Proceedings of GFAR-FAO Forum
"Forward Thinking for ICT use in Asian Agri-food Chains"
Organized at AFITA 2014 Conference, Perth, Australia
30 September 2014

Introduction

Asian agriculture and farming is rapidly changing keeping up with global trends. However, it also has its uniqueness and complexity. It still remains largely small-holder, family based and resource-poor. The shift to becoming market-oriented with ability to compete in cost, quality and safety of products also remains a major challenge.

Within Asia, Agri-food chains are rapidly evolving to meet local, national, regional and international markets' needs. These needs, which may be sometimes conflicting, include providing easily accessible, affordable, safe, nutritious, healthy, wholesome, quality food and economically viable industrial feedstock produced ethically in globally competitive markets. Emerging needs also include those to be produced, through sustainable means for farming systems, agriculture related livelihoods, energy, cleaner environments with more efficient use of natural resources such as land, water and soil nutrients, reduction of "greenhouse" gases emissions, sequestering carbon, contributing to the conservation of socio-cultural heritage and improving quality of life including through recreation in a rapidly urbanizing society. These chains may also be soon considered important producers of vital data and information affecting many areas of human activity including food and agricultural commodities availability, access, cost, price and affordability, environment, cultural heritage etc.

Information and Communication Technologies (ICTs) are rapidly transforming agriculture globally. They have the potential to make Agri-food chains more productive, sustainable, and resilient. They can also improve the quality, safety and lower costs in these chains. However, while ICTs are increasingly pervading agriculture and food value chains, their long-term developments and impacts are difficult to anticipate. Uncertainty depends on several factors, including the pace of technological progress (we are still at the dawn of the digital revolution), the speed of deployment and take up of technologies and infrastructures across the continents, the long lasting effects of mass digitisation of Agriculture and food chains on economy and society as a whole. The developments of Agri-food chains may also influence the further development of ICTs that are useful to one or the other among several different forms of these chains. Reciprocally, the development of ICTs may bring about new forms of Agri-food chains. In such an inter-locked and interacting relationship between development of a technology and a vital system for life, the role of the society and of Government in deciding upon choices available and direction to be taken also become critical.

The complexity of Asian Agriculture and emerging, complex, trans-boundary food chains now requires holistic and forward-looking thinking to chart the role of ICTs in these Agri-food chains. A foresight approach is crucial to analyse trends and uncertainties and formulate scenarios and options for action towards effective and efficient use of ICTs along with other technologies in these Agri-food chains[1].

GFAR-FAO Forum

I. Background: Issues in Agri-food Chains

[1] Foresight is defined here as "A systematic, participatory and multi-disciplinary approach to explore mid- to long-term futures and drivers of change" (http://bit.ly/FTPglossary).

The issues at stake for discussion in the Forum included:

- The creation of shared visions and roadmaps on Agri-food chains of the future and to identify issues that require global, regional and national responses as also local, systemic actions that bears enormous potential to catalyse change. This requires strategic thinking and planning at appropriate levels.
- Risks and benefits to be analysed as part of the Global, Regional, National and Local actions.
- Institutional and Cultural change, combining grassroots spontaneous action with structured, top down measures
- Agri-food chains that are becoming increasingly data and information intensive. Competitive advantage will be built by those who will get there first and will build data moats around their business as also have the capacity to process, analyse and interpret them. The technical, technological and ethical issues involved in the management of information and data of Agri-food chains.
- The direction ICTs applicable to Agri-food chains may evolve. Issues such as over-proliferation and fragmentation of formats, methods, processes, algorithms used across the Agri-food value chain.
- The asymmetries of capacities to effectively use ICTs, especially big data that could be the hallmark of these Agri-food chains.

The facilitators for the Forum were:

- **Robin Bourgeois**, Senior Foresight Advisor, GFAR Secretariat
- **Ajit Maru**, Senior Officer, Knowledge, GFAR Secretariat
- **Gerhard Schiefer**, International Center for Food Chain and Network Research, University of Bonn
- **Gerard Sylvester**, Knowledge & Information Management Officer, FAO-Bangkok

II. Activities: Program of the Forum

There were three sessions organized on 30 September 2014:

1. Providing the Background
2. What could be the Agri-food Systems of the future? What Agri-food systems we want?
3. What would be the role of ICTs in future Agri-food Systems? What could be the role of ICTs in the future Agri-food systems we want?

