

Summary of E-Discussions

1. Asian Agri-food chains are massive economic structures with deep links to agri-business and agro-industries whose contribution may be among the largest of any economic sector of an individual country. Through agricultural commodities trade they span the region and across regions and influence and are influenced by geopolitics, global finance and international trade trends. These trends also affect the evolution of Agri-food chains which in turn affect the selection, use and innovation of ICTs used in these chains.
2. Agri-food chains are continuously changing and evolving at different paces even within a country. They can be categorized as those in which 1. the Government or public sector 2. the producer organization such as a cooperative 3. Private sector made up of large corporates such as Supermarkets and fast food restaurant chains and 4. the free market with micro, small, medium and large entrepreneurs are actors who have pivotal control on the functioning of each of these categories of Agri-food chains. Some of these chains may have one or more pivotal actors in some form of partnership across the categories, for example Government with the producer organizations and/or private sector and form hybrid chains.
3. Rapid economic growth, equally rapid urbanization, diet change and widespread public concerns of food safety appear to be the most important driving forces for change in Asian Agri-food chains. These together are bringing market transformations which are effecting change in farming and production systems in Asia. These systems are becoming intensified in production and use of technologies.
4. Following global trends, the need to increase efficiency and reduce wastage of all input resources and outputs, which would include energy, from the farming and production system and in Agri-food chains, preservation of the environment and cultural heritage could be the driving forces expected to emerge in Asia . However, these driving forces could also be based on a social construct emerging from layers of causalities. The deeper layers would be societies and individuals' values about environment, equity and poverty, their beliefs in different ideals that are rooted in cultural dimensions. They may not be the same or in great prominence yet in Asia as in other Western developed countries. In Asia, with its current stage of economic development, they may even be politically viewed to include the interests of countries and organizations to promote this trend as an attempt to impose self-interests in agriculture especially by taking the excuse of environmental and climate change issues. The drivers in the future will be the extent to which these underlying values will be unveiled in the Asian context and the extent to which different individuals and different interest groups will be willing and be able to take action.

5. The Asian farmer and producer, a key actor in these chains, is largely a small holder who is resource poor in all inputs she needs for farm production and weak when participating in markets for her inputs and outputs. Along with Institutional and other changes, including new forms of aggregation such as Producer organizations, use of ICTs, along with biotechnology, nanotechnology, space technology and new materials are expected to contribute to improve production, productivity, incomes and livelihoods of these farmers.
6. ICTs are also expected to improve efficiency, reduce costs, improve timeliness of commodity, financial and information flows as also reduce drudgery in human efforts in Agri-food chains. They would also contribute to formation and management of Asian producers organization and their linkages, especially for information exchange and sharing, with other actors in Agri-food chains and consumers.
7. ICTs in Agrifood chains have potential to:
 - ***Lower food and agricultural commodity prices through:***
 - Lowered input, throughput and harvesting costs and reduced wastage through more efficiently informed and monitored supply chains
 - Improved Farmer and Farm Information Systems that brings better management of farms
 - Improved distribution
 - 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
 - ***Assure safe foods through:***
 - Labeling, Traceability and Identity preservation
 - Safer handling, processing and transport of agricultural products, especially food. An important area of ICT use is in maintaining and monitoring cold chains as also logistics as agricultural commodities pass through various actors in these chains.
 - Monitoring of food production in farms for safety and quality
 - Reduction in human interventions and possible contamination through robotics and automation
 - ***Decrease energy and chemical consumption through:***
 - Improving farm, processing and marketing logistics
 - Optimization of labor and machinery use
 - Optimizing utilization of energy, fertilizers, pesticides, herbicides, water and packaging
 - ***Contribute to producing healthy and nutritious foods through:***
 - 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 through:***
 - Rational Taxation and Subsidies
 - Improved Policies, Legislation and Regulations for cost, quality and safety of foods

- Supporting Cultural preferences, authenticity assurance and reduction in waste
- Assuring animal welfare and ethically produced food
- Contributing to protection and rejuvenation of environment/ecology and reduction in pollution
- Improved trade, local, national and international

8. The ICTs that are currently impacting Agri-food chains are:

- 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, QR, NFC and other new technologies
- Telematics
- Variable rate Irrigation/Fertigation and prescriptive planting
- Weed, Biodiversity and Pest Management through Integrated systems

9. The trends in ICT use in Agri-food chains are:

- 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
- Development of the Semantic Web
- More advanced wearable Computers for farmers, actors in food chains and livestock
- Development of Internet of Things
- Advances in Telematics, Geographic information Systems with location services and more precise, real time earth observations
- Further development and lowering of costs of field sensors/embedded computing
- More and new social media
- More crowd-sourcing models
- Advances in 3D printing
- Development of Visualization

- Increased Automation, Linked Tools and Processes, Robotics
- Development of more, portable, robust, lower cost, multifunctional Drones
- More smart phones and tablets

10. In future, ICTs can contribute to transforming Asian Agri-food chains with:

- ***Pervasive computing, low cost connectivity along 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 Agri-food 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.
- 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.
11. The possible transformations, through disruptions in current Agri-food chains, may occur in Asia leading to development of:
 - Large Corporate Driven Food Chains around multinational supermarket chains and fast food restaurants supplying densely populated urban areas
 - Farming cities, Peri-Urban and Urban Farming satisfying local urban demand
 - Rural – Urban Continuums with all services and facilities of Urban areas and revitalization of rural areas
 - Rural Ghettos resulting from abandonment of rural areas and smallholder farming
 12. Technology per se may not play a major role in transforming Asian Agri-food chains. They will abet any of the choices the Government Institutions will make for the development of Agri-food chains. It will be policies, rules, regulations, standards, norms, standards, finance, capacity development, infrastructure etc. that will define the development of Agri-food chains in Asia.
 13. However, in the context of Asian farming and agriculture which is largely smallholder based there may be a possibility of a mix of Agri-food chains operating simultaneously even in the same geographic locality. Virtual aggregation of farmers and enabling capacities for agricultural communities to manage their own informatics needs through use of customised ICTs (hardware and software) and knowledge services could enable sustainable and more resilient livelihoods and quality life of these communities.
 14. In democracies, it will be for the communities that depend on these Agri-food chains for food, clothing, health, recreation and other essentials for their quality of life to decide. The key issue for use of ICTs would be in informing members of communities about the choices they could make and their consequences.