Information Communication Technology for Agriculture Development

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Abstract: In developing countries information and communication technology has played very important role in the development of education, health, rural development as well as in agriculture development. This technology has brought a significant change in agriculture development in third world countries where farmers directly connected with market, buyers, customers and metrological department to get information regarding weather and price. Information communication technology has also increased the income of farmers in different countries. Now there is need to provide facilities to farmers and introduce technology in rural areas where farmers are unaware and they do not have knowledge and skills regarding this technology. It was also indicated by different research that this technology has increased the product of agriculture by adopt information and communication technology tools in agriculture farming. However, farmers are facing major problems and challenges including poor agricultural practices inadequacies in information delivery reconciliation of records among farmers, government and traders similarly lack of information on best practices to farmers.

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Introduction

Agriculture plays an important role in the economy of most developing countries. Agriculture faces many problems hindrances and challenges such as poor agricultural practices, inefficiencies in information delivery, records maintenances between farmers and traders, and lack of information on best practices to farmers. Agriculture is vital economic activity in different third world countries where most population of the country live in the rural areas and derive their livelihoods, directly or indirectly, from agriculture (Alila and Atieno, 2006).

Information communication technologies (ICT) provide new approaches and ways of communicating, transferring and enhancing the knowledge and information among different communities. ICT could use to facilitate, strengthen, replace and existing information systems and networks. The term ICT used to include a radio, television, mobile phone, internet, telephone, Ipad video voice information system fax and computer (Warren, 2002).

ICT is main source of information for all people and has reduced the gap among people and places. It could regard as both a driver and an enabler (Herselman, 2003). ICT spread formation of knowledge societies in rural areas of the developing countries, which can realize when knowledge and information are effectively improved agricultural and rural development (Gregg& Irani 2004). The use of internet email Microsoft PowerPoint and other webpages for increase the development skills in the dissemination of agricultural information. ICTs such as e-mail, mobile phones, and Internet among others are required for effective extension information among farmers (Arokoyo, 2005).

It was showed that main problem of the poverty, illiteracy and sharing information among developing countries is poor communication technology lack of infrastructures and limited access in developing world. The shortages of information were also a factor in restricting economic advancement for developing countries. Especially agriculture sector is facing many problems in obtain new information about market price, weather updates and other related issues (Man & Sadiya, 2009).

In different developing countries technology providers could not provide such agriculture technology that is highly practical to the farming community and easy to accept by farming comities in these countries. Furthermore, ICT infrastructure could develop by taking the advantage of existing infrastructures by which farmers not only increases the acceptability of the new technology similarly it minimizes the costs of the technology and makes it affordable by the farmer communities (Van Biljon & Kotzé, 2007).

There is no doubt that ICT is challenge and an opportunity for developing countries. It is one of the important driving forces behind globalization. ICT is powerful tools for handling and spreading information. It has impact on all aspects of life by reducing time, distance and the information gap. ICT is increasing day by day for greater and faster interaction within different groups of people from different societies especially among farmers (Khong et al., 2009).

However, ICT is an influential and a powerful tool for growing productivity, generating economic growth and facilitating trade, transport and financial issues, similarly creating jobs and improving the quality of life of different society's people in developing countries. Furthermore, ICT could help to reduce poverty by creating employment opportunities and increasing productivity ICT could play an important role to reach people living in far flung and remote areas (Wielicki and Arendt, 2010, Sharifah Mariam, 2004).

It could say that ICTs can bring awareness and adoption of ICTs technology and different kind of information on modern agricultural system in rural communities. It can also enhance agricultural production, processing and marketing which will increase farm income, improved nutritional status as well as diversified consumption, processing and marketing of agro-based products in developing countries (Opata, et al., 2011).

ICT tools such as mobile phones have provided new approach to farmers to make tentative decisions much more easily than before. Use of mobile phone leads to greater social cohesion and improved social relationships. However, short message service SMS and voice record have given improvements in social relations. Mobile phone based social-networking in the developing countries goes to show the growing importance of this aspect (Bayes et al., 1999, Goodman, 2005, Kwaku & Kweku 2006).

