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

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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

Text organized and edited by Ajit Maru

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

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.

Introduction

Asian agriculture and food chains (Agri-food chains) are rapidly evolving to meet local, national, regional and international markets' needs. These needs include providing easily accessible, affordable, safe, nutritious, healthy, quality food and economically viable industrial feedstock, both produced ethically in globally competitive markets within their own countries and for export.

Asian Agri-food chains are already complex in their geographic coverage, sourcing, variety etc. and they are increasingly becoming more complex. Within each country in Asia, as they improve incomes and quality of life, issues of food inflation, affordability, quality, safety, nutrition and health have emerged. While all Asia countries strive to increase production, productivity and profit from farming and trade in agricultural commodities, they also have to now even within their own domestic markets compete with global markets. This competition is not only of price but also of assured safety and quality. In China, there is significant distrust, after the surfacing of several cases of food adulteration, of its Agri-food chains. In India, inefficiencies in Agri-food chains have resulted at one hand huge amounts of wastage of food and at the other end high food inflation and food becoming unaffordable to the poor. India also suffers the same distrust of its Agri-food chains as in China. Many other countries in Asia have similar issues including the more developed countries such as Japan.

Asian countries trade in large quantities of food and other agricultural commodities. The region imports corn, soya, wheat, processed foods, cotton etc., and are also exporters of rice, edible oil, wheat, fruits and vegetables, meat, poultry, cotton etc. The international market is both within the Asia region and across regions. This participation in international markets entails significant trans-boundary flows of information along with the commodity and finance. The information, in addition to that needed commercially, also needs to inform and assure that the food is not only safe but produced as per internationally accepted standards for production, quality and hygiene. Increasingly, agricultural commodities are also required to assure that they are ethically produced. As Asian countries, notably China, South Korea, Malaysia, Japan and India enter into the International processed food markets, the demands on information systems that support Agri-food chains and those related to these chains will increase significantly.

The Framework for the E-Discussion

This discussion will be in 3 phases. In the first phase we will consider "What will Agri-food Chains in Asia be like in the future (2020-2030)?"

As facilitators, we suggest that within the overarching question of Agri-food chains in the future we can discuss the following questions also.

- What sort of farming and agricultural production systems are features of Agri-food chains?
- What will be the driving forces for development of Agri-food chains?
- What will be the role of ICTs in driving the development of Agri-food chains?
- What are the possible disruptions in the development of Agri-food chains?
- Based on the above, what will be the future scenario of Agri-food chains?

Comment

It might be helpful to define Agri food chain - clarify e.g. F2F (Farm to Fork), levels in the chain - e.g. food for cows leads to milk to cheese production which leads to brand design which goes to wholesale, retail and consumer (cooperative) which has its own outlet, etch variations. This will enable going deeper into the details of each unique stage and, re chain overriding focus, detail the "between" aspects between the stages/links in the chain.

This procedure might streamline comments ingestion and enable reactions to them by various participants from various points of view.

Comment

It is very difficult to have one definition of Agri-food chains as they are very contextual. There is a very interesting document from IICA (available here: http://repiica.iica.int/docs/B1617i/B1617i.pdf) which explains why.

It would be very interesting for our participant to further elucidate what they consider Agri-food chains in the context of this discussion.

Comment

Thank you for the extremely thoughtful questions. If I may reorder and rephrase them just so that we get a different vantage point:

What do we want to represent the future scenario of Agri-food chains? How do we disrupt the development of Agri-food chains to satisfy the objective from the above question? (This should also suffice for the driving force question?

What will be the role of ICTs in driving the development of Agri-food chains?

What sort of farming and agricultural production systems are features of Agri-food chains?

Comment

Five inter-linked transformations in the Asian Agri-food economy: Food security implications

By Thomas Reardon, C. Peter

Global Food Security 3 (2014) 108–117

Abstract

"Five interlinked transformations" of the Agri-food system are occurring rapidly in Asia and are well along in Latin America and emerging in Africa: (1) urbanization; (2) diet change; (3) Agri-food system transformation; (4) rural factor market transformation; (5) intensification of farm technology (the agricultural transformation). These transformations are linked in mutually causal ways in all directions—the transformation is of an integrated system rather than piecemeal, independent changes. This means the overall transformation has the potential to be very rapid and complicated. The new situation is not linear and easily predictable, but there remains the need to act – by both the private and public sectors –in this rapidly changing environment. Having an informed vision of these dynamic interrelationships can sharply improve the potential to act appropriately.

Full paper at: http://ac.els-cdn.com/S2211912414000091/1-s2.0-S2211912414000091-main.pd...

Comment

Many thanks first raising the issue of Agri-food chain, for CIARD, facilitators, and for all the colleagues who have made their contributions so far.