Session 1

Providing the Background

- 11:00- 11:15 Overview of Asian Agri-food chains and Background to the Workshop – Ajit Maru
- 11:15 – 11:30 The futures of Agriculture and Agri-food chains in Asia – Robin Bourgeois
- 11:30 – 11:45 ICTs used in Agri-food chains – Gerard Sylvester
- 11:45 – 12:00 Traceability Systems – Gerhard Schiefer

Session 2. Facilitated Group Discussion on:

A. **What could be the Agri-food systems of the future?**
B. **What are the Agri-food systems we want or do not want?**

- ***13:00-15:00 Group Discussion (2 groups)***

Material:

- A set of cards about the drivers of change and trends and disruptions in general and implications for rural areas
- A set of cards about the rural transformations and open space for the role of
- Sheets with the schema of an agri-food chain

Implementation:

Each group received a cards set of drivers of change and trends and disruptions in general and implications for rural areas (Annex 2a)and a cards set about rural transformations (Annex 2b) and sheets with the schema of an agri-food chain (Annex 2c).

.

1. For each driver the groups defined a plausible state of the future 20 years ahead for Asia, ensuring that the states they define are mutually compatible (that is they can happen logically together). 30 mns.
2. The groups combined each state together to form an image of the future. They compared this image with the seven rural transformation cards and selected which transformation is compatible with the image they had. If several rural transformations were compatible they indicated in which proportion they could co-exist in Asia. 30 mns.
3. Then they characterized the corresponding agri-food system using the reference schema provided. 30 mns.

- ***14:30-15:30 Plenary***
  1. 5mns per group: a description of the agri-food system.
  2. 30 mns: A discussion about which ones are most/less desirable and why.

Session 3: Facilitated Group Discussion on:

A. **What could be the role(s) of ICTs in the future Agri-food systems we want?**
B. **What actions can be taken for achieving the desired role(s) of ICTs in future Agri-food systems?**

15.30- 16:30 Group Discussion (2 groups)

Implementation:

Group 1 worked on how to ensure that each technology will best contribute to the desirable agrifood system and related rural transformation in Asia.

Group 2 uses the TRIZ* approach to identify how to make sure each technology will not contribute to the most desirable agri-food system and related rural transformation in Asia.

In both cases, each participant identifies one key condition and results are combined through the Method 1-2-4-All.

- ***16:30 -18:00 Plenary and Conclusion of Workshop***

1. 20 mns: each group presented the “Do” (group one) and “Don’t” (group 2).
2. 40 mns: plenary discussion about the actions needed so that ICT will work towards desirable rural transformations and the related agrifood systems.
3. 30 mns: Conclusion of the workshop

III. Results: outputs from E-Discussion and activities

The Forum began with presentations summarizing the outputs from the E-Discussion on Forward Thinking for ICT use in Asian Agri-Food Chains was organized by CIARD from 13 August to 8 September 2014 by the Facilitators (See Annex 1a,b,c,d). The summary and proceedings of the E-discussion is attached as Annex 2.

Outputs from Session 2

The Groups defined a plausible state of the future 20 years ahead for Asia and compared this image with the seven transformation cards. They selected the rural transformations compatible with the image they had developed.

Group 1 considered the changes that could be caused by use of sensors, social media, predictive analysis and internet of things in Asian Agri-food chains, out of the nine drivers given to them by facilitators. The rural transformation(s) they had as images was close to “Rural stations” as also “Farming cities”.

For the image close to Rural stations they imagined a production scenario with high level of homogeneity, deep human-machine interaction and the overcoming of geographic barriers. They felt that privacy could be threatened and marketing and transportation costs would be high.

In “Farming cities”, marketing activities would be considerably reduced along with the need to transport commodities and products long distances. There would be more direct linkages between producers and consumers.

They also had two alternative images considering all disruptive technologies resulting in either “Rural continuums” arising when knowledge is shared and “Rural ghettos” when knowledge is not shared.

Group 2 considered “use of sensors” and “predictive analysis” as disruptive technologies. With sensors they anticipated completely connected knowledge system and Cyber-brain, all in a computer with possibility to insert different optimized knowledge model for production, and making also consumer more aware about the product to inform all in the Agri-food chain and the consumer (about how good it is for her). It could lead to more food, less use of land and waste. But it could hinder farm level innovation and limit farmer knowledge as they will not need farming knowledge anymore. There could be a loss of diversity, like indigenous foods. A major risk associated with this transformation would be the lack of capacity to compensate for a possible failure of that kind of heavily automated knowledge network.