Marketing information and ICT

The uses of mobile phones for getting agricultural information and operations about market prices of crops at various markets, receiving information regarding seed variety and contact veterinary doctors has played a significant role for the development of different countries. In the context of the India mobile phones have played an important role in farmers daily business by providing needed agricultural information related to modern farming techniques and market prices. The mobile based agricultural services are also obtaining enthusiastic response from the farming community. Another study indicated about Philippine that the use of mobile phone was introduced among farmers for agricultural development. Where mobile phones help farmers about feed their fields agricultural extension programme information about market price and deliver fertilizer advice by text message by mobile phones and other tools of communication technologies in different farmers communities (Kashem, 2010).

In Bangladesh the use of Grameen phone was also increased the income of farmers further it was showed that communication media used by farmers were receiving technological information and marketing information from concerning authorities In India today farmers were closely attached with media and they get market information from different sources such as mobile phones, radio and by television. Farmers now work with various information sources to tap markets and provide consumers with good-quality commodities (Kashem, 2009, Adhiguru et al., 2009).

Farmers get advice and information from input and technology providers about new technologies importance it usage and benefits Agro buyers and input suppliers have a Vested interest in providing advice. Similarly farmers obtain information regarding market for sell their product in good price (Ferroni & Zhou, 2012).

Farmers indicated that ICT has played an important role by use of these technologies the access to agricultural information were improved. This could show that farmers use mobile phones in rural areas to access market information. in the context of the Ghana Trade net, based trading platform was established which allowed farmers to sign up for short message service (SMS) for commodities and markets information where farmers can sell their product of their own choice. Furthermore farmers could request and receive actual and real prices about different commodities from different markets across West Africa. The Ghana Agricultural Producers and Traders Organization is a major beneficiary in 2006 this organization purchased products from farmers by use email or mobile phone contact to farmer. This organization purchases such as tomatoes, onions, and potatoes (Oladele, 2011).

Most of the communities' people such as farmers have an access through digital technologies could promote innovation, and increase their productivity. By use such kind of technology farmers could improve the quality of their lives. ICT help farmers to make their own decision for sell their produce in different markets it is a powerful tool for directing and expressing our creativity. The role of ICT is important for the development of economy in enhancing the effectiveness of market, productivity and competitiveness (Nor Sharifah, 2003).

In Bangladesh the Agricultural Market Information System (AMIS) project was established

to provide information about local agricultural markets and, in particular, supporting small farmers. The aim of this project was to make market information to farmers that improve their position in the value chain by increasing their knowledge and able to make decisions about increase their bargaining for sell their produce in market with good margin (Islam & Grönlund, 2007).

In Sri Lanka many largest wholesale agricultural markets have produce list of different commodities where produce prices were available by automated voice system accessible through mobile phones. It was showed that most farmers believed that they were able to get knowledge and information about prices through the system. The mobile phone empowered them to bargain for higher prices (De Silva & Zainudeen, 2006).

In different parts of Nigeria many communication and media channels were used to transmit market and agricultural information to farmers. The communication media include farm magazine, leaflets, newsletters, newspapers, pamphlets, radio and television, internet and mobile phone have played a vital role in developing countries (Dare, 1990).

ICT especially nowadays mobile phones could improve access to and use of information about agricultural technologies, potentially improving farmers learning and marketing information to farmers. It was showed that farmers have required information on different topics at each stage of the agricultural production process. In many developing countries still many countries get information by traditionally way such information provided by personal exchanges, radio and perhaps newspapers. Mobile phones could significantly reduce the costs of obtaining marketing and agricultural information about cost of price information for different types of search mechanisms. In most regions of the country and radio provides price information for specific products and markets on a weekly basis. It was observed that mobile phones were one of the better tools among many for disseminating and collecting information on agricultural technologies yields and prices in developing countries (Aker, 2011).

The study was conducted in Matale Srilanka about transaction cost it was indicated that most of the farmers were obtained information by use of mobile phone either make their trip to go their market or other places. Furthermore the total costs that would be reduced are in the region of three per cent (Ratnadiwakara, 2008).

The scenario of media use it was indicated that different national and international organizations were using new media ICT tools to attach the potential of new technology in various ways. The growth of new technology such as use of mobile phones for getting and exchanging the information has provided a positive influence to farmers' communities. ICT keeps farmers up to date about market price and by keeping them abreast of latest information about market for selling their goods in better price. The use of internet among farmers was increasing. In this context marketing information was increasing among farmers for sold their produce in different market (ITU, 2009).

