access is difficult to estimate, partly due to extreme variations between urban and rural areas (Yusuf & Shoemaker 2013) not accurately reflected in mean survey figures and variations in reporting TV household owners versus TV viewers (who may belong to the same household or access TV outside the home), though it is generally acknowledged that urban areas hold greater access to electronic infrastructure. Nationwide television sets were reported to total 12 million in 2010 (PEMRA), of which an unknown number of households owning more than one television set blindly skews this figure. Additionally, estimates vary widely: 86 million television viewers (52% of the population) were reported in 2009, of which 48 million lived in rural villages (Yusuf & Shoemaker 2013); however, the same year other surveys report TV sets in only 13% of rural households (Siegmann 2009) and 30.2% (Chapelier & Proudlock 2013). According to a Pakistan Institute of Public Opinion (PIPO) 2010 Media Report, 81 percent of Pakistanis said that they watch television (both terrestrial and cable combined) (Yusuf 2013). Although there are clear regional divides in television access, Pakistani television viewership is undoubtedly expanding, and continues to be one of the most relied upon electronic information sources (Chapelier & Proudlock 2013).

While news, entertainment and religious programs make up the majority of television programming in Pakistan (ibid), both public and private TV channels incorporate some

agricultural news items in their current affair programs and news bulletins (Zia & Khan 2012). The two largest public networks each air a weekly 1-hour (PTV network) and 30-minute (ATV network) discussion program, which are not regularly watched by farmers (ibid). APNA Channel is collaborating with AgriPunjab to offer daily 1-hour agricultural education programs: Apna Kissan and Apni Zarat (ibid). In 2010 Sohni Dharti, a UK based company, began operating as the single 24-hour agriculturally-focused television channel (Saif-ur-Rehman 2012), providing educational programs addressing agricultural and environmental issues, trainings on farming techniques and new technologies, weather forecasts and warnings, and improved plant and livestock varieties (ibid).

The advancement beyond audio (radio) to audio/video combination allows television to be a more effective form of communication and can be a promising platform for ICT in agricultural extension use (Saeed 2013). Several studies targeting farmers in Pakistan show that while TV as an information source for farmers ranks third after relatives/friends/neighbors and extension services (Naveed et. al 2012); however, among electronic media television predominantly ranks highest and has been identified as a useful source by 81% (Farooq et. al 2007) and 56.7% (Abbas et al. 2003). Factors affecting viewership of agricultural TV programs may be due to low access to television sets, education levels, electricity problems and program timing (ibid), and, importantly, awareness of agricultural and production technologies broadcasts (Abbas et al. 2003).

Mobile Phones Services

As in many developing countries, mobile phones in Pakistan are a rapidly growing market. Estimates of cell phone subscribers have jumped from 5 to 125 million in the ten years since 2003 and then to 133 million in 2016 (PTA Annual Report). Mobile phone users comprise nearly 70% of the population (PTA 2016), accounting for a vast majority of the total teledensity in the country (only 73.5% including wireless local loop and fixed land lines).

Mobile technology (AMPS, analog format) was introduced to Pakistan in 1990 by Instaphone and Paktel, followed not long after in 1994 by “modern” digital (GSM) mobile

networks (Looney 1998, cited in Siraj 2012). Today, mobile users can choose from among 6 cellular providers: Mobilink, Ufone, CMPak, Zong, Telenor, and Warid⁵.

The rapid growth in the sector is attributable to the government's success in establishing a coherent policy and regulatory framework for both consumers and investors (see Regulatory Framework section) (Siraj 2012). While foreign and domestic investment has improved both fixed and mobile networks, mobile technology shows the most promise for growth in the telecommunications sector. Over ninety percent of Pakistanis live in an area with cell phone coverage from at least one provider, and the construction of fiber optic networks continues to expand mobile network coverage, yet the high cost of infrastructure and low-user density limits the extension of fixed-line service to rural areas (Siraj 2012). As a result, in contrast to the large user gains in the mobile sector, fixed lines and wireless local loop systems have shown decreases or relative stagnation in teledensity, respectively (PTA Annual Report 2016).

