

ICTs Improving Family Farming

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Abstract

At the recent Agrifuture Days 2014 Conference held at Villach, Austria 130 participants from 35 countries discussed “*Information and Communications Technologies Improving Family Farming*”.

They considered the directions family farming across the world was evolving, the development in Information and Communications Technologies (ICTs), the impact these trends are having on farming and agriculture and the ICT related needs especially of resource poor family farmers. The participants recommended the following for ICTs to improve family farming:

- Policies promoting and enabling aggregation of family farmers and farming systems such as through cooperatives, producer organizations, farmer organizations etc.

ICTs can contribute to “virtual” aggregation of farms, synchronization of farm inputs, processes, outputs and logistics to participate in markets.

- New Forms of advisory and support systems for knowledge, skills and technology.

ICTs can enable access to just-in-time information for decision support and action.

- Trust Centers with Data and Information Agreements, Treaties with regulatory and enforcement mechanisms to share data at various levels and among multiple categories of users from plot, farm, farming system, region, national to global agricultural and related systems.

With the emergence of big data, cloud computing and advanced analytics, new issues and concerns on privacy, security, intellectual and property rights, values, ethics etc. are emerging in data and information management related to agriculture and farming. This will need transforming existing and developing new Institutional arrangements at various levels for data and information.

- New business-models that integrate governments, farmers and banks, insurance, market intermediaries, cooperatives etc. for participation in markets
- Inclusive governance of flow of data, information, knowledge, skills and technology
- Inclusive development of standards
- Open Technologies – Open data, information, knowledge, learning
- Increased democratization of science, learning and support to exponential innovation

- Lower cost of Hardware, infrastructure and connectivity

This paper presents the discussions that resulted in the above recommendations at the Agrifuture Days 2014 Conference.

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Introduction

At the recent Agrifuture Days 2014 Conference held at Villach, Austria, 130 participants from 35 countries discussed “*Information and Communications Technologies Improving Family Farming*” as a topic through expression of their research findings and collective, experiences, opinions and knowledge on trends and disruptions influencing:

- Family farming in different parts of the world which in general reflected trends globally
- Development of information and communications technologies, especially those influencing agriculture
- Family farming in the future that can be improved by the developments in information and communications technologies
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From this, they considered issues that are and would emerge for policy, Institutions, organizations, use of technology, in particular Information and Communications Technologies (ICTs), and the participation by agricultural and related communities in improving family farming.

Current status of family farming

Family farming of the present was under severe threat. Incomes from family farming are on decline. The youth from farming families are reluctant to take up farming as a vocation. Family farmers faced difficulties and are challenged in their ability to participate in markets, by change in climate and severe weather aberrations, loss, degradation and difficult access to land, water and other inputs for farming and loss of biodiversity which affected their livelihoods. Their access to new information, knowledge, skills and technology that was useful to their farming was being continuously eroded and reduced increasing their isolation from economic, social, political and technological change. In general, family farmers across the world are abandoning their traditional livelihoods and their numbers are diminishing rapidly. However, even with the current decreases, family farming will remain a livelihood for a majority of rural people for the foreseeable future till 2030 and after.

Though family farming has many commonalities across the world, when scrutinized they face heterogeneous and different conditions such as in crops grown, size of farms, government policies, access to new knowledge and technology etc., in each region, country and community. This entails that the applications of ICTs will need to be adopted and adapted for local conditions and their effective use.

The trends in family farming were:

- Aggregation of farmers/Further disaggregation (Breakdown of traditional communities and families)
- Increased market participation but also isolation from markets
- More complex food chains/Reemergence of simple food chains
- Access to massive data/information with capacities to process and use but also can cause new forms of inequities and information conflicts/Lack of capacities to learn and use information effectively and to adopt/adapt to change
- Increased more equal availability and access to affordable, safe, high quality, nutritious, healthy food but also reduced availability and access to adequate, wholesome, nutritious food for some individuals, households and communities.
- Agriculture as a polluter, major extractor of natural resources, contributor to greenhouse gases causing climate change and environmental degradation but also as a means, mitigating directly and indirectly climate change, for environmental protection and its rejuvenation.
- Greater recognition of farmer and farming services for protecting environment, heritage and quality of life

The future of family farming

There are several scenarios that may happen, with current trends, for family farming in the future. Family farming could end up into:

1. Rural poles of farms and farming linked to complex agri-food chains,
2. Continuum of rural-urban multifunctional systems of activities linked to local markets of diversified products,
3. Agro-industrial systems of activity linked to global markets of standardised products
4. Marginalized family farms in abandoned rural areas.

