Bridging inequality in agriculture through ICTs

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Abstract

The Sustainable Development Goals (SDGs) have put forward ambitious targets for the world to reduce inequality and usher equal opportunities and development across regions. Agricultural development is a common thread that goes across the 17 SDGs and development (or lack of it) in the sector has the potential to affect all others. Global development agencies and research bodies have emphasized on the transformative power of Information and Communication Technologies (ICTs) in making the highly ambitious SDGs achievable by 2030. And this makes combining ICTs with agricultural development a necessity. ICTs can influence the agriculture sector by increased rate of diffusion of technologies and through development in the ICTs themselves. While ICTs are most important tools for development, their strategic implementation will only ensure success in bringing about the desired change.

Global development and ICTs

The Sustainable Development Goals (SDGs) of the United Nations (UN) followed the Millennium Development Goals (MDGs) which proved to be great success in improving lives of people by reducing extreme poverty, mortality rates from infectious diseases like HIV/AIDS and child mortality in the developing nations. SDGs are expected to further the progress aiming to end poverty, extreme hunger, provide quality education and healthcare, and overall improve the social and economic status of people worldwide. The ambitious SDGs call for bold breakthroughs to meet their goals by 2030 with efforts that go above and beyond the comfort zone of the present rate of progress and as per the Overseas Development Institute (ODI) report, not a single goal will be achieved by 2030 if the current rate of progress is continued. But then again, the idea behind the SDGs was to continue the efforts of the MDGs with higher vigor to provide better quality of life to the estimated 9 billion population by 2030. Currently, 70.1% of the global adults hold only 3% of the global wealth, while only 8.6% of the global population own 85.6% of the global wealth. While those in the middle income bracket (earning $10–20/day) have doubled in 2011 compared to 2001 globally, still 79% of the world's population belong to poor ($2/day) and low income group ($2–10/day). These are also the part of the global population that belongs mostly to low and middle income economies of Africa, Latin America, and South East Asia (Inequality.org, 2018). Because of their disadvantaged position, access to important resources like education, healthcare, food and nutrition, proper livelihood becomes limited, which leads to a cycle of poverty and further increasing inequality. And to break this ongoing circle of inequality and poverty, Information and Communication Technologies can prove to be a useful tool (Close-the-gap.org, 2018; Sustainable Development Knowledge Platform, 2018).

Using ICTs for achieving the SDGs can be critical as they can accelerate innovation and change, share good practices and exemplary cases, improve 'capabilities to gather, analyze, manage, and exchange information' (Wahlen, 2017). For achieving the goals, no one should be left behind in the process of connecting online and that requires special attention to make sure the poor and marginalized have access to ICT enabled services in a coordinated environment of multi-stakeholder partnership (ITU, 2017). The highly ambitious nature of SDGs makes it crucial to innovatively use ICTs to increase access to financial resources as well as helping the development agencies to track and extrapolate necessary data and information to understand better how ICTs can reduce poverty and hunger; promote gender equality; make quality healthcare, education, affordable clean energy accessible; ensure sustainable development and economic growth across regions; developing and disseminating climate smart technologies; and ensuring stronger partnership for better development (ITU, 2017). Developments in ICTs industry have shown highly productive growth in the recent years and with increased affordability of the technology access has increased worldwide. Dramatic increase in mobile subscriptions in Africa and Asian countries has revolutionized health, education and financial service delivery and has also positively impacted agriculture, trade and commerce, and transportation. With further advancement in mobile broadband, Internet-of-Things (IoT), robotics, and Artificial Intelligence (AI), development can leapfrog in priority sectors. Major ways in which ICTs can contribute are accelerated service delivery in sectors like health, education, financial services, agriculture, and low carbon energy systems; reduced service delivery costs; enhanced awareness and public engagement; increased innovation, connectivity, productivity, and efficiency among sectors; and faster upgrading of service quality (Sachs et al., 2017a,b). The Huawei ICT SDGs Benchmark study suggests that countries that have performed well on ICTs have better

chance of reaching the SDGs by 2030, especially for SDG 9 (Infrastructure, Industrialisation and Innovation), SDG 4 (Quality Education), and SDG 3 (Good Health and Well-being). The study further suggested that it is the implementation and use of resources rather than their availability that influences the performance of the SDGs and ICTs can become the key influencing factor there (Huawei, 2017a).