As the mobile sector has grown, decreasing prices and affordable pricing structures (such as pre-paid schemes) have opened cellular markets to people of lower economic status. Many see the availability, accessibility, and affordability of mobile phones as an opportunity to reach poor, rural markets via ICT technology, both to increase the agricultural information access of the poor and as a low-cost method for the government to assess rural agricultural needs and issues (Siraj 2012).

Internet Services

Internet access, first initiated by the state-owned Pakistan Telecommunication Company Ltd (PTCL), has been available in Pakistan since the mid-1990s. PCTL began offering internet [1.0] access via the nationwide local telephone network in 1995, though by the year 2000 there were only a reported 133,900 users (0.1% of population) (PTA Indicators 2016). In the last decade, national leaders have been pursuing an aggressive IT policy, aimed at boosting Pakistan's drive for economic modernization and creating an exportable software industry (Internet World Statistics 2016), which has encouraged the growth of internet usage to 35.83 million users (18% of population) in 2015 (CIA World Factbook 2016).

⁵ Mobilink and Warid began the merging process in 2016 to become the largest mobile operator, with over 46 million customers (PTA Annual Report 2016; ProPakistani.pk 2016)

English presently remains the dominant form of internet usage in Pakistan, however, there exists a shift toward the Urdu language. Many Urdu based newspapers have established an Urdu presence online and common usage is often done in Romanized Urdu (Khan 2012). Notably, Google introduced instant web translation interface to Urdu in 2010 (ibid).

Pakistan Telecommunications Authority reported 1.5 million broadband subscribers in 2011; growing to 2.6m subscribers (excluding mobile BB) in 2016. The largest broadband providers are PTCL, LINKdotNET, and Wateen, though there are dozens of smaller competing DSL operators. In August 2007 PTCL launched its Smart TV service, an IPTV (Internet Protocol Television) service, allowing high-speed broadband internet and voice telephony to subscribers with existing telephone lines (Sikandar 2010). Mobile phone internet access subscriptions grew to 35.4 million subscriber in 2016, up from 13.4m in 2014 (PTA Indicators 2016), signaling an opportunity for further developing IT services and sectors (PTA Annual Report 2016).

Social Media Services

Facebook

Social media websites such as Facebook are being utilized by extension service organizations. In 2012 Agriculture Extension Wing Punjab Pakistan opened a page where bi-weekly agricultural recommendation documents for specific crops are posted, as well as farming training advertisements, digital extension newsletters and videos on new farm technologies. Other extension districts have followed suit, including Agriculture Extension Lodhran and University of Agriculture, Faisalabad.

This is perhaps an underexploited service, given the district population of over 100 million (Bureau of Statistics 2015) of whom 63% are involved in agriculture (ibid), with only 8,811 followers of the Punjab Agriculture page in December 2016. However, concurrent with the rapid growth of mobile web access since 2012 (PTA Indicators 2016), Pakistani profiles on Facebook are increasing (6.08 million report in 2012, source: Tribune; surpassing 25 million in early 2016, source: Umair 2016).

The National Agromet Centre (NAMC) also hosts a Facebook page under the authority of the Pakistan Meteorological Department. Founded in mid-2012, NAMC uses the platform to post weekly weather advisories, monthly updates and season-long forecasts. The site does not appear to capitalize on interactive social media potentials, rather serves as an extension/ outreach

channel for agriculture industry personnel and growers with internet access to link into NAMC service.

YouTube, Vimeo, and Metacafe

Initiatives to circulate video extension services and farmer educational tools are published on the social media sites YouTube, Vimeo, and Metacafe. One series includes recordings by Dr. Ashraf Sahibzada, a leading Pakistani agricultural scientist whose television series, Kissan Time Helpline⁶, provides agricultural information to farmers and responds to both telephone and email questions which are published and made instantly accessible through such online video databases.