The issue of Agri-food chain by itself is a very broad topic in nature. It is not growing so quickly mainly due to its interlinks with various aspects and sectors of any society at micro and macro levels. Farming and agricultural production systems change slowly. Many overlapping factors enter into the circle each of which comes to play a certain role. For example, the climate change; the level of socio-economic transformation, and many other local-specific dimensions of a certain country are of critical relevance in this respect. The development efforts in areas of irrigated agriculture conditions in many countries have induced more market responsive production. This was directly and indirectly affected by development interventions at least in the beginning. This might have lasted for 1-2 decades and perhaps more under other situation. The trends referred to have truly occurred but without a certain mode or model. It might have taken different time spans in different zones within same country, and in different countries or region, i.e. urbanization and changes of food consumption patterns. Development being a process of learning how to change in the right or desired direction has led to the creation of new change agent, producer, broker, merchant, organization, market, vehicle owners, food processing worker, and so on and so forth. The extent to which the Agri-food chains would change and grow is linked to similar exercise of the particular society resulting from its developmental learning and accompanying changes in attitude, knowledge and practice including decision-making. Certainly, there will be some changes overtime, in Asia and elsewhere too, but how much of the same may happen in each case? Possibly, such a change be felt where there is fast-growing economies and more stable states as compared to others where the producers, consumers and the whole society is suffering from many severe problems and serious obstacles afflicting the whole nation.

Commodity demand, price and profit, number of actors in the chain, presence or absence of subsidies, systems sizes, equity and equality, corruption, smuggling, political and armed conflicts, terrorism, policies and strategies, regional and international relations, infrastructure, ICT, science, technology and innovation systems, the free-trade treaty, standards and specifications are possibly some, but not all, factors affecting Agri-food chains or systems. For specific commodities the chain may grow and will be subject to change much more as compared to another commodity. For example, in Yemen the prickly pear (Indian

fig/opuntia) until recently was a neglected crop and was mainly grown in marginal un-tilled areas. It has recently grown into an important, cultivable, and exportable crop. Though drought, poverty, market demand, government responsiveness and support, active role of the private sector alongside with the quickly growing ICT's role in the society, are important factors that have contributed towards such a development.

In this regard, based on many examples and changes, one may anticipate the development of more collective and specialized Agri-food chains.

Many other points and questions need to be tackled but maybe next time.

Comment

We (the University of Freiburg/Geography together with AVRDC -The World Vegetable Centre) have recently accomplished a pilot project on "Understanding Urban and Per urban Vegetable Production and Marketing Systems through GIS-based Community Food Mapping in Greater Bangkok, Thailand" (VegGIS).

In order to understand the food system, a holistic approach combining quantitative and qualitative methods needs to be applied. The food system comprises of producers, markets, street vendors and consumers, who interact with each other on different spatial and temporal scales.

The system is not static but subject to changes and fluctuations depending on external and internal political, socio-economic and geographic drivers. From our observation the key drivers of the system are still the (small-scale) farmers often overlooked.

In the context of rapid urbanization, Agri-food systems are subject to changes, which of course have an influence on food supply, nutrition and consumption.

In the future, various environmental changes might endanger the food supply of the urban and the peri-urban areas, especially regarding vegetables:

- Available arable land in peri-urban areas is being reduced by urban sprawl respectively by the ongoing development of settlement compounds.
- Rising prices for development sites might seduce farmers to sell their arable land.
- Global climate change may cause extreme weather conditions like higher temperatures, droughts, heavy rainfalls and floods.

- Aging farmers and the unwillingness of the younger generation to work as farmers might cause a different land use of formerly cultivated land.

ICT was used in the form of a GIS-based Collaborative Research Environment (CRE) which in fact proved to be an efficient web-based tool to store, handle, analyse and visualize data, and make them public. On a larger scale this tool is suitable for decision makers on the Community level (e.g. farmers) as well as on the policy level (e.g. Ministry of Agriculture).

More Info: http://veggis.geographie.uni-freiburg.de/

Comment

In continuation of points raised an interesting document about Global Agri-food chains is available here:

http://www.unido.org/fileadmin/user_media/Publications/Pub_free/Global_v...

Comment

This working paper from the organization could also be useful:

http://www.unido.org/fileadmin/user_media/Publications/Pub_free/WorkingPaper_VC_AsiaFinal.pdf

Policy

Comment

I have been following with interest the comments and the participant's prioritising of the Phase 1 issues namely: "What will Agri-food Chains in Asia be like in the future (2020-2030)?"

and

"…..what futures may happen for Asian Agri-food systems and ICTs through research innovation, changes in institutions, regulatory frameworks and organizations at international, regional and national levels……?"

Prior to moving on to Phase 2 I would like to share again that it is very difficult to have one definition of Agri-food chains as they are very contextual. In the discussions till now it is sometimes difficult to associate the comment to which Agri-food chain definition the comment is directed.