Agriculture and its implications on global development

Agriculture is the only sector that probably connects almost all the 17 SDGs and so, developments in the sector can directly and indirectly play immense role in reaching the SDGs by 2030. While it can directly address hunger and poverty, water and energy use, climate change and climate smart technologies, and unsustainable production and consumption, the indirect effect is mostly on all of them. Rural people form the largest part of world's extreme poor and are directly or indirectly dependent on agriculture, development of which will result directly in their poverty alleviation (SDG 1). Agricultural extension services increase access to skills, tools, knowledge, and inputs, ultimately impacting education (SDG 4). Women farmers are as important part of the sector as their male counterparts in terms of both number and contribution, and investing in gender equality in the sector can go a long way in reducing global hunger as well (Goal 5). Agriculture sector is one of the major consumer of water resources and smart technologies to save and harvest water consumption can make efficient water use a reality by 2030 (Goal 6). While agriculture is a major consumer of energy as well, proper technology and investment in bio fuels can make the sector producer of clean energy (Goal 7). Agriculture can be a major source of employment generation in rural areas accelerated through pro-poor economic growth (SDG 8). Promoting urban and peri-urban agriculture can help develop a sustainable ecosystem and reduce pollution in the cities most effected by pollution like Beijing, Delhi, and so on (SDG 11). Channelizing and utilization of the production to reduce waste of agricultural produce can contribute to responsible consumption without increasing pressure on production systems (Goal 12). Climate smart agricultural technologies can not only help farmers cope with changing climatic conditions, but reduce carbon emission and increase productivity at the same time (SDG 13). Reducing deforestation, promoting biodiversity through indigenous crop varieties, and increasing efficiency of farmland can help improve life on land (SDG 15). But specifically SDG 2 which calls for ending hunger, achieving food security and improved nutrition, and promote sustainable agriculture required major initiatives in policy, planning and implementation fronts to 'provide access to food to all; address nutritional needs of the vulnerable sections of population; increase productivity and income through secure and equal access to land, other productive resources, inputs and knowledge, financial services, markets, and opportunities for value addition and non-farm employment'; ensure sustainability and resilience in face of natural and man-made disasters; and promote biodiversity through sound management of plant genetic resources. This will require investments in infrastructure, agricultural research and extension services, technology development, enhancing productive capacity, corrections in world agricultural trade policies, and proper regulation of food commodity markets to prevent price volatility and ensure increased access (FarmingFirst, 2018).

Agriculture sector is complex with involvement of multi-stakeholders – institutions, organizations, and national governments, who are required to align their interests and goals with the SDGs or mainstream the SDGs based on their mandates. With an estimated 50% higher food requirement by 2030, sustainable food production will require sincere investments in multi-faceted approach addressing scientific, economic, cultural, and logistical aspects of food security and agriculture challenges. As the agriculture sector will effect access to food, food waste management, efficient production and consumption, without well strategized implementation of programmes and policies, the effect can be across sectors (Mancini and Korosis, 2015).