The mobile phone has given new ways and approaches to the farmers for selling their produce in market rather than only relying on radio or TV for dissemination of agriculture information. Mobile phone technology could provide farmers latest and quick information in a variety of ways. Mobile phone has become different purpose portable and affordable tool for accessing different types of agricultural related information regarding production practices to marketing. In this context the short service message (SMS) could effectively use for latest update agricultural information such as marketing information that facilitate the farmer about making logical decisions (Murthy,2009).

Mobile phone technology was introduced among rural people as well as farmers which enables the people to be in contact with each other and share information regarding different issues. Similarly farmers could connect with the agriculture officers and experts for getting agricultural related information. According to Pakistan Telecommunication Authority (PTA) in Economic Survey of Pakistan the total subscribers of mobile phone have become 91.4 million and growing day by day (Govt. of Pakistan, 2009). It was indicated that the number of people increasing of subscribers of mobile service is an indicator of the popularity of this technology among people living in even remote rural areas. Farmers have easy access to communicate with buyers in market for getting information regarding their product.

There is no doubt that telecommunication play very important role in education, health and in agriculture development as well as in economic growth of the countries. The contribution of ICT regarding poverty alleviation by empowering the rural farmers to access markets, health care and other services provided by the government. In the perspective of Pakistan ICT in agriculture was increasingly being recognized in Pakistan. It provided the double benefit of growth access to information for the poor farmers and different rural communities. Total tele-density has reached 65%, and as Pakistan is largely a pre-paid market where rural people and farmers could afford these technologies such as mobile phones (Siraj, 2011).

The use of ICT could provide latest information about market rates of their product to farmers, buyers and producers this technology has increased the power of bargaining among farmers. The project was launched in 70 village of Maharashtra India to allow theses villagers and farmers to get information about agriculture, medical by use of internet this project given a good benefit to farmers and villager for increase their income and knowledge. The buyers and farmers access to price information ICT could reduce the prices that suppliers could charge for their goods. Similarly ICT could decrease the competitive advantage of location and allowing a foreign investor to under-price a local competitor (Bhatnagar, 2000).

The study was conducted in Tanzania where the organization deployed the farmers which was called market spies near cities to inform about the latest price of the product and its availability in market by mobile phone. This strategy improved the market access and provided a good profit to the farmers. Such kind of awareness were changed the market trends and given a new opportunities to farmers. The first mobile project was established in Tanzania to bring farmers, buyers for learn about develop strategies and share their knowledge and experience to meet their identified needs. The mobile phone provided new trend among farmers to work together and sharing their experience and develop a better way for increase their income (Lightfoot et al., 2008).

Weather and Pesticide Information

There were number of satellite system have been have been deployed worldwide to connect farmers and provided latest and timely information and relevant knowledge. However, most of these have focused on the provision of specific knowledge resources, such as weather and seed information to famers. Furthermore, in India broadcast different related announcements of general interest such as, regarding animal husbandry relevant programmes and weather information to farmers for save their farms from disaster (Patel, et al., 2010).

The use of mobile phone for agriculture application could provide a positive result if the farmers have experience in using other mobile applications such as, social network applications, mobile banking and money transfer applications and weather information. The study revealed that 57% of the respondents was mobile phones had used other mobile applications for instance, money transfer application. Farmers use ICT in different ways to get their information and communicate with people in the context of cattle farming farmers requesting various veterinary services and pesticides payments to workers extension officers obtaining weather conditions by use of mobile phone. Similarly farmers contact with transport services and getting information on diseases and suggestions and controlling on diseases through different tools of ICT (Gichamba & Lukandu, 2012).

The solar-powered wireless sensor network provided weather information in remote areas. Such application server relayed data from sensor network to local users via Wireless Local Area Network (WLAN) and to remote users through cellular network and the Internet where farmers could obtain information about weather Tsunami and other disaster by use this technology (Crossbow Technology, 2004).

In India 2008, Indonesia and China in 2009, goods of agricultural resources were cheap such as Nokia phones. Subscribers received SMS in a choice of 10 different languages and two service levels. The mostly information was related about price of crops and seed Information includes local prices for individually chosen crops, seed while weather forecasts and other farming tips were text to the subscribers where the farmers taken good advantage from this technology and improved their income and product (Ferroni & Zhou, 2012).