One or several of these scenarios (Bourgeois and Ferrand 2014) may exist or co-exist in a country or region depending upon policies implemented by governments.

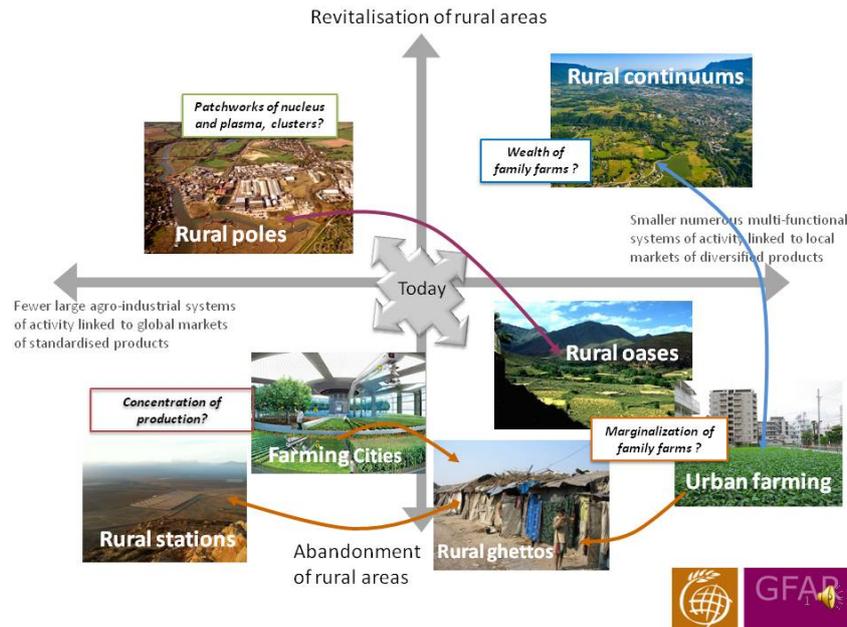


Fig. 1: Possible Scenarios for Future Farming Systems

Application of ICTs could influence the emergence and the function of underlying systems that support the above scenarios. Vice-versa the emergence of these scenarios could influence the application and use of ICTs. For example, rural poles with complex agri-food chains for agricultural commodities used as industrial and manufacturing feedstock and food would benefit from ICTs automation, robotics, integrated farm management systems and traceability systems and this scenario may drive the emergence and rapid development of these ICTs. Rural-urban systems could benefit significantly from information systems that enable educating producers and consumers on linkages between production and consumption in terms of resources used, wastage, ecosystem conservation and community participation. Similarly, large agro-industrial systems would greatly benefit from ICTs that can monitor and support decision making at various levels as also automate many human labour intensive farming functions.

An important question is whether ICTs can contribute to reducing marginalization of family farming and abandonment of rural areas by these farmers. These farmers also play a vital role in preserving cultural heritage and ecosystems that enhance the quality of life of urban areas, a role that is not yet fully recognized by society and such marginalization and abandonment of family farming could have disastrous consequences for the society.

Trends in ICTs

The trends in ICT were identified by participants as:

- Exponential increase in computing power, memory, storage, capability (Moore's Law) with lowering of costs
- Near-ubiquity of mobile computing
- Spread of broadband connectivity
- More big/open/real-time data
- More Cloud for data and apps
- Content Co-Generation

- Predictive Analytics and decision support systems
- Semantic Web
- Wearable Computers
- Internet of Things
- Telematics, Geographic information Systems with location services and more precise, real time earth observations
- Use of field sensors/embedded computing
- More and new social media
- More crowd-sourcing models
- 3D printing
- Visualization
- Automation, Linked Tools and Processes, Robotics
- Drones
- More smart phones and tablets

ICTs that are currently impacting agriculture

The ICTs currently impacting agriculture were identified by participants as:

- Automation, Robotics, Autonomous, Linked Tools, Equipment and Process Monitoring,
- Wearable Computing
- Controller Area Networking/Sensor Networks/Grid Computing
- Big data at different scales from field, farm to global
- Farm Management Information System
- Global Positioning System – Multi satellite
- Drones and Low cost Satellites/Micro satellites
- More precise geo-spatial data and 3D maps with elevation information
- Humidity, Ambient Environment and Soil Nutrient sensors
- Photometry
- Visualization and Integrated Display
- Social Media, MOOCs, Online Learning
- Rural access to online financial services
- Traceability systems using low cost RFIDs, NFC and other new technologies
- Telematics
- Variable rate Irrigation/Fertigation and prescriptive planting
- Weed, Biodiversity and Pest Management through Integrated systems

The current centrality of the Smartphone with mobile connectivity and access to cloud based data and applications are bringing to new and innovative knowledge based services to rural communities.