ICTs in agriculture – disruptive technologies for grassroots

Changes in technological innovation has been affecting the agriculture sector for a long time now, and with increasing advances in the technology industry combined with higher demand for information and technology in the agriculture sector, ICTs in the future have an increasing importance. Efficiency in the agriculture sector is currently low in terms of sustainability, climate smart technologies, stagnant productivity, and waste management. And as identified and reiterated by the ICT and SDGs report (Sachs et al, 2017b), ICTs will impact the SDGs and agricultural development in two ways – increasingly transforming society and its elements through accelerated and augmented communication, and through swift breakthroughs in increased capabilities of the technology itself. For agriculture, it means increased use of advanced robotics technologies like Drones for soil and field analysis, monitoring of farm activities, crop health assessment helping in better decision making; sensors to easily analyze air, water, and soil and better data accumulation, analysis, and subsequent decision making from crops to livestock sector; Artificial Intelligence (AI) making decision making easier through image based automatic inspection and data processing for easier decision making; Augmented Reality (AR) for agricultural planning and research; and Blockchain technology to gather, interpret and share information (Connolly, 2016). Digital agriculture has the potential to make farming highly optimized, individualized, real time, hyper-connected and data-driven management (Es and Woodard, 2017). While the possibilities of ICTs in agriculture are immense and encouraging, digital divide is just as real a truth in the developed as well as developing economies.

Use of ICTs in the developing economies is mostly limited to TV, radio mobile phones, and web portals. While use of big data analytics, AI, robotics technologies, and IoTs are yet to pick up and become affordable for the economies, these tools are taking care of ICT requirements of the agricultural stakeholders. Major

functions carried out by the tools are offering localized and customized information; knowledge management; enabling collaboration, sharing, and partnership for innovations among extension stakeholders, giving farmers and other stakeholders at the grassroots to voice their opinions, and facilitating capacity development. The functions are generally performed to various capacities by the ICT tools described in Table 1.

Digital divide plagues both developed and developing nations, though their nature and scale are largely different. Digitalization is a pre-requisite for smart farming and rural broadband infrastructures, access to e-skill development, and strong policy roll out is of urgent need for European farmers in rural areas (Michalopoulos, 2017). Digital divide, with increased accessibility of ICTs have shifted from inequality of physical access to inequalities of skill and usage, commonly referred as second level divide (Hargittai, 2002; Dijk, 2012). The deepening digital divide caused by unequal skills, motivations, and preferences often limited to certain age, gender, education level, and occupation. In the agriculture sector, it translates to exclusion of women and older age group farmers, who practically require the information more. Also, income inequality makes access to certain ICTs difficult. In India, many rural women are found to own a cellphone but do not know how to operate, dial numbers, or read or write messages because of illiteracy; many do not know their mobile numbers and depend on their husbands (Aneja and Mishra, 2017). This digital illiteracy constraints its use both on and off farm, marginalizing a significant part of the population, and thus rendering the digital divide wider. While inclusion of ICTs in farming communities is important, strategic implementation is crucial as well depending on the need of the community. As discussed in case 1 below, integrating digital extension services with offline interactions with extension professionals increase efficiency, reduce cost, and contribute to better income in the long run.

Case 1: eArik – Agricultural extension for tribal farmers through ICTs

The e-Arik (Arik meaning Agriculture in the local Adi tribal dialect of Arunachal Pradesh) project, implemented in 2007 in Arunachal Pradesh state in North East India, was a unique one given its location in one of the remotest part of India where electricity itself was a rarity. The project covered 12 tribal villages and 500 registered farm families and aimed at single window extension service delivery through computer, Internet, phone, radio and television. Extensive personal contact with extension professionals under the project was also initiated to increase awareness about the project as well as consultation on agriculture production, protection and marketing aspects through ICTs. A two tier information delivery system was followed, where the extension professionals under the project visited the farms of the villagers and based on the identification of pest and diseases or other problems, suggested the remedies. In case they were unable to give a solution, the problem was recorded using digital photographs and communicated to experts in the eArik Village Knowledge Centre or the experts at Central Agricultural University, the implementing institution and the recommendations were communicated back to the respective farmers. The project portal provided further information on crop cultiva-