In this new technology environment farmers were changing and require new ways to provide extension information and services where the introduction of information and communication technologies (ICTs) played a powerful role in services and rural development projects in general. ICTs could deliver information which was important for the development of rural areas in the short and long term policies such as education and agriculture information. ICT could provide information on weather and profitable income to farmers (Chapman and Slaymaker, 2002).

Weather information is very essential for adapting to climate change and providing timely information weather. The program initiated in Mali in 1982 helped farmers to get information and better control climate risk which was given a positive result (World Bank, 2007). The introduction of ICT was closely related to the issue of learning and could facilitate and enhance the distribution of important information about weather, pesticides, seed and different diseases to farmers (Byerlee et al., 2010).

The mobile phones increasing day by day among young agriculture farmers where the infrastructure is improving productivity of agriculture and improving the economy of the countries. Mobile phone provided weather information and has opened opportunities for new services providing agriculture information through SMS (Nigel, 2004).

Farmers of ICTs use in different ways to provide information various communities the Radio and TV programs regularly broadcast feature weather and agricultural information in developing countries and

tele centres provided information regarding price as well as keeps up to date about weather. It was observed that in many developing countries government has established ICT centres for providing information to farmers about upcoming disaster such as Tsunami, rain, or bad weather conditions furthermore some centres also give information regarding use of pesticides in farming and its precautions. By increase of the mobile phone many traditional methods have covered mobile telephony including voice mail SMS and internet-based services (FARA 2009, Goyal 2010).

E-learning programs have also given new approach to farmers including internet kiosks that allow farmers to access computers and the internet for agriculture related information. Internet provided information by different mechanisms include especially weather, technical advice and suppliers and buyers in local markets. A majority of these services focus on weather and transport costs most likely because this information is easy to collect and disseminate by internet. Uses of ICT in agricultural extension mostly depend on the type of information provided. The information regarding prices and weather could easily disseminate by mobile phone to farmers and now a days mobile technology replaced the traditional methods of transferring information (Aker, 2011).

In the perspective of globalization of trade economy and agriculture farmers have need to provide special information regarding efficient procedures of communication technology. Farmers could select suitable variety of seeds fertilizers pesticides and other agricultural information. Similarly farmers need efficient knowledge for land preparation, cropping, and water management and most important farmers need to know weather information before starting pesticides in farming (Zakar & Zakar, 2009).

By use of mobile phone farmers could provide proper information and instructions about use of pesticides. Furthermore, the concern department could inform farmers about the mixture and right use of pesticides in their field. The metrological department could give the weather pests, and other specific conditions of the farming area. The use of pesticide properly could prevent agriculture crops from many diseases. However, proper use and dose of pesticides helps to reduce environmental contamination (Wang, 2001).

Most common ICT tools are mobile phone among farmers which use for information on livestock and crop maintenance proper use of seed and livestock varieties. Planning to cultivate crop on time and weather information. Specially, individuals indicated that use of mobile phone to clarify agricultural methods (Martin & Abbott, 2011).

Most of the developing countries farmers use mobile phones such as, in Kenyan, Nigerian, Tanzanian and Zambian where farmers get information regarding technical advice from agriculture expert extension officers. In Kenyan farmers obtain some of the costs of seeds fertilizers and pesticides and about bad weather by using mobile phone technology (Kashem, 2010).

Conclusion

Information and communication technology has reduced the gap among communities and increased the knowledge among farmers of developing countries but still there is gap among farmers ,buyers and extension services most of the farmers need ICT trainings, facilities and skills to enhance their product in future. Many developing countries facing lack of infrastructure, service delivery from government. Therefore it is need to increase ICT based advanced models to expand in developing countries for information delivery to farming communities with proper structural arrangements and connections at different levels of the agricultural supply chain.

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References

1. Adhiguru, P., Birthal, P.S., & Ganesh Kumar, B. (2009). Strengthening pluralistic agricultural information delivery systems in India. *Agricultural Economics Research Review,* 22, 71–79.
2. Aker, J. C. (2011). Dial "A" for agriculture: a review of information and communication technologies for agricultural extension in developing countries. *Agricultural Economics*, 42(6), 631-647.
3. Alila, P. O., & Atieno, R. (2006). Agricultural policy in Kenya: Issues and processes. *In the proceedings of the Future Agricultures Consortium Workshop, Institute of Development Studies*. March 20-22.
4. Arokoyo, T. (2005). ICTs application in agricultural extension service delivery. In S.F. Adedoyin (Ed.), Agricultural extension in Nigeria (pp. 32–40). Ilorin, Nigeria: Agricultural Extension Society of Nigeria.
5. Bhatnagar, S. (2000). Social implications of information and communication technology in developing countries: Lessons from Asian success stories. *The Electronic Journal of*

Information Systems in Developing Countries, 1, (4), 19.