The uses of these ICTs individually and with other ICTs in systems are resulting in complex applications to improve productivity, resource use, reduce time and drudgery such as for farm management, forecasting, marketing, logistics and quality assurance. ICTs are increasingly improving access to information, knowledge, skills and technology for farmers and their communities, improving farm productivity and ability to participate in markets and in contributing to increased sustainability and resilience of farming systems while transforming them to meet new challenges.

There are fresh trends not only in digital ICTs but in all ICTs such as print media and in learning. There were also trends such as in the democratization of science and education that enabled increasing flow of new information and learning to family farmers. This could be harnessed and lead to an exponential increase in innovation and capacity to adopt and adapt new ideas, skills and technologies to improve family farming.

Key ICT drivers currently influencing Agriculture

A range of ICT drivers impact on a wide array of agricultural finance, credit, market, weather, aging population, cultural changes, energy cost, risk management, quality and safety assurance and other services for agriculture that are delivered by public, private and community organizations. These bring new forms and types of services. The key drivers are:

- Pervasive Computing
- Low Cost Connectivity
- Massive Processing Power through “Cloud” based computing
- Shareable tools, applications and intelligently linked content and data
- Mobile devices with multi-sensory inputs and outputs
- Ability to collect, analyze and reuse massive, distributed collections of data
- Ability of individuals and “amateurs” to create, manage and draw inferences from sophisticated information and learn
- Interactions of ICTs with biology, biotechnology, nanotechnology, space technology and materials science. These interactions are leading to development of high quality information from diverse entities and sources leading to new perspectives, concepts and innovation. The interactions and the information emerging from them is many a times self-organizing.

Pervasive computing, low cost connectivity along agri-food chains through a wide range of devices and platforms to access and use data, information and knowledge already contribute to increasingly knowledge-rich environments for agri-food chains. The use of mobile phones and other mobile devices as interfaces to connecting in these environments is now well documented. In future, multiple connectivity paths using devices different from those seen today will provide not only more but different connectivity than we see today.

Sensor sharing data and linked to Decision Support Systems and Geographical Information systems now enable monitor soils, weather, market and crop/livestock conditions and digital signatures and labels to track inputs and products from producer to consumer. In future, applications will come in many new shapes and sizes to suit even the most specialized needs.

Increasingly accessible data and information from public institutions, communities and individuals are becoming visible, publicly accessible and re-useable at the click of a device, many a times which is mobile, removing the constraints of location and bringing greater inclusion in their use. This is leading to need for and development of intermediary skills and applications to enable effective harvesting, making sense and adds value from this data and information for agricultural systems.

Increasingly interconnected knowledge bases and diverse sets of tools and applications available through digital clouds and as mentioned earlier made accessible and useable across

different devices from any location are enabling collaboration across boundaries as never before. Different communities are starting to connect and share their knowledge with each other, along value chains and across disciplines in new forms of innovation chains with wider actors including farmers, processors, traders and politicians enhancing innovation processes and their rapid spread.

As a result, pervasive computing, low-cost connectivity, massive computing power accessible through cloud computing with shareable tools, applications and intelligently linked content and data will provide **individuals and communities ability to create and manage sophisticated information and knowledge**. This “democratization” of science will draw actual farmers/producers and other agri-food chain actors into agricultural research, innovation and development processes. This could transform the entire structure of agricultural research and innovation systems and lead to an exponential increase in innovation (Maru 2014).

Indeed, much of the **data in future will be generated and shared by communities**. For farming and agriculture, this will be by agricultural communities who contribute to agricultural commodity chains from input, farming, processing, marketing to consumption. Fields and farms and all the processes in between will generate huge sets of data, “big” data that will need to be processed many a times instantaneously.

ICTs together with bio and nanotechnology, space technology and materials sciences are now defining the core direction of agricultural science, research, innovation, technology and development and opening hitherto unexplored new directions. This will intensify in the foreseeable future till replaced by new approaches and disciplines.