A point of interest in this sense is the assumption that an Agri-food Chain is a "positive" entity – positive defined as a "desirable solution to a defined need". Experience indicates that such a "chain" (in entity or in part) can become a platform for political manoeuvring, a tool of malicious competition, external intervention in production sequences, external economic considerations, and other negative eventualities.

The discussion comments till now mainly reflect and adopt participants "top down" perspectives and attitudes. It might be insightful to include "hands-on" producer's points of view within their domains. These range from the discussion already mentioned re small-scale farmers, their local small scale aggregations up to eventual dominant positions in some or all aspects of multi-faceted Agri-food chains.

Re Phase 2 - ICT oriented discussion:

Two understandings are essential in the discussion:

a. Differentiating between ICT's impact on existing routines and on innovative procedures and aspects; b. Relating ICT to inclusion, exclusion and digital divide issues of influence.

Regarding the aspects of ICT as the controlling factor of an Agri-food chain - defined as a publicly owned utility - the list of issues is long. Isolating technical and content concerns might help in pinpointing action

priorities for an Agri food Chain. For example - Once you master an ICT what do you do with it?

Regarding the role and impact of ICTs on various aspects of ICT Adoption in general, Agri-food chains, Agricultural Extension and more - the following links can be informative and useful in discussing Agri-food chains:

a. e-Book Table of Contents: ICT in Agriculture: Perspectives of Technological Innovation http://departments.agri.huji.ac.il/economics/gelb-table.html

b. ICT Adoption Trends in Agriculture: A Summary of the EFITA ICT Adoption Questionnaires (1999 - 2009) http://departments.agri.huji.ac.il/economics/voet-gelb.pdf;

c. Information and Communication Technologies (ICT) for Agricultural Extension http://departments.agri.huji.ac.il/economics/volfson-gelb-gal.pdf;

d. The Village Knowledge Centers of Pondicherry (An Indian ICT Adoption case study) http://departments.agri.huji.ac.il/economics/gelb-swindell.pdf

e. Agri-food chains: a tool for strengthening the institutional framework of the agricultural and rural sector http://repiica.iica.int/docs/B1617i/B1617i.pdf

Comment

The above Comment gives an important insight about Agri-food chains being "positive entities" and that they are in their development designed around a desirable need. In most cases the needs are defined by political and/or economic goals. A classic example is now being played out in India. There is a call for allowing foreign direct investment (FDI) in multi-brand retail which will allow foreign capital and arguably, technology, through multinational supermarket chains to improve India's Agri-food chains through improved efficiency to lower food costs. At one end of the debate is the opinion that it will severely affect the micro, small and medium entrepreneurs that service India's food retail markets. At the other end, there is a rising demand from the now increasing urban middle class to have access to supermarkets for satisfying their needs. The argument is that most votes and financial contributions in urban areas for the political party now in power are from these entrepreneurs. There are similar instances elsewhere, in China, Koreas, and Japan where political direction defines Agri-food chains. This was discussed obliquely when it was

indicated there must be policy direction for development of Agri-food chains.

As a consequence of Agri-food chains being "positive entities", ICTs that may be used or not used in these chains also are indirectly defined by political direction. For example, bar coding on labels of food packets to be sold in India. Bar coding leads to more easy financial accounting and tracing products but is resisted because it brings greater transparency in the tax system as also reduces spurious, adulterated and fake products etc. entering in the market. In the long run, investments in technologies such ICTs are not encouraged and with it indigenous research and innovation.

Unfortunately, the discourses on issues such as FDI in multi-brand retail or in changing Agri-food chains seldom discuss the impacts it has on technology use. It is only when very severe problems as seen in the "Mad Cow disease" episode in Europe and North America or the Melamine contamination in milk in China occur that issues of technology, in these cases for traceability systems, are discussed and acted upon.

Comment

An interesting video about Agri-food Chains by Government of Western Australia.

It states many of the issues we are discussing.

The video link:

https://www.youtube.com/watch?v=kB8i-yD0Wrg

Trends

What decides development of farming, agricultural production systems and Agri-food chains?

Till the use of fertilizers, based on the discovery of an artificial way of producing urea by Friedrich Wöhler and Justus von Liebeg's studies on plant nutrition, farming and agricultural production systems largely developed on the basis of soil fertility and water availability. The use of fertilizers freed farming to be driven by other forces such as markets, politics and technology. Alongside this, industrialization created demands for agricultural commodities such as cotton and gave rise to cities with concentrations of large populations that were not involved in food production but which had to be fed.

Of course, politicians and rulers since the beginning of civilization like food to be cheap for consumers. They make policies and rules towards this end. Many of today's farming systems and Agri-food chains are a result of this politics.