6. Byerlee, D., de Janvry, A., Sadoulet, E., (2010). Agriculture for development – revisited. Lessons learned from the University of California at Berkeley conference. *In Paper Presented at the Conference Agriculture for Development* Revisited, University of California at Berkeley, CA, October 1–2
7. Bayes, A., von Braun, J. and Akhter, R.,(1999). Village Pay Phones and Poverty Reduction: Insights from a Grameen Bank initiative in Bangladesh. ZEF discussion Papers on Development Policy No. 8 Centre for Development Research, Bonn.
8. Crossbow Technology (2004). Smart Dust/Mote Training. Paper presented at *Crossbow Technology Seminar*, San Francisco, California.
9. Chapman, R., Slaymaker, T., (2002*). ICTs and rural development: review of the literature, current interventions and opportunities for action*. In: Working Paper 192, Overseas Development Institute, and London
10. De Silva, H., & Zainudeen, A. (2006). Perceived impacts of access to telecom at the bottom of the Pyramid. Living the information society: *in the proceedings of the impact of information and communication technologies on People, Work and Communities in Asia,* held on April 23-24, 2006 Makati City, Philippines.
11. Dare O (1990). The role of the Nigeria mass media in national rural development and transformation. *Paper Presented at the Media Forum* Organized by IITA, Ibadan.
12. Ferroni, M., & Zhou, Y. (2012). Achievements and Challenges in Agricultural Extension in India. *Global Journal of Emerging Market Economies,* 4 (3), 319-346.
13. Forum for Agricultural Research in Africa FARA (2009). Inventory of Innovative armer Advisory Services using ICTs.
14. Gregg, J. A., & Irani, T. A. (2004). Use of information technology by county extension agents of the Florida Cooperative Extension Service. *Journal of Extension*, 42 (3)
15. Govt. of Pakistan. (2009) Economic Survey 2008-2009. Finance Division, Economic Advisor's Wing, and Islamabad. Retrieved from http://www.finance.gov.pk Date 12, 10, 2012.
16. Gichamba, A., & Lukandu, I. A. (2012). A model for designing M-Agriculture applications for dairy farming. *The African Journal of Information Systems*, 4 (4), 120-136
17. Goyal, Aparajita. (2010). Information, Direct Access to Farmers, and Rural Market Performance in Central India." *American Economic Journal Applied Economics*, 2(3), 22-45.
18. Goodman, J., (2005). Linking Mobile Phone Ownership and Use to Social Capital in Rural South Africa and Tanzania, Vodafone Policy Paper Series, Number 2.
19. Herselman, M. E. (2003). ICT in rural areas in South Africa: Various case studies. *In Proceedings of Informing Science Information Technology Education Joint conference* Retrieved from *www.informingscience.org/*
20. Islam, S. M., & Grönlund, Å. (2007). Agriculture market information e service in Bangladesh: A stakeholder-oriented case analysis. *In the proceedings of 6th International Conference, EGOV 2007, Regensburg, Germany*
21. ITU. (2009). ICTs and food Security. ITU T Technology International Telecommunication Union. Retrieved from www.itu.int/ITU T/techwatch. Date 15, 12, 2012.
22. Kashem, M. (2010). Farmers' use of Mobile Phones in receiving agricultural information towards agricultural development. *In the Proceedings of the 2nd International Conference on M4D Mobile Communication Technology for Development.* November 10-11 Kampala, Uganda
23. Kashem, M. A. (2009) Shifting from Personal Media to Mass, Interpersonal and Interactive Electronic Communication Media by the Farmers for Receiving Agricultural Information. *Journal of Global Communication,* 2 (2).
24. Khong Sin Tan, Siong Choy Chong, Binshan Lin (2009), Internet-based ICT adoption: evidence from Malaysian SMEs, *Industrial Management & Data Systems*, 109(2), 45-58.
25. Kwaku Kyem, P. A., Kweku. & Le Maire, P. (2006). Transforming recent gains in the digital divide into digital opportunities: Africa and the boom in mobile Phone, Central Connecticut State University, USA. *Electronic Journal of Information Systems in Developing Countries* (28). 35-56
26. Lightfoot, C., Gillman, H., Scheuermeier, U., & Nyimbo, V. (2008). The first Mile Project in Tanzania. *Mountain Research and Development*, 28 (1), 13-17.
27. Man, N., & Sadiya, 1. (2009). Off-farm employment participation among Paddy Farmers in the Muda Agricultural Development Authority and Kemasin Semerak Granary Areas of Malaysia. *Asia-Pacific Development Journal*, 16(2), 14 1- 153.
28. Martin, B. L., & Abbott, E. (2011). Mobile Phones and Rural Livelihoods: Diffusion, Uses, and Perceived Impacts among farmers in rural