Though advantageous in the potential scope of impact, at various times the Pakistani government and PTA have shut down or blocked social media internet sites such as YouTube, Twitter, and Facebook as a result of political and conservative religious motivations (Bytes for All 2013). Access to YouTube was blocked in September of 2012, following airing of the controversial film trailer for “Innocence of Muslims”, while Facebook, Twitter and various news websites have been intermittently taken down under the guise of protecting morality (Jansen 2013). While government censorship continues to exist these ICT tools will not be able to realize their full potential in advising agricultural services. Further, internet and social media information sources are least likely to reach small-holder farmers, especially in rural areas.

Summary of Initiatives

Completed, current and anticipated ICT extension initiatives in Pakistan employ mobile phones, Internet, radio, video, social media, and computers. A summary of these projects is found in the table below in alphabetical order. Projects are then described in greater depth; where cross-sectoral collaborative implementation occurs, the project is listed alphabetically under the project title named first in the table.

⁶ <http://www.youtube.com/playlist?list=PL0F442DB740502F52>

Program Name	Years Active	Implementing Organization and Sector	Donor Organization and Sector	ICTs Used	Reach
Agri Data Warehousing, Data Mining and Online Analytical Processing (Punjab)	2006-08	National University of Computer and Emerging Sciences, National ICT R&D fund, AIOU Virtual University	Ministry of Food and Agriculture (MINFA) (Gov't)	<i>Internet, computer software</i>	Punjab
Agricultural Commodity Trade (ACT)	(pilot) 2009-11 Cont'd expansion	Telenor Group; Tameer Micro Finance Bank, AZIZ Group (input supplier)	Aga Khan Rural Support Programme (AKRSP) (NGO), Department of Agriculture (Extension and Adaptive Research) (Gov't); Endowment Funds Secretariat of the University; United States Department of Agriculture (USDA)	<i>Mobile [planned phases 2 and 3 include call-in IVR system and community computer centers]</i>	Nationwide, pilot group programs in Punjab and KP
Agricultural Marketing and Information Service (AMIS)	2004-present	Directorate of Agricultural Information (Gov't)	Pakistan Government (Gov't)	<i>Internet, computer (or tablet) programs or applications.</i>	Punjab
Agriculture TV Program	2010-present	Sohni Dharti TV	Tilton Communications Ltd (private)	<i>Internet, television</i>	Punjab, Sindh
AgriPunjab Website	2004-present	AgriPunjab; Directorate of Agricultural Information (Gov't)	Pakistan Government (Gov't)	<i>Internet</i>	Punjab
Agrobusiness Consortium Portal	2002-present	Pakissan.com	Pakissan (pvt) Ltd	<i>Internet, computer</i>	Nationwide
AIOU Virtual Learning	1974-present	AIOU; Radio Pakistan; PTV World	Allama Iqbal Open University (AIOU) (Private)	<i>Radio, television</i>	Nationwide

Distance Education	2002-present	Virtual University	Ministry of Information Technology and Telecommunications (MoITT) (Gov't)	<i>Television, Internet, computer</i>	Nationwide
e-Pak Agriculture	2013-present	University of California, Davis	United States Agency for International Development (USAID)	<i>Internet, computer</i>	Nationwide
Extension Programming Services	1962-present	Directorate of Agricultural Information (Gov't)	Pakistan Government (Gov't)	<i>Radio, television, video, internet.</i>	Punjab
Farmer Help line	2011- 2013	Directorate of Agricultural Information (Gov't); CABI (NGO)	Department for International Development (DFID) (Gov't)	<i>Mobile, internet</i>	Punjab
Farmer Support (Extension Services)	varies	Syngenta, FMC, Ali Akhbar & Dada jee group, Auriga Group, Fauji Fertilizer Company	Input Dealers (Private)	<i>Mobile, computer programs.</i>	Nationwide
Farmer Weather Forecast	1988-present	National AgroMet Center (Gov't)	Pakistan Meteorological Department (PMD) (Gov't) and Regional AgroMet Centers (RAMCs)	<i>Internet, [planned mobile/ SMS]</i>	Website accessible nationwide; forecasts focus on Punjab, Sindh, Khyber Pakhtunkhwa, Baluchistan, Gilgit-Baltistan & Kashmir
Kissan Time Helpline	2000-present	PTV World	PTV World (Gov't)	<i>Television, mobile, internet, social media</i>	Nationwide