Agri-food chains are increasingly being driven by globalized, highly competitive markets. This is seen through large scale emergence of super markets and fast food chains as in developed countries where foods and agricultural products from a wide variety of sources across the world are available. They are replacing traditional markets and avenues of accessing food and many other agricultural products. They are also making Agri-food chains more closed and controllable by single entities.

However, several forces have also started exerting pressure. Foremost among these are the demands for safe foods and those produced ethically. Other forces include the need to reduce wastage, especially of natural resources and energy, make agriculture sustainable, reduce pollution and harmful effects on the environment, produce and trade agricultural commodities fairly and prevent monopolies, produce foods locally as also preserving heritage of the environment, ethnicity and culture.

Some of these driving forces are forcing new forms of farms and farming systems. We now see factory farms, corporate farms and farming complexes producing huge quantities of the same type of agricultural commodities. We are also seeing huge swaths of rural areas, once productive farms, now abandoned or under farmed as farming as a livelihood is not attractive and remunerative with these new driving forces, especially those that bring globalized agricultural markets.

We should also consider that farm inputs are also now a part of complex Agri-food chains. Seeds, fertilizers, pesticides, farm machinery, energy, even knowledge and skills have a variety of sources and very complex paths till they reach farms. And from the farm, food and agricultural commodities again have a complex chain along which they pass and are processed and packaged till consumed.

We may reach an interesting conclusion emerging from examining today's Agri-food chains. Are farms and farming central to the design of these chains as commonly assumed? And, do they design the construct of Agri-food chains. Or vice-versa, do Agri-food chains design farming systems? And if so, what sort of farms and productions would we have when designed around an Agri-food chain?

To me, the driving forces in future would be, in addition to those now in force and emerging, would also be how technology fashions what we may at present not even call as agricultural products or produced in units that we do not recognize as farms. For example, farms producing "farmaceuticals" or medicines and biologicals for medical treatment or high tensile silk from milk (See http://learn.genetics.utah.edu/content/science/pharming/) and industrial factories producing meat through tissue culture.

The developments of Agri-food chains in Asia are at a very interesting point. Asian countries have to feed huge populations with India and China together making more than a third of the global population. And these populations are still growing. Many Asian countries have comparatively rapid economic development. Because of this, there is growing demand for more high value foods, especially animal products. This makes them major importers of food grains, pulses and animal feeds. Rapid industrialization in these countries creates large migrations of rural people to urban centres that are increasing in numbers and sizes. Each of these countries has and still experiences high food inflation that ultimately eats into economic growth and creates political instability. Many of these countries face huge challenges in assuring safety and quality of their foods. Several of them face issues of large scale malnutrition, obesity and epidemics of other related diseases such as diabetes.

Asian countries, notably China, India, South Korea, Malaysia and Thailand have been exporters of agricultural commodities and in the recent past food grains. They are also now vying for international markets as exporters of processed foods. They will now, in addition to being globally competitive in prices, need to also meet international standards of quality,

safety and ethics. In the long run, as their participation in global food and agricultural commodities markets grow, they will also be influenced by the same driving forces that are emerging elsewhere.

A very wide spectrum of ICTs will need to be employed in Asian Agri-food chains as they change and develop driven by forces described above. ICTs will need to make agricultural production and marketing with lower costs and higher quality and safety that is assured and trusted. Asian Agri-food chains will need to integrate ICTs so that they can participate in global markets.

The main challenges for Asian Agri-food chains are in its largely small farmer based farming systems. And this is also a challenge in the uses of ICTs in its Agri-food chains. How can Asia meet these challenges? Can Asia use ICTs innovatively for its agriculture to be both small holder based and its Agri-food chains to be globally competitive? If yes, how?

Comment

"The food chain" usually is to emphasize the whole chain management from field to the table, and not only confined to food security, greater emphasis on food safety.

From the design point of view, we are still in a strong traditional regulating food safety system. In theory, the realization of food security has three stages, the first stage of food security is the number of security; the second stage is the quality guarantee of food security; the third stage of the food security is the emphasis on food security and nutrition to meet consumer preferences. At present, China is in the transition from the second stage to the third stage of the process. Therefore, to adjust traditional food security strategy to the grain security strategy and to undertake a top design on agricultural food train management system are the biggest issues facing agriculture and rural reform in Chinese current agriculture and rural reform and also one of the most urgent tasks.

With advanced ICT support, the national food train system may be even efficient and facilitate the modern management in the future.

Currently, genetically modified food is a major subject of Chinese public concern. The public want to know whether the food we eat is genetically modified or not. With the development of information technology, I hope that all food product has a two-dimensional code that uniquely identify the whole process of the food chain, including whether the raw materials is genetically modified. The public will be able to know the whole process of

the food chain through mobile scanning. Of course, IT alone cannot solve the problem. However, I think that IT will play an important role in the food chain tracking and the public right to learn the truth.