Table 1: Appropriateness of use of different ICTs for various functions

***** appropriate *** moderately appropriate *less appropriate

Functions	Information and Communication Technologies (ICTs)													
	TV		Radio		Mobile phones (basic/feature)		Computer/laptop/smart phones							
							Without internet			With internet				
	TV broadcasting	Video with DVD	Radio broadcasting	Community radio	Text	Voice	Expert systems/ decision support systems/interactive multimedia CDs	Digital video	Animation	Website/web portal/ knowledge banks/ online repositories	Tele/video conference	Mobile apps	e-Learning platforms	Social media
Offering localised and customised information, advisory, and other services	***	***	*****	*****	*****	*****	*****	***	*	***	***	*****	*	*****
Helping to create, document, store, retrieve, share, and manage the information	***	*****	***	*****	*****	*****	*****	*****	***	*****	*	*****	***	*****
Enabling collaboration, sharing, and partnerships for innovation among extension actors	*	*	*	***	***	***	*	*	*	*****	***	*	***	*****
Enabling farmers and others to gain a voice	*	*	*	*****	***	***	*	*****	*	***	***	***	*	*****
Facilitating capacity development of farmers, extension professionals, and other AIS actors	***	*****	***	*****	*	*	*****	*****	*	*****	***	*****	*****	*****

Global Forum for Rural Advisory Services (GFRAS) www.betterextension.org

Source: Saravanan et al., 2015a

tion, general agricultural practices, various schemes and programmes of agriculture and rural development department, market information, weather information, etc. A library at the village knowledge centre also made available a collection of publications, multimedia CDs on agriculture, and daily newspapers for the villagers. Computer training was also given to the young school students in the village for increased awareness (Saravanan, 2008, 2010).

The cost of extension service delivery to the farmers reduced by USD 53 per farmer, expenditure compared to conventional extension service delivery system was reduced by 3.6 times. Time taken by the farmers to avail extension services was reduced by 16 times, whereas, the time required for delivering the services was reduced by 3 times. The project also highlighted the need of appropriate methods of extension service delivery that balance offline and online methods depending on the context and need of the people to increase efficiency, rather than depending on solely ICTs, which might not have given the same outputs without the human contact. ICTs are also required to facilitate a multi-stakeholder partnership to carry forward the development initiated (Saravanan, 2012).

The project introduced computers to the farming community of the villages undertaken. With development, accessibility and availability of technological developments in the concerned villages, the project also introduced the concept of e-Village, a model ICT village for better access to information. With introduction of broadband connectivity in the areas, e-Agrikiosk was introduced or supporting the farmers with better decision making regarding agricultural activities and receive important information. As mobile phones became popular, the project m4AgriNEI (Development and Deployment of Mobile Based Agro-Advisory System in North-East India) was initiated in 2013 for mobile based information delivery to farmers. In the first phase of the project, push/pull information was delivered along with integrated IVRS calls in local languages. Database of registered farmers were maintained for better reference and accurate advisory. In second phase of the project starting from January 1, 2018, it is undertaken by Government of Meghalaya and maintained by iTEAMS (Integrated Technology Enabled Agricultural Management System). Market extension advisory services are also provided through toll free number 1917 in addition to earlier online and offline information delivery services and capacity development programme.

Mobile phones have revolutionized use of ICTs in the agriculture sector and have opened the gateway for inclusion of revolutionizing technologies of social media platforms. As of January 2018, there are 5.13 billion unique mobile users and 8.48 billion mobile connections, which is 112% of the total population. Active mobile social media users are 2.98 billion with a penetration of 39%. (WeAreSocial, 2018). Convergence and linkages have moved from linear research-extension-farmer mode to multi-stakeholder networks in complex settings. Interactive homogenous and heterogeneous groups follow different pathways and have varying nature, and social media platforms have opened up both for the pluralistic global networks in agricultural sector. Social media involves and engages the agricultural stakeholders; helps disseminating broad based information; the interactiveness gives it a flexibility as well as fluidity with changing times; archived information can be accessed anywhere, anytime; and enhances the facilitative role of extension organizations through gatekeeping of information, providing necessary linkages and supports, and forming a community online. A global survey on social media use by extension professionals worldwide emphasizes the increasing importance of its use in agricultural communities (case 2) (Saravanan and Suchiradipta, 2013; Saravanan et al., 2015b).