They had two possible images of rural transformations: “Rural stations” operated by farmers in the cities, but also an original view of “Rural continuums” where people in the cities would come back to the rural areas where activities would not be any more farming based and those returning to the rural areas would produce part of their food as a hobby and lifestyle.

The conventional representation of the Agri-food systems as a chain was challenged by both the groups especially when they considered Rural continuums and the implications of 3D printing in Agri-food chains. In order to better understand future transformations of rural areas and food systems, the concept of network (and network of networks) deserves to be further explored.

Outputs from Session 3

The Groups were challenged with the possibility that food and its form as people could consume it in the future may be very different from what is currently eaten.

Outputs from Plenary

Both the Groups after significant deliberation came to the conclusion that what mattered most as a result of this forward thinking process, it was not the technologies they had identified in Session 2 but how these technologies could or would be used, and to what extend that would contribute to the creation of desirable Agri-food systems and related rural transformations in Asia. Political, social and economic factors would shape financial, commodity and information flows across Agri-food systems which would in turn be significantly dependant on how consumer preferences for food might develop in the future. Political, social and economic factors would also impact upon consumer preferences and this would then reinforce how resources, commodities and information would flow across Agri-food systems.

The above consideration resulted from discussion in the plenary about the development of the technology of 3-D food printing.

3-D printing of food is already possible today, and could further develop. The ingredients used in such printing would be quite different from those used for conventional food production. These ingredients may be produced through manufacturing units in closed Agri-food systems as todays inks for Ink-jet and laser printers is produced with all the intellectual property rights controlled. But, there may also be a countermove from such a scenario leading to a great divide in society between those who can afford the “slow food” and those consuming 3D printed food which would be like today’s “fast food” sold by fast food chains.

How would that change the Agri-food system? Would “farmers” still produce the raw material for ingredients used in 3-D printing of food?

There was a controversy with some participants indicating that farmers will still have to produce the raw material and other saying no, there will not be anymore “farmers” in the process. The discussion then led to how 3-D printing of food would impact upon organizations. Using the example of the Australian Grain Development Research Council (GDRC), it was deliberated and concluded that 3-D printing of food would completely change

the way food would be produced, processed and transported and the GDRC would have to research many of the new ways and approaches that would emerge with these transformation and disruptions in Agri-food chains. It was pointed out that many of the possibilities that 3-D printing of food would bring out are already practiced in todays' food chains, for example, by-products that were not consumed as human food are increasingly used in the market after being processed in human food and we have also accepted flavored food so we have already started to walk the path towards Agri-food systems amenable to 3-D printing of food.

The plenary also discussed how not to make the 3-D printed food scenario happening, considering it as undesirable. The conclusions were:

- Use all other technologies available to enhance the natural food production system so that no 3D food printing will occur or only as a particular choice of people. If 3D food printer goes in the market, a social movement of farmers and the public can act to impede its invasion.
- To make the scenario where "Rural continuums" would produce and distribute more natural and conventional food to happen as this was considered the most desirable scenario. For this, participants proposed the following:
    - Develop decentralized and personalized technologies for farmers
    - ICT provide several options, these must be used judiciously by societies.
    - ICTs provides data for decisions about farm but these decisions are within set level of values, accepted norms and guidance and "regulations" of the Society. The concept such as of network neutrality and provision of information are utopian scenarios. Society must influence through politics and social pressures the use of ICTs in the long term for its own good, including challenges such as sustainability and harmless carbon foot print.

The also concluded that:

- All technologies are acceptable but what matters is how they are used, the choice in use is the key element.
- ICTs are developed because developers think it will help all problems but they should start with asking themselves what is needed and how it will be used for desirable outcomes.
- The future is not based on ICTs, but social inclusion, justice and social choices. Once we are clear about the future we want then we can be clearer about the technologies we want.
- Key issues are the mindset of the public as also satisfying basic needs for adequate, safe, nutritious food produced sustainably in line with the values of the society.

The take-home messages were:

- “To solve problems ICT and domain experts should work together”
- “We started with messy ideas but finally have a joint conclusion linking it to values of society, this was not expected”
- “Humans will make their own future”
- “Technology is an amplifier”
- “The core issue is the values and norms and how you get bring agreements and consensus at different scales”
- “We should not be driven by technologies but we should drive technologies”

IV. Follow up

The process will now be towards integration of all the perspectives presented in the workshops at Agrifuture Days, submission to the DG Connect, the E-discussion and AFITA face-to-face workshop and the Workshop conducted at CSIRO- Ghana on the same topic. This integrated report of all perspectives will be discussed in the context of how we can drive ICTs to contribute to the agricultural systems we want in the future.