Pakistan Agricultural Resource Center	2011-present	Pakistan Agricultural Research Council (PARC), National Agricultural Resource System (NARS), National Agricultural Research Center, Islamabad (NARC), 9 Research Centers	Pakistan Government (Gov't)	<i>Internet, computer</i>	Nationwide
Pakistan Agriculture and Cold Chain Development Project (PACCD)	2010-2013	Winrock International	U.S. Department of Agriculture (USDA) (Gov't)	<i>Radio, television, mobile</i>	Balochistan
UKissan	2007-present	UPhone tele-operator; Habib Bank Limited (HBL) (Private), Summit Bank (Private)	Habib Bank Limited (HBL) (Private), Summit Bank (Private)	<i>Mobile</i>	Nationwide
ZaraiBaithak	2001-present	University of Agriculture, Faisalabad; Pakissan.com	Department of Agriculture (Extension and Adaptive Research) (Gov't); Endowment Funds Secretariat of the University (Public); United States Department of Agriculture (USDA) (Gov't)	<i>Internet, computer</i>	Punjab
Zaraimedia.com	2012-present	ZaraiMedia	Private advertisements	<i>Internet, computer</i>	Nationwide

Agri Data Warehousing, Data Mining and Online Analytical Processing

Model: Digital Database (Public)

Target Audience: Researchers, Government, NGOs

Service Description: Initiative supported under MINFA to collect disparate agricultural information and research into a cohesive, organized digital storage structure (ie warehouse) using one or more commercially available hard and software platforms (ex. PPM-DWH). Data Mining refers to the use of On-Line Analytical Processing (OLAP) tools for analysis among multiple dimensions of information collected in the data warehouse.

Agricultural Commodity Trade (ACT) (Telenor Group)

Model: Commodity pricing via SMS packages (Private); m-Money (EasyPaisa) for cash transactions (Private)

Target Audience: Farmers, Merchants/ Retailers

Service Description: Agricultural Commodity Trade (ACT) allows Telenor mobile phone users to receive text message updates of wholesale produce prices that are updated daily. Service agreements with Tameer Bank and AZIZ Group allow farmers mobile banking to purchase farm inputs from AZIZ Group. Telenor advertises success of this project to the development of an inventory management module of their e-mandi application.

Additional pilot groups in Punjab and KP began testing the launch of an SMS package for agricultural and livestock information services. Telenor's website claims phase 2 of the ACT project will allow farmers to call in to IVR system for information and advice; phase 3 will be to build community computer centers for farmers to access agricultural information via the Internet.

Website: <http://www.telenor.com/sustainability/initiatives-worldwide/farmers-cut-a-better-deal-with-their-mobile-phones/>

Agricultural Marketing and Information Service (AMIS)

Model: Digital Database (Public)

Target Audience: Large and small-scale distributors, merchants and farmers

Service Description: AMIS website publishes daily closing prices of agricultural commodities from the international market and 135 markets located across the Punjab province. International commodity prices are converted in real-time from U.S Dollars and Indian Rupee to Pakistani Rupee, and aims to suit the needs of its users by offering information in tabular and

graphical displays as well as translations into Urdu. The site also hosts links to scholarly articles on agricultural topics such as post harvest practices, feasibility studies published by government research organizations, weather forecasts, discussion forums advertising exporters in cotton, wheat and corn industries, and wiki links on food processing how-to's.

Website: <http://www.amis.pk/Default.aspx>

Agriculture TV Program (Sohni Dharti TV)

Model: Educational channel on agricultural topics (Public)

Target Audience: Large and small scale farmers (general public)

Service Description: 24 hour privately-operated television channel devoted to agriculture and farming topics. Sohni Dharti began airing nationwide in 2010, in response to a low level of agriculturally focused television programming in Pakistan. Topics include educational, news, discussion and farmer spotlights. Company website hosts news articles and how-to material, and has potential for live streaming.