Case 2: Social Media and Agricultural Extension: A global perspective

Social media has given voice to the common people in every aspect, in every sector in the past decade and agriculture has not been away from it either. Facebook, Twitter, WhatsApp, YouTube and blogs are the major social media platforms used by farmers as well as agricultural extension service providers to reach peers, clients, and experts alike. While the intensity of use varies between developing and developed countries, it is getting a wider reach and acceptability nonetheless. GFRAS Global survey on use of social media in agricultural extension and rural advisory services conducted online survey across 62 countries and 229 respondents to understand how and why social media is used by extension professionals worldwide. Facebook was the most preferred medium and searching for news and events and sharing information were the major drivers for social media use. Authenticity of information shared online was perceived as a barrier by the respondents. Social construction of information (development and publication of information socially by the users) was considered as the most important feature of social media (95.1%). Optimism about the importance of social media in agricultural information dissemination was high among the respondents (95%). While popularity was high, many of the extension professionals (71%) expressed the need for further training on how to best use social media across platform, content creation for social media, etc. At organizational level too, while increase in social media use was increasing, there was a rising awareness and need for social media guidelines in the organizations to better guide and monitor the employees in their social media use. Overall, the respondents viewed social media as not just a tool to connect with larger audience, but to build relationships as well. Lack of skill and competency among extension professionals, absence of proper organizational guidelines, lack of infrastructure, identification of training needs, knowledge management through dedicated social media managers, an overall attitude towards social media, and inclusion of rural communities on the platform were identified as major challenges in increasing inclusivity of social media in agriculture sector, which needed multipronged approach at individual, institutional, infrastructural, and policy levels to overcome (Suchiradipta and Saravanan, 2016).

Strategies for ICT implementation in developing countries

Strong e-agriculture policy: Implementation of ICTs needs a push from policy front to legitimize the inclusion efforts. Planning at national level will not just help integrate ICTs at the grassroots, it will also help in budgetary allocation for carrying out the activities.

eReadiness and skill development: For making ICTs part of grassroots level activities, a positive attitude and understanding of the long term effects of ICTs is necessary. Skill and capacity development programmes to enhance user capacity can also bring about a positive attitude towards their use.

Backend support with infrastructure: Policy support and skill development can only do so much without proper infrastructure to translate the information into action. And for that, better broadband facilities, market and transport access, access to inputs, etc. also needs to be in place.

Convergence through e-platforms: Convergence of multi-stakeholder engagement have been a major constraint in agriculture sector in spite of their coexistence. To make the value chain efficient, high importance is required for promoting convergence and online platforms are a good place to start. Extension organizations can play crucial role in facilitating the convergence.

Promoting ICT champions: At community level, documenting and promoting ICT champions can not only be good indicator of its benefits, it also creates a pool of information for long term understanding of how ICTs impact communities. As good practices and success stories, they motivate ICT adoption too.

Implications of ICTs in bridging inequality in Agriculture sector

A round up of data from Indian Human Development Survey from 2005 to 2012 showed households without mobile phones have more access to private healthcare compared to those without mobile phones (Irwin, 2018). While developed economies rely on ICTs to enable social and economic development through transforming markets, creating new industries, and drive efficiency gains; least developed countries continue to be at a disadvantaged position due to lack of broadband infrastructure and poor internet connectivity. And considering most of the rural population of the developing and least developed economies engage in agriculture and allied sector, the gap keeps widening (UN, 2015). The Huawei Global Connectivity Index (GCI) 2017 (Huawei, 2017b) analyzed 50 countries of which, mostly developed countries emerged as front-runners in digital inclusion while middle and low income economies belonged to the adopters and starters group. ICTs were also found to be an engine of economic growth. But it was also observed that inequality among the nations have also increased making the 'digital divide a digital chasm'. This required attention from global community, policy makers and development agencies for increasing the need of ICT infrastructure development in the developing economies to give them a head start in the race to development. ICTs can specifically help the marginalized as has been observed in Pakistan, where food ordering platforms link home based women in informal food industry to wider pool of customers; in Rwanda where women farmers are connected through mobile technology to information, market, and finance; empowering women by employing them in information centres for delivering priority information to women clients in Bangladesh; identifying women innovators through grassroot innovation networks and helping them through financial assistance in India; and so on (Tottho apa, 2018; Mlambo-Ngcuka, 2018). There are more than enough evidence across the globe about how lack of ICT infrastructure can pull behind development and agriculture being a key driver in global development and reaching the SDGs, special efforts are required to bridge the inequalities at international, national, regional, and individual level.