Uganda. *Information Technologies & International Development*, 7 (4), 17-34.
29. Murthy, C. (2009). Use of convergent mobile technologies for sustainable economic transformation in the lives of small farmers in rural India. *The Turkish Online Journal of Distance Education*, (10), 1-8.
30. Noor Sharifah, S.S. (2003). Model planning on traditional village in peninsular Malaysia. *Paper presented at Rural Planning Center, Faculty of Alam Bina, and UTM. Penerbit Technology University of Malaysia, Skudai, Johor.*
31. Nigel, S., Batchelor, S., Ridley, J., and Jorgensen, B. (2004). The impact of mobile phone in Africa. Paper prepared for the for the Commission of Africa. Availabl onhttp://www.commissionforafric.org
32. Oladele, O. (2011). Effect of information communication technology on agricultural information access among researchers, extension agents, and farmers in South Western Nigeria. *Journal of Agricultural & Food Information*, 12 (2), 167-176.
33. Opata, P., Nweze, J., & Rahman, M. (2011). The place of information and communication technology in promoting agro-based enterprises in third world countries. *Journal of Agricultural Technology*, 7 (2), 207-214.
34. Patel, N., Chittamuru, D., Jain, A., Dave, P., & Parikh, T. S. (2010). Avaaj Otalo: a field study of an interactive voice forum for small farmers in rural India. *Paper presented at the Proceedings of the 28th international conference on Human factors in computing systems*. April 10–15, 2010, Atlanta, GA, USA
35. Ratnadiwakara, D. (2008, February (21). Cost of information in agriculture markets: A case study Analysis of the Production and sale of produce at the Dambulla Dedicated Economic Centre. Retrieved from http://www.lirneasia.net.D ted 13.12.2012
36. Sharifah Mariam Syed Mohammed Alhabshi (2004), Bridging Digital Divide in Marginalized Areas: A Focus on IT Policy, Planning and Implementation Issues in Malaysia, *Indian institute of ManagementNewsletter*, 14 (1), 1-5
37. Siraj, M. (2011). A model for ICT based services for agriculture extension in Pakistan. Retrieved from http://www.cabi.org date 16, 12, and 2012.
38. Tom Wielicki and Lukasz Arendt (2010). A knowledge-driven shift in perception of ICT Implementation barriers: Comparative study of US and European SMEs. *Journal of Information Science*, 36: 162-174.
39. Van Biljon, J., & Kotzé, P. (2007). Modelling the factors that influence mobile phone adoption. *In the Proceedings of the 2007 annual research conference of the South African institute of computer scientists and informationtechnologists on IT research in developing countries.*
40. Warren, M. F. (2002). Adoption of ICT in agricultural management in the United Kingdom:The intra rural digital divide. *Agricultural Economics,* 48 (1), 1–8.
41. World Bank, (2007). *World Development Report* 2008: Agriculture for Development. World Bank/Oxford University Press, Washington, DC/Oxford.
42. Wang, M. (2001). Possible adoption of precision agriculture for developing countries at the threshold of the new millennium. *Computers and Electronics in Agriculture*, 30 (1-3), 45-50
43. Zakar, M. Z., & Zakar, R. (2009). Diffusion of information technology for agricultural development in the rural Punjab: Challenges and opportunities. *Pakistan Vision*, 9, 136-174.

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