Comment

In continuation of contributions made, in my opinion, at least in the Asian context, public policy direction by Governments towards transformations of Agri-food chains is imperative. Without such direction, the issues raised indicate, i.e. difficulties in system organization and focus of content remain and emerge anew. There is evidence elsewhere for such policy directions, for example, ensuring and assuring food safety to public. The "Mad Cow Disease" (Bovine Spongiform Encephalopathy) episode in Europe and North America in the 1990's brought to fore the need for traceability of meat. Similarly, Dioxin contamination in poultry feeds in Belgium in 1999 forced traceability issues to shift from product level traceability to process level traceability.

It is important to note that the use of ICTs to manage traceability related information were a result of this policy direction in Europe and North America. A similar story can be narrated for the implementation of EUREPGAP standards and computerization of farm information management in Europe.

Thus, a conclusion can be made that availability of ICTs for a farm or agricultural activity does not result in a transformation of Agri-food chains/systems. Appropriate ICTs however support and enable and many a times innovate Agri-food chains following a policy direction. This has implications for many ICT based development programs for agriculture in Asia that without clear policy direction for transforming Agri-food chains, it is futile to develop programs around use and application of ICTs in them.

The role of media, and now social media, is also very important for politically and socially bringing transformations. The organic foods movement and the "Green" movement of protecting and rejuvenating the environment are also how they have brought transformation in Agri-food chains and as a consequence to the use of ICTs to support this transformation.

From current trends, I observe that Agri-food chains in Asia are now under pressure to undergo or are transforming. In India, food inflation, implementation of the right to food and ensuring food safety and quality is forcing the transformation. China also has pressure to curb food inflation though its cause is in some ways different from India's and a huge task to

assure the public of safety and quality of the foods they consume. Certain countries such as South Korea, Thailand and Malaysia are orienting their Agri-food systems further towards participating in global processed food trade which will need a shift in focus of information systems related to agriculture and farming. In the next few years the focus of transformations, looking at trends in developed countries, would be to include reducing wastage and bringing greater efficiencies in use of natural resources and energy, protecting the environment and cultural heritage preserved in rural areas. This would bring new perspectives in managing information in Agri-food chains. Data collection processes will change, the focus of current content will change, new issues of integrating information and information systems will emerge with concerns about privacy and intellectual property rights. We now have a wide variety of ICTs that will be used to support all these transformations in Agri-food chains. We now need to consider these ICTs use in the future in more detail.

Comment

If we were to look at standard frameworks for example sharing agricultural data and information related to Agri-food chains in Asia how would we go about developing them?

In my opinion, the first task would be to set a purpose, for example to improve trade in agricultural communities for Asian countries. The second would be to establish which country trades, both import and export, on what commodities with whom within Asia or outside Asia. Having established the commodities, volumes and values, the next step would be to prioritize and identify appropriate sets of data and information to be shared and exchanged. This would lead to identifying the standards for sharing, including interoperability of data and information systems as also rules for protecting intellectual property rights, privacy and security of data and information and the systems that manage them. This would be followed by agreements and treaties between countries. It must be remembered that if the purpose changed or was different, the entire process would need to be repeated. It is also important to remember that even within countries, agro-ecological zones and production systems may vary. For example, in India, Kerala, parts of Orissa and Assam may have a lot to share with Myanmar, South-western China, Thailand and Malaysia which have tropical climates and grow different agricultural crops than with Gujarat and Rajasthan which are semi-arid. While the principles in developing the standard frameworks may remain the same, the content and possibly some standards may change.

As regards the suggestion regarding existing Institutions, in my opinion, these at the community level may have new roles to play, for example in managing and processing data and information and enabling its sharing as also providing data support. We will also need new Institutions, for example data and information repositories and trust centres for information.

Comment

Economic benefits associated to all agricultural activities will drive it through the Agri-food chains.

Development of Global GAP certifications and bringing more farms in the circle will ensure quality food supply

• What sort of farming and agricultural production systems are features of Agri-food chains?

I see a necessary cooperative movement in agriculture production systems - collective farming, group farming and farming for profitability. This is necessary to take the farm produce onto the table with minimal loss and if possible value addition at affordable prices to all (there should be some Govt. interventions for making them affordable to some part of the society).

• What will be the driving forces for development of Agri-food chains?

I see that data and information which builds up knowledge and its dissemination are the driving forces for Agri-food chains from production to consumption via markets.

• What will be the role of ICTs in driving the development of Agri-food chains?

ICTs should be playing a greater role in the collection, value addition to the data and transmitting into a knowledge capsules helping to take decisions (prior informed decisions).

• What are the possible disruptions in the development of Agri-food chains?

Lack of mechanism to collect the data and information from each node of production and all through the chains.

• Based on the above, what will be the future scenario of Agri-food chains?