Conclusion

In a world where knowledge and information is power and ICTs are transforming economies, it is not about if but how ICTs should be integrated to national and international development plans. While developed economies are way ahead in this aspect, developing and least developed economies need a boost. Majority of the poverty striken people from these regions are engaged in agriculture and so, strategically implemented ICT initiatives in agriculture sector can prove to be a boon for development. But then again, ICTs need to be supported by proper planning, infrastructure development, capacity building, and appropriate implementation to reap their full benefit, or they may end up increasing the inequality that exists. ICTs in agriculture sector can prove to be transformative to meet the ambitious SDGs, only if employed with understanding of their nuances.

References

- ✓ Aneja, U. and Mishra V. (2017). "Digital India Is No Country for Women. Here's Why" The Wire. https://thewire.in/139810/digital-india-women-technology/ (Published on May 25, 2017; Accessed on March 2, 2018).
- ✓ Close-the-gap.org (2018). "The role of ICTs in the UN Sustainable Development Goals". http://close-the-gap.org/the-role-of-ict-in-the-un-sustainable-development-goals/ (Accessed on February 25, 2018).
- ✓ Connolly, A. (2016). "8 Disruptive Digital Technologies... with the Power to Transform Agriculture" https://www.linkedin.com/pulse/disruptive-digital-technologies-power-transform-aidan-connolly-7k-?trk=mp-author-card (Accessed March 1, 2018).
- ✓ Djik, J. A. G. M. (2012). "The evolution of the digital divide: The digital divide turns to inequality of skills and usage" in Bus J. et al., eds., *Digital Enlightenment Yearbook 2012*. doi:10.3233/978-1-61499-057-4-57.
- ✓ Es, H . V., and Woodard, J. (2017). "Innovation in Agriculture and Food Systems in

the Digital Age" Chapter 4 in *The Global Innovation Index 2017: Innovation Feeding the World* Tenth Edition, Cornell SC Johnson College of Business, INSEAD, and World Intellectual Property Organization. http://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2017-chapter4.pdf