ICTs impacts on agriculture

How these drivers will develop and combine in the future will have an impact on agriculture. More investigation is needed but among expected impacts the following are highlighted:

- ***Lower Food and Agricultural Commodity Prices***
 - Through lowered input, throughput and harvesting costs through more efficient supply chains and reduced wastage
 - Improved Farmer and Farm Information System
 - Sensors and equipment linked to GPS systems linked through sensor networks and Internet of Things enabling more precise decision support systems, modeling and simulation for planning, monitoring, optimization and forecasting and automation
- ***Safe Foods***
 - Labeling, Traceability and Identity preservation
 - Safer handling, processing and transport of agricultural products, especially food
 - Monitoring of Food Production in Farms for safety
 - Reduction in Human interventions and possible contamination through robotics and automation
- ***Decreasing energy and chemical consumption***
 - Improving farm, processing and marketing logistics
 - Optimization of labor and machinery use

- Optimizing utilization of energy, fertilizers, pesticides, herbicides, water and packaging
- ***Healthy and Nutritious Foods***
 - Farm information Systems for monitoring good agricultural practices including those for inputs, crop management and harvesting
 - Monitoring of quality and safety during transport, processing and storage
 - Enabling logistics for “Just-in-Time” delivery of foods to consumers
- ***Socio-political and Cultural***
 - Taxation and Subsidies
 - Policies, Legislation and Regulations for cost, quality and safety of foods
 - Cultural preferences, authenticity assurance and reduction in waste
 - Animal welfare and ethically produced food
 - Environment/Ecology and pollution
 - Trade, local, national and international

Possible disruptions to trends

The possible disruption to the trends in farming and use of ICTs include:

- Health scares (food, environment)
- Trade disruptions and exclusions (Non-tariff, tariff, political, market failures)
- Political upheavals
- Information conflicts
- Other Resource conflicts (water, land)
- Developments in other technologies such as Nanotechnologies, Materials, Biotechnology, Space Technology
- Emergence of alternative socio-economic values to short-term profit and productivity
- Counter Movements such as for privacy and against intellectual property rights

Needs of Family Farmers for improving their Farming Systems through ICTs

The various trends (and possible disruptions) in family farming and ICTs, their possible scenarios and the key driving forces, equitable participation in fair and just markets and the need for learning to learn and effectively use knowledge, skills and technology for continuously adapting and improving family farming to emerging challenges indicate that family farmers for improving their farming systems through ICTs need:

- Policies promoting and enabling aggregation of family farmers and farming systems such as through cooperatives, producer organizations, farmer organizations etc.

ICTs can contribute to “virtual” aggregation of farms, synchronization of farm inputs, processes, outputs and logistics to participate in markets.

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There are several dimensions in fulfilling these needs such as for investment through public, private, crowd and community, infrastructure such as for data, applications, analytics, hardware, software and connectivity, content, integration of data, information, information systems and applications and governance.

These needs have to be considered together and actions taken to be holistically addressed to yield benefits to family farmers. They cautioned that action on only one or two items, as it usually happens, may not have beneficial results.

Summary

The conference concluded that ICTs can contribute to improving smallholder family farming in a more knowledge driven agriculture by:

1. Enabling family farmers to participate equitably and as entrepreneurs in markets that are more transparent, just and fair
2. Reducing transaction costs, wastage, improve quality, save time and decrease drudgery
3. Enabling and involving small, medium entrepreneurs and research institutions to provide knowledge based services for these farmers
4. Enabling gender and youth to access and share information and participate and engage effectively in all aspects of decision making in their farming and related livelihoods
5. Enabling and supporting small holder farmers to aggregate into cooperatives, producer companies and organizations with similar functions
6. Supporting these farmers to continuously innovate their farming and participate in research
7. Helping formulate policies and change Institutions, their structures and work processes

References

Club of Ossiach (2014) Agrifuture Days 2014: ICTs Improving Family Farming. Abstracts and Presentations. Parts 1, 2, 3. Agrifuture Days 2014, Villach, Austria, 2012.
<http://www.progis.com/events/agrifuturedays2014/downloads.html>

R.Bourgeois and N. Ferrand (2014). The Futures of Family Farming: Needs to achieve greater resilience. Agrifuture Days 2014, Villach, Austria, 2012.

A. Maru (2014) The Status of Global ICT for Agriculture and Possible Future Trends. Agrifuture Days 2014, Villach, Austria, 2012.