I see a bigger picture of the active roles by all the stakeholders and a very good value creation

Comment

This has been attempted in Indonesia when the government tried to promote corporate agriculture following some example from Korea. The idea was to have one manager operating on the aggregation of the farm fields in order to get more scale efficacy (more products to sale, grouping purchase of inputs, better coordination of irrigation and cropping decision, etc.). The problems they faced were the following:

* Even if 100 farmers aggregate, the aggregated farm is about 25 to 50 hectares, thus output is still not very big to provide better bargaining power

* All adjacent farmers must be willing to participate and share common decisions and the transactions cost is very high

* All farmers must engage in similar cropping system in order to enable scale efficiency

* The added value was not enough to pay for the collective management

* Farmers are very different from an economic perspective and some could not afford the cost of aggregation

As a result the program did not work and was discontinued. So let's be careful about good ideas which seemed relevant and working under specific conditions as they might bring more unexpected and unwanted disruptions under other circumstances. The idea of collective data and collective ownership of data may be a good idea, but it could work only if implemented on an ad hoc basis after collective engagement of the farmers in the decision to move or not in that direction. Pre-constituted formula designed by foreign experts will not work.

Comment

True. Many of the cooperatives and producer organizations in many countries in Asia have not worked because of Institutional, management capacity, scale and size and several other reasons. But then there are some good examples where they have worked such as milk cooperatives in Gujarat in India.

However, the use of ICTs enables virtual aggregation especially for data that need not be limited by geography or even size. Take for example Facebook as a community. If all of its users (almost a billion) or even a sizeable part of it got together and told Marc Zuckerberg that he has to

share the profits/value of Facebook Inc. (About USD 365 Billion) he earns with them as it is their data he uses to make profits, we would all as Facebook subscribers get at least a 10 dollars each as profit and USD 365 as value in Facebook. We can work out the proportion of profit depending upon the data we provide in our posts, likes etc.

In the same way, think that all coffee growers or vegetable producers in a region get together and consider the gains and benefits of virtual aggregation. ICTs break the barriers of scale and size as we now see in banking, social media, on-line shopping etc. With ICTs used for virtual aggregation, there can be transitory coalitions which share values, interests etc. and make common decisions, based on forecasts with possible outcomes and options on their data, that may be only "Just-In-Time" and not be permanent as in physical cooperatives of the type you mention. ICTs have amply proven that they when effectively used reduce transaction costs. The farmers need not even aggregate by having the same cropping system and growing the same crops. They may aggregate only for accessing energy or water and share their data on usage etc. to bring efficiency and economy in their use. This may even contribute to sustainability of their farming. I again go back to Facebook example about the added value issue. The profits it makes indicate that this may not be true with use of ICTs. I would only say that if the current costs of information management of a farmer to participate in an organized Agri-food chain as in Europe (where now each farmer is required to have access to a computing device to regularly provide data as per Common Agricultural Policy, Eureo-GAP, Regulations needs etc.) are considered, the cost of virtual aggregation would be marginal.

I agree that such approaches will work only when farmers are engaged collectively to move in a direction but then it is our duty as Scientists to show and explore new paths that may improve the farmers' quality of life.

Comment

This contribution (ICT & POs)seems to be good as well for our ongoing e-discussion on Producer organizations http://www.aesa-gfras.net/Resources/file/E-Discusssion%20on%20POs%20and%20Extension%20

Driving Forces

We have so far discussed:

- What sort of farming and agricultural production systems be features of Agri-food chains?

There is a vast variety of farming and agricultural production systems in Asia. The majority of these systems are based on small holder farming. These farming systems contribute to one or more types of Agri-food chains, namely the public sector/Government operated, the Supermarket and fast food restaurant chains, the cooperatives operated chains and the laissez-faire chains of open market or subsistence farming systems.

- What will be the driving forces for development of Agri-food chains?

There are many interacting driving forces for development of Agri-food chains in Asia. Some of these discussed include:

- Providing food and nutritional security at National, community and household levels
- Ensuring National sovereignty
- Reducing poverty and providing livelihoods
- Reducing cost of food and agricultural commodities
- Ensuring stability in agricultural production
- Meeting food consumption needs in rapid urbanization occurring in many countries
- Meeting demands from diet change and food preferences due to increased incomes
- Meeting food safety and quality demands and standards
- Participating in competitive national and foreign markets
- Integrating into Agri-food chains
- Preventing spread and controlling diseases and pests
- Practising sustainable and resilient agriculture
- Conserving natural resources

- Reducing wastage

These driving forces are causing interlinked transformations of Agri-food systems such as:

- Agricultural transformation through coalescence and aggregation among producers and of land as also by the use of technology

- Diversification and commercialization of farming• Increased organization, structuring and urbanization of Agri-food chains

- Change in diet and food preferences

- Rural transformation with increased rural-urban linkages and industrialization as also change in rural infrastructure and capacities

- Intensified use of technology and "external" farm inputs and rural services such as banking, insurance, certification

- Economic, social and technological disparity and exclusion of communities and regions in a country

- What will be the role of ICTs in driving the development of Agri-food chains?