- ✓ FarmingFirst (2018). "The story of agriculture and the Sustainable Development Goals" https://farmingfirst.org/sdg-toolkit#home (Accessed on February 28, 2018).
- ✓ Hargittai, E. (2002). "The second-level digital divide: Differences in people's online skills", *First Monday,* Vol. 7 Issue 4.
- ✓ Huawei (2017a). "2017 Huawei ICT Sustainable Development Goals Benchmark" (HUAWEI Technologies Co. LTD., Shenzen, China) http://www-file.huawei.com/-/media/CORPORATE/PDF/Sustainability/2017-ICT-sustainable-development-goals-benchmark-final-en.pdf
- ✓ Huawei (2017b). "Harnessing the Power of Connectivity: Mapping your Transformation into a digital economy with CGI 2017" http://www.huawei.com/minisite/gci/files/gci_2017_whitepaper_en.pdf?v=20171115 (Accessed on March 3, 2018).
- ✓ Inequality.org (2018). "Global Inequality". https://inequality.org/facts/global-inequality/ (Accessed on February 25, 2018).
- ✓ Irwin, A. (2018). "Mobile phones worsen healthcare inequality in India" https://www.scidev.net/global/digital-divide/news/mobile-phones-worsen-healthcare-inequality-in-india.html?utm_medium=email&utm_source=SciDevNewsletter&utm_campaign=international%20SciDev.Net%20update%3A%2019%20February%202018 (Published on February 2, 2018; Accessed on March 2, 2018).
- ✓ ITU (2017). "Fast-forward progress: Leveraging tech to achieve the Global Goals" (International Telecommunication Union, Geveva, Switzerland) https://www.itu.int/en/sustainable-world/Documents/Fast-forward_progress_report_414709%20FINAL.pdf.
- ✓ Mancini, W., and Korosis, J. (2015). "Know your SDGs: Role of sustainable agriculture in ending hunger and achieving food security" https://www.chemonics.com/know-your-sdgs-the-role-of-sustainable-agriculture-in-ending-hunger-and-achieving-food-security/ (Accessed on March 1, 2018).
- ✓ Michalopoulos, S. (2017). "Smart farming hinges on e-skills and rural internet access" https://www.euractiv.com/section/agriculture-food/news/smart-farming-hinges-on-e-skills-and-rural-internet-access/ (Accessed on March 1, 2018).
- ✓ Mlambo-Ngcuka, P. (2018). "Reshaping the future: Women, girls and tech for development" http://news.itu.int/reshaping-future-women-girls-icts/ (Published on February 9, 2018; Accessed on March 3, 2018).
- ✓ Sachs, J. D., Modi, V., Figueroa, H., Fantacchiotti, M. M., Sanyal, K., Khatun, F., and Shah, A. (2017a). "ICT and SDGs: How Information and Communication Technology can achieve the Suatainable Development Goals" Interim report (The Earth Institute, Columbia University and Ericsson) https://www.ericsson.com/assets/local/news--archive/documents/press-releases/2015/9/ict-and-sdg-interim-report.pdf
- ✓ Sachs, J. D., Modi, V., Figueroa, H., Fantacchiotti, M. M., Sanyal, K., Khatun, F., Ramos, S. L., Grunewald-Weidman, E., Scharp, M. P., Shah, A., Gray, V., Biggs, P., and Reid, K. (2017b). "ICT and SDGs: How Information and Communication Technology can achieve the Suatainable Development Goals" Final report (The Earth Institute, Columbia University and Ericsson) https://www.ericsson.com/assets/local/news/2016/05/ict-sdg.pdf
- ✓ Saravanan , R. (2008). "e-Arik: ICTs for Agricultural Extension Services to the Tribal Farmers", Paper presented at World Conference on Agricultural Information and IT, IAALD-AFITA-WCCA 2008, Tokyo, Japan.
- ✓ Saravanan, R. (2010). "India", in Saravanan. R. Ed. *ICTs for Agricultural Extension: Global Experiments, Innovations and Experiences* (New Delhi, New India Publishing Agency), pp. 115–168.
- ✓ Saravanan, R. (2012). "e-Agriculture Prototype for Knowledge Facilitation among Tribal Farmers of North-East India: Innovations, Impact and Lessons", *The Journal of Agricultural Education and Extension,* Vol. 19 Issue 2 2013, pp. 113–131.
- ✓ Saravanan, R. and Suchiradipta, B. (2013). "Mobile Phone and Social Media for Agricultural Extension: Getting Closer to Hype & Hope?" Paper presented at International Conference on Extension Educational Strategies for Sustainable Agricultural Development: A Global Perspective: December 5-8, 2013, University of Agricultural Sciences, Bangalore, India.
- ✓ Saravanan, R., Sulaiman, R. V., Davis, K., and Suchiradipta, B. (2015a). "Navigating ICTs for Extension and Advisory Services". Note 11. GFRAS Good Practice Notes for Extension and Advisory Services (Lindau, Switzerland, GFRAS).
- ✓ Saravanan, R., Suchiradipta, B., Chowdhury, A., Hambly Odame, H. and Hall, K. (2015b). "Social Media for Rural Advisory Services". Note 15. GFRAS Good Practice Notes for Extension and Advisory Services (Lindau, Switzerland, GFRAS).
- ✓ Suchiradipta, B., and Saravanan, R. (2016). "Social media: Shaping the future of agricultural extension and advisory services", GFRAS interest group on ICT4RAS discussion paper (Lindau, Switzerland, GFRAS).
- ✓ Sustainable Development Knowledge Platform (2018). "ICTs as a catalyst for sustainable development". https://sustainabledevelopment.un.org/index.php?page=view&type=20000&nr=579&menu=2993 (Accessed on February 25, 2018).
- ✓ Tottho Apa (2018). "Brief description of TOTTHO APA" http://www.totthoapa.gov.bd/en/node/1401 (Accessed march 3, 2018).
- ✓ UN (2015). "Closing Digital Divide Critical to Social, Economic Development, Delegates Say at Second Committee