Website: <http://www.sohnidharti.tv/>

AgriPunjab Website (AgriPunjab)

Model: Government extension service (Public)

Target Audience: Literate, large scale farmers; extension personnel

Service Description: This English language website promotes and describes the extension activities, projects, and accomplishments of the Agriculture Department in the Punjab. Useful reports posted include: prices and stock for inputs (seed, fertilizer), contact information for agribusinesses such as sugar mills, crop yield estimates, and registered pesticide firms. The site advertises links to Punjab Agricultural Helpline and SMS Helpline, promising “facility for computerized recording of calls of farmer and display of callers ID with date and time at the helpline facilitates in locating callers for prompt feedback by technical experts on the same day”. It is unclear who will return calls to provide technical expertise. Coupled with the SMS helpline, these offer potential for creating a user database for tracking callers' needs.

Website: <http://www.agripunjab.gov.pk/index.php>

Agrobusiness Consortium Portal (Pakissan Ltd)

Model: Agro-Business Consortium and Consulting (Private, for-profit)

Target Audience: Agriculture and livestock-related business operators

Service Description: Agro-business consortium for news and information related to commodities trading, input suppliers, weather reports, and new crop/ production technologies. Advisory Panel includes university researchers, PARC members, economists and engineers. While the website hosts a wide variety of agricultural information, the audience intended is not clear.

Website: <http://www.pakissan.com/>

Allama Iqbal Open University (AIOU) Virtual Learning

Model: Distance Education/ Virtual Learning (Private)

Target Audience: Government Extension Employees and NGO staff wanting to increase skills and qualifications; Literate farmers

Service Description: Offers students a wide range of educational programs, including agricultural sciences, using state radio and television networks as additional support to traditional teaching correspondence methods. Programs are also sent to students in the form of audio and videocassettes. Masters of Science degrees focus on Agricultural Extension, Forestry Extension, (Hon) Livestock Production and (Hons) Rural Development.

Website: <http://www.aiou.edu.pk/>

e-Pak Agriculture

Model: Digital Database (Public)

Target Audience: Researchers, Government, NGOs, literate large and small scale farmers

Service Description: Initiative in collaboration with UC Davis, International Maize and Wheat Improvement Center (CIMMYT), International Livestock Research Institute (ILRI), Asian Vegetable Research and Development Center (AVRDC), Pakistan Agricultural Research Council (PARC), the University of Agriculture, Faisalabad (UAF) and the University PMAS-Arid Agriculture University Rawalpindi, to provide useful project and extension training material and bring key extension partners together to share and use good practices.

Website: <http://epakag.ucdavis.edu>

Farmer Help Line (CABI)

Model: Extension software and program (Public)

Target Audience: Large and small-scale farmers

Service Description: Call center helpline connecting extension agents and field specialists to the farming community through mobile phones. Farmers call in with queries (standard farming practices, commodity pricing, weather warnings, pest attack advice) that are answered by call center specialist with access to agriculture databases and software, or conference call the farmers with a field agent.

Website: <http://www.cabi.org/projects/project/10880>

Farmer Support (Extension Services) (Syngenta, FMC, Ali Akhbar & Dada jee group, Auriga Group, Fauji Fertilizer Company)

Model: Support marketing and sales of products while providing information on production methods and advice; paid informational service (Private)

Target Audience: Large-scale farmers

Service Description: Extension services provided by company field staff (though main function is to support marketing and sales of products based on customer feedback). Companies maintain a customer profile database and most offer on-going product and farming advice through tele-centers; one company (AliAkhbar) specifically offers weather status updates and crop advisory alerts. The advice provided is logged and recorded for each contact farmer, similar in concept to patient history in human health and has similar benefits when extension staff next visits the farmer to diagnose and solve their problem.