We have not yet discussed the role of ICTs though they have been mentioned. The above transformation are changing the needs for and flows of information for managing the emerging Agri-food chains, for example, meeting new standards for food or for assuring food safety, improving efficiencies and reducing wastage in entire Agri-food chain in water, land, energy, fertilizer and pesticide use and in logistics and rapidly acting to meet shift in consumer preferences.

I am sure all colleagues will discuss this issue now onwards.

- What are the possible disruptions in the development of Agri-food chains?

The possible disruption could be:

- Health scares (food, environment)

- Prevention of spread and control of diseases and pests

- Trade disruptions and exclusions (Non-tariff, tariff, political, market failures, embargoes, sanctions)

- Political upheavals

- Information conflicts
- Other Resource conflicts (water, land)

We also now may discuss:

Based on the above, what will be the future scenario of Agri-food chains or, as K. Bharath suggests what do we want to represent the future scenario of Agri-food chains?

How do we disrupt the development of Agri-food chains to satisfy the objective from the above question?

What sort of farming and agricultural production systems are features of Agri-food chains?

What will be the role of ICTs in driving the development of these new Agri-food chains?

Disruptions

Comment

Some recent disruptions in Agri-food chains are:

1. Banning by Russia of import of food items especially fruit and vegetable from Europe. The root cause is politics, both domestic and international.

2. Supply and use of stale and discarded meat as also unhygienically kept and processed meat by fast food restaurants in China. Driven by greed and poor implementation of quality and food safety standards.

3. Banning of Onion exports by India to curb high prices for domestic consumers.

Comment

As this e-discussion advances, it appears that we agree that ICTs may contribute to change Agri-food systems in Asia, among other drivers of change. We also agree on these major drivers of change currently at work both in Agri-food Chain and ICT. We have discussed a lot the likely changes and we know that current trends might not lead to desirable futures for the Agri-food chains and in particular for Asian farmers.

I would like to share with you some questions and thoughts about disruptions leading to different paths for ICT and Agri-food chains in Asia (and not only).

The Major Disruption: change the way ICTs are designed. Most ICTs used in agriculture and to be used in agriculture are not initially designed to serve the needs of (Asian) farmers. Most Asian farmers are "ICT technology takers" in the same sense that they are "price takers" for the product they sell. This leads to a standardization of the ICT user while we all acknowledge the diversity of farmers in Asia and the diversity of their needs. Design ICT that will make people happy to farm, to work and to live in rural areas. The true "ICT for sustainable agriculture" transformation will not be in the pursuit of the top down conception of ICT adoption by farmers. It will not be either in the continuation of the development of technologies by a class of innovators from the West and the North, carrying their own views about what farmers need or could use. It will be, in Asia, but also elsewhere, through co-creation of locally generated technologies where the users team up with innovators in the design of the new ICTs.

The following disruptions are related to the "How we implement this major disruption":

Disruption 1. Design ICT for people and welfare not just for goods and profit

Most recent development of ICT expected to impact on the agricultural sector target the production of goods per se. They are not designed for different type of users but for one type of usage and function (producing more, and eventually for less). Implications on people's life is at best indirect (by reducing production cost, or improving access to market information, one expects that the lives of small farmers will significantly improve), and the chain of causality between the use of ICT and the final transformation of the lives of people is very loose if not inexistent. This just requires every inventor to ask him (her) self what their innovation will change in the life of those who may be using it. And of course it is easier done if the users are there when this reflection takes place.

Disruption 2. Put clearly sustainability and resilience before productivity in the design of ICT for Asian farmers.

Asian farmers produce more than one crop. Most of Asian farmers do much more than farming. ICTs are needed to improve the livelihood of Asian farms and rural inhabitants, and not just their productivity. For example how good would it be to disseminate thousands of sensors at field level, registering soil and climate conditions, if they are linked to a decision support model offering just one conventional model of pesticide application? This just requires every inventor to ask him (her) self how their innovation will improve resilience and sustainability where it will be used. And of course it is easier done if the users are there when this reflection takes place.

Disruption 3. Give more information than you take.

ICTs are media providing a two-way flow of information and communication (in and out), not to extract information from farmers and communicate recommendations to farmers. For example how good would it be to disseminate thousands of sensors at field level, registering soil and climate conditions, if they are linked to a decision support model offering just one conventional model of pesticide application? This just requires every inventor to ask him (her) self what their innovation give in exchange of the data it will extract. And of course it is easier done if the users are there when this reflection takes place.

Comment

I would like to share with you some thoughts elaborating a bit further on disruptions.