Annex I

Background Discussion Summary

E-Discussion on "Forward Thinking for ICT use in Asian Agri-Food Chains"

13 August – 8 September 2014

Contributions to the E-Discussion

Conducted on http://www.ciard.net

Organized by:

GFAR

FAO FIAT PANIS

CIARD

ASICTA

AFITA

Contributors*

Ajit Maru	Italy
Anita Mann	India
Asad Rahman Nile	Bangladesh
Axel Drescher	Germany
Bharath Krishnan	United Republic of Tanzania
Biswajit Mondal	India
Cuiping Tan	China
Dean Diepeveen	Australia
Dhananjaya BN	India
Ehud Gelb	Israel
Fahd Rasul	Pakistan
Gerard Sylvester	Thailand
Gerhard Schiefer	Germany
Honghui Wan	China
Jancy Gupta	India
Jiayi Liu	China
Jieying Bi	China
Khalil Alsharjabi	Yemen
Leifeng Guo	China
Mahesh Chander	India
Mohammadreza Davari	Iran (Islamic Republic of)
Nengfu Xie	China
Nidhi Nagabhatla	Germany
Pisuth Paiboonrat	Thailand
Robin Bourgeois	Italy
Shuchun Pan	China

Singh Satendra Kumar	India
Sridhar Gutam	India
Tang Yan	China
Urs Wittenwiler	China
Wenjun Ma	China
Xue Yan	China
Yan Tang	China
Yin Yuan	China
Yin Yuan	China
Yunpeng Cui	China

*The list may not have included all contributors. If a contributor to the E-discussion has not been acknowledged in this list please inform CIARD organizers.

Facilitators

Leisa Armstrong, Senior Lecturer, Edith Cowan University

Robin Bourgeois, Senior Foresight Advisor, GFAR Secretariat

Dean Diepeveen, Research Scientist at DAFWA and Adjunct Associate Professor at Murdoch University

Ajit Maru, Senior Officer, Knowledge, GFAR Secretariat

Gerard Sylvester, Knowledge & Information Management Officer, FAO-Bangkok

Gerhard Schiefer, International Center for Food Chain and Network Research, University of Bonn

CIARD Team

Giampaolo Rugo

Imma Subirats

Valeria Pesce

Vassilios Protonotarios

Summary

1. Agri-food chains produce and transact commodities, finance (money) and information from agricultural production systems for consumption as food and industrial feedstock. This is through a web of actors involved in production, transaction and consumption functioning as a network.

2. The role of ICTs in Agri-food chains is to bring efficiency in production, transaction and consumption and use and sharing and exchange of commodities, finance and information towards a desired, common goal. The efficiency sought could be in one or more of the following: reduction of costs, decrease in time of transaction, improvement in quality and reduction of drudgery and human pain of some or all involved as actors in these chains. Some Agri-food chains may include social and therefore political goals such as to bring transparency and greater equity among actors, especially producers and consumers, to share benefits.

3. Governments, through policies and Institutional structures, and in open economies, the market defines the evolution and further development of Agri-food chains.

4. The objectives of research and innovation activities related to Agri-food chains are to recommend intervention and generate technologies to maximize benefits, especially achieving economic goals though some Governments, the private sector and communities may consider research and innovation in Agri-food chains to also achieve social goals.

5. 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 geo-politics, 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.

6. 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.

7. 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.

8. Agri-food chain development in Asia can also be perceived as moving across three phases i.e. the first phase of feeding, in numbers, the populations of each of the countries and ensuring food security, the second phase, in addition to feeding the population and ensuring food security also assuring food safety and quality and the third phase of feeding the population and ensuring food security, assuring food safety and quality and proper nutrition for their populations.

9. 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.

10. 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.

11. 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.

12. ICTs in Agri-food chains have potential to:

A. 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, modelling and simulation for planning, monitoring, optimization and forecasting and automation

B. Assure safe foods through:

- Labelling, 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

C. Decrease energy and chemical consumption through:

- Improving farm, processing and marketing logistics
- Optimization of labour and machinery use

D. 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

13. 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

14. 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

15. 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.

16. 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

17. 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.

18. 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.

19. 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.