Debate on Information and Communications Technologies" Meeting coverage and Press Release. https://www.un.org/press/en/2015/gaef3432.doc.htm (Posted on October 28, 2015; Accessed on March 3, 2018).

✓ Wahlen, C. B. (2017). "ICT report showcases role of ICTs in accelerating SDG achievement". http://sdg.iisd.org/news/ict-report-showcases-role-of-icts-in-accelerating-sdg-achievement/ (Accessed on February 25, 2018).

✓ We Are Social (2018). "Digital in 2018: world's internet users pass the 4 billion mark" https://wearesocial.com/blog/2018/01/global-digital-report-2018 (Accessed on March 4, 2018). ■

Technologies and practices for small agricultural producers (TECA)

TECA is an FAO initiative that aims at improving access to information and knowledge sharing about proven technologies in order to enhance their adoption in agriculture, livestock, fisheries and forestry thus addressing food security, climate change, poverty alleviation and sustainable development.

The interactive TECA – technologies and practices for small agricultural producers – is an online platform developed by FAO's Research and Extension Branch to facilitate access to information that can benefit small producers around the world. This information can be accessed both through:

- a database of applied technologies and practices on various rural activities and supplied by partner organizations and initiatives; and
- online forums – or Exchange Groups – where members can enquire a community of practitioners about a specific agricultural technology or practice, and at the same time share their own experiences with other members looking for support.

The TECA platform:

- gathers and facilitates access to practical information (technologies and practices) that can help small producers in the field;
- enhances the participation of rural stakeholders in the development and improvement of technologies and practices for small producers; and
- contributes to food security and to the sustainability of farming systems managed by small producers

TECA targets practitioners from: producers' associations, advisory services (extension agencies), national research and development organizations, NGOs, universities, the private sector, and any group or initiative working for and with small producers

Technologies

Technologies consist of practices or techniques, tools, equipment, know-how and skills, or combinations of the aforementioned elements. To be included in TECA, technologies have to be:

- Applied by small agricultural producers. They have been successfully tested or used by small producers under actual field conditions
- A public good. These technologies are expected to benefit society in general and its application shall incur no copyright fees

TECA provides technologies and practices in: Agricultural mechanization, Capacity development, Climate change and disaster risk reduction, Crop production, Fishery and aquaculture, Forestry, Livestock production, Natural resources management, Nutrition, and Post-harvest and marketing

With TECA, users have easy access to a vast knowledge database to improve their production systems, product marketing and farm management. They can also benefit from online communities of experts (Exchange Groups) where they can share experiences and find solutions for small-scale systems.

TECA partners inside and outside FAO are responsible for providing the information on agricultural technologies and practices. These partners usually consist of national, regional and international research organizations, advisory services, universities, NGOs, development agencies, farmers' association and FAO technical divisions.

Exchange groups

Exchange Groups are online forums where people share their experiences and knowledge about different farming systems for small producers. They can be organized around a specific topic (for example, the Beekeeping Group or the Farmer Innovation Exchange Group), around a project (for example, the SALSA Project Group) or around a region or a country (for example, the Uganda Group).

For more information, access:

http://teca.fao.org