Major uncertainties about the future of food, agriculture, and rural areas prevail. Uncertainties are due to the possible combination of adverse driving forces and the possible occurrence of disruptions in existing trends. Futures Studies help us to better understand them. What can we learn from Futures Studies?

First, policies and societal values are increasingly considered as direct and important forces shaping the future. They are not seen any more as external issues to call upon in order to fix food, agriculture and rural development issues once problems have been identified. They are central dimensions of the issues at stake. Second, consumers and their consumption patterns are having an increasing impact on the future of food, agriculture and rural development. This is now recognised but still not well understood, in particular what drives consumer preferences, including but not only values and policies. Third, most of these Futures Studies look at the food question at a global food security level, focusing on scenarios or models for matching in the future global food supply and global food demand. However, we produce today on our planet enough food, calories or nutrients to nourish all of us today and in 30 years. The crucial questions which need to be researched are why, then, are there still food insecure people today? Who will be food insecure tomorrow, in 15 or 30 years, and why?

This leads us to the farming world question: What could be the futures of the people working today in agriculture: who would be farming; what would happen with employment and more generally with the future of (rural) societies, given that these questions must take into consideration a diversity of situations at local/national level.

These uncertainties make the future unpredictable but it does not mean that different futures cannot be explored and anticipated. They are also location specific which means that we may also consider that in the future there will be different transformations happening in different places rather one single path.

The decision we make both as individuals and as organisations of people will shape these futures. Do we let the trends go and adjust to what they will lead us to? Or do we want to make a difference and operate through

inflections, disruptions, choices which may lead towards alternative futures?

When looking at the future of rural areas and the role of small farmers, there are at least seven plausible transformation paths we may consider according the type of answer that will be given to the major challenges that are the sources of uncertainty. These transformation path lead to significantly different futures and can be represented on a graph along two crossing dimensions which offer each one alternative societal choices.

The first dimension of societal choice is about abandonment or re-vitalization of rural areas. This choice is political, economic, cultural, and value-based. The trend is that more people leave rural areas and go to cities. Reasons are that more investment goes to cities, life in cities is more attractive, employment is in the city, social life is in the city; connectivity is in the cities, policies are promoting cities. And these are interconnected in self-reinforcing loops creating a path dependency. Some consider it even as an irreversible trend. This of course has implications for the food system: mass consumption in huger cities will require transportation of huger amount of food which could be easier and economically more profitable if products are standardized and massively produced in one or a limited number of places. Costs would also be reduced if products are transported from closer places including from the cities themselves or their immediate surroundings. But disruptions already occur where people leave the cities and go and work back in rural areas, not just as farmers but with many other activities in particular from the tertiary sector of services. This opposes to the abandonment of rural areas and could lead to their re-vitalization.

The second dimension of societal choice is a combination of consumer preferences and Agri-food chain transformation. On one hand concentration of Agri-food chain is seen as the current trend with a growing role of large supermarket chains and vertically integrated agribusiness providing standard products at low price. Reasons are the economic power of these chains, able to mould consumer preferences to fit their own standards of profit, the Western/Northern life styles they represent in a consumerist world where having is more valued than being. On the other hand, concentration and standardization of products can induce a disruption from a growing number of consumers concerned not only with quality and diversity of food, but also ethics of food production and transformation, health issues and environmental hazards. This result in more local, heterogeneous segments of Agri-food chains supplying local consumers with more diversified products.

When we cross these dimensions which are not fully disconnected, we may identify at least some contrasted yet plausible futures for rural areas, agriculture and farmers:

In a future where rural areas will be further abandoned and mass consumption of cheap products prevail, we may see

- The growth of gigantic agro-industries, employing a limited number of workers living in the agro-industrial complex. Most work is robotized, unless local poverty level makes human labour cheaper than robots. These complexes are highly specialized, geographically isolated but hyper-connected to markets though roads, railways, air and maritime freight, and ICT.

- The growth of farming cities were high-tech hydroponic agriculture will be undertaken using all interstitial spaces (parks, walls, roofs, balconies) and specialized areas Agri-buildings to provide a diversity of products. Farmers will be graduated technicians, employed by municipalities or city-farm companies.

In a future where rural areas will be abandoned and consumption favours diversified local products, we may see

- The growth of peri-urban farming where small farmers will grow a diversity of crops close to urban consumption centres. This includes also urban farming using interstitial spaces.

- The growth of "niche" farming where small farmers will benefit from private or public investment targeting specific market segments with a comparative advantage in producing high quality, high added value products. These areas will be connected to urban consumer markets though local segmented chains serving specific types of consumers.

In these cases of abandonment of rural areas, we will see

- The growth of rural ghettos with marginalized poor population surviving through self-subsistence. They will grow products for self-consumption and seek employment either in the gigantic agro-industries around