Call Centre/Tele Marketing in Private Sector Extension

Type	Company	Tele-center?	Customer data base?	Notes	Products
MNC	Syngenta Pakistan Ltd	Yes	Yes	Agriculture Graduates work as CSAs	Pesticides, seeds
MNC	FMC United (Pvt) Ltd	No	Yes		Pesticides, seeds
National	Ali Akhbar & Dada jee group	Yes	Yes (1000 farmers)	Telemarketing centers in the field to cater to weather and crop advisory alerts to a contact database of 1000 farmers	Agrochemical, seeds, fertilizer
National	Auriga Group	Yes	Yes	Advise customers on product use and farming techniques. Very good visual aids available to the call centre agents	Pesticides, new breeds of seeds
National	Fauji Fertilizer Company (FFC), Ltd	Yes	Yes		Fertilizer

Farmer Weather Forecast (National AgroMet Center)

Model: Government services hosted by consulting web portal (Public-Private)

Target Audience: Large-scale literate farmers; General public

Service Description: Provides weather information to farmers and researchers via a free, open-access web site via collaborative effort of the Pakistan Meteorological Department (PMD), RAMCs (weather stations), and the private for-profit Pakissan website. Agromet Pakissan posts weather data from PMD meteorological stations in major agricultural areas of the country identified by “agricultural authorities” (Agromet 2013). The website reports actual/ observed temperature, solar radiation, and soil moisture conditions, as well as forecasts and cropping calendars. Except for forecasts, which are updated daily using data from the National Weather Forecasting Centre, data are updated monthly. According to the website, weather reports will soon be available to farmers via SMS. Scrolling bulletin encourages users to register email address for news and weather bulletins, presumably also to build user database.

Website: <http://pakissan.com/agromet/index.htm>

Pakistan Agricultural Resource Center (PARC)

Model: Digital Database

Target Audience: Researchers; Large-scale literate farmers

Service Description: Web portal linked to national government website that aims to provide a database for publications by PARC’s 9 collaborating research centers. The website also hosts links to an AgroForum listserv, meeting notes of the Association of Former PARC Scientists (AFPC), and links to other government organizations such as the Plant Genetic Resources Program, Insect Database of the National Insect Museum, and the NARC library catalog. At the bottom right of home page is a “Farmers’ Section” linking to a page of links in Urdu script. These links provide informational pamphlets categorized by commodity type (staple/grain crops, vegetables, fruits, etc.); also linked here are Urdu transcripts from a television show “Green Farms” telecast on ATV.

Website: <http://www.parc.gov.pk/>

Pakistan Agriculture and Cold Chain Development Project (WINROCK)

Model: Public extension services funded by USDA

Target Audience: Large and small-scale farmers; Fish distributors and merchants

Service Description: PACCD aims to increase horticultural and fishery production linkages in Balochistan to modern markets in Lahore, Islamabad, Karachi and Hyderabad, and decrease post harvest losses. In addition to local trainings, Winrock developed and aired 10 educational programs through local TV stations, using visual aids as a response in improving previous agriculture/farm-related radio programming.

Website: <http://www.winrock.org/project/pakistan-agriculture-and-cold-chain-development-project>

UKissan (UPhone Telecompany)

Model: Paid informational service (Private)

Target Audience: Large and small-scale farmers

Service Description: Mobile phone package allowing farmers to connect to IVR database to stream information relating to “agricultural crops, livestock farming, non-conventional crops, poultry and fruit farming, weather alerts, mandi alerts and folk songs in regional languages” (UPhone.com).

Website: <http://www.ufone.com/vas/info-Services/UKisaan/>

ZaraiBaithak (University of Agriculture, Faisalabad)

Model: University Extension Services (Public)

Target Audience: Large and small-scale farmers; extension personnel

Service Description: A key component of the university’s outreach approach appears to be an online information portal for village farmers and extension agents, and the companion Village Information Centers (VICs); two VICs currently exist in Tandillian Wala and Kabir Wala (Punjab). The online site enables two-way communication between farmers and extension staff in rural areas, and researchers at the University of Agriculture, Faisalabad and experts from the Agriculture Department Govt. of the Punjab. VICs are physical locations in selected villages staffed by “operators” who can assist farmers with low levels of literacy and familiarity with technology to access the portal. The site promotes “technology transfer through cyber extension.”

Website is available in both English and Urdu, and offers:

- Means for the user to ask questions to agricultural specialists via email
- Frequently Asked Questions with fact sheets responding to questions on a range of agricultural issues, but in no particular order

- “Articles”/ information sheets and publications on a variety of agricultural topics, organized by subject matter. These are written by researchers and professors for publication in other governmental websites (ex. AgriPunjab) or agricultural magazines/digest (ex. Zaratnama, Zarai Digest); published on ZaraiBaithak with permission.
- A compilation of agricultural news drawn from various sources
- Links to farmers’ weather forecast via Agromet website
- Farmer database capabilities

Website: <http://www.zaraibaithak.com/>

Zaraimedia.com

Model: Database/ Web-portal

Target Audience: Farm industry specialists; literate farmers

Service Description: Website seeks to improve agricultural production in Pakistan by increasing the exchange of information between farmers and the agriculture industry. The site appears to be created by CEO Khurram Shahzad, also the manager of a similar ZaraiMedia Facebook page, and acts as a private business that sells advertisements among a wide variety of news posts on various agriculture-related topics.

Website: <http://zaraimedia.com/>

Promising Options

Mobile phones coupled with other forms of interactive technology are a promising option for expanding the country’s extension network because they are low cost, ubiquitous, and increasingly accessible for people of all genders, language and literacy levels. There are several programs already in use, such as Agri-Punjab’s call-in helpline and the Tele-Kissan pay-per-minute IVR database. Programs such as these can be improved upon through optimization and the use of sophisticated data management software that would streamline the process for a farmer to obtain suitable information. This may include number, season and/or region recognition that can quickly route callers to more relevant topic options (such as a wheat farmer to IPM and daily market prices rather than livestock or grape production techniques), faster service, and assistance by a preferred gender or language. By limiting the number of menus users must navigate,

farmers are more likely to succeed in accessing the information and services that are most relevant to them.

Another way to expand and improve upon current ICT initiatives is to enable farmers to customize the information presented by prompting them through additional tools. Utilizing multiple technologies alongside in-person extension leads to more effective engagement and transfer of knowledge. For example, television and radio programs, even when fully accessible, are more relevant to farmers who can use mobiles to call in with their questions that specifically address their needs. By allowing multi-way communication, and in particular offering both audio and visual explanation of new technologies and farming practices, ICTs move from Web 1.0 beyond Web 2.0 to 3.0. Additionally, analytic management programs are useful for host organizations to characterize users, evaluate impact, and identify opportunities for service improvement.

Given that word of mouth is the top reported source of information by farmer surveys (Naveed et al. 2012), social media has great potential for success if applied strategically. Social media initiatives are currently limited to sporadic video posting on sites such as YouTube, Meta Café, and Vimeo, largely by Dr Ashraf Sahibzada and AgriPunjab. Rural farmers may lack awareness of these videos, as well as lack access to Internet, reliable electricity, and a viewing device to see them. Nevertheless, these tools are useful for extension agents and stakeholders working with farmers. As ICT accessibility continues to expand, farmers will increasingly gain access to these tools. It is important to establish these social media communities so that as farmers become connected they can join in the conversation.

In the meantime, there are ways to work around current barriers to social media utilization. An example of this is exemplified by India-based Digital Green, where farmers are encouraged to voice their concerns and share strategies by filming short videos which are played by battery powered, portable projectors at community gatherings. One contributor to Digital Green's success is the direct engagement by farmers who highlight localized concerns and solutions in a way that is useful and understandable by others. If adapted appropriately, ICTs that utilize social media can successfully empower individuals and communities to capitalize on local knowledge more effectively.

Conclusions

Options for IT investments are rapidly expanding, coupled with an increasing number of Pakistanis having access to technologies such as cell phones, television, computers, etc. This environment enables new technologies to be used to communicate with farmers, especially in remote areas, to help increase agricultural production methods and access to markets. However, there exist numerable factors preventing farmers' adoption of ICTs. Primarily these include presentation style and lack of relevancy to farmers' individual needs, gender and language barriers, infrastructure and electricity services, and access to communication technologies. A growing number of initiatives seek to develop ICTs, though not always with users in mind. Accessible technologies and multi-way communication initiatives hold the greatest potential for success. As electricity and ICT tools expand in ubiquity throughout Pakistan, such tools can be positively exploited for a more effective agricultural extension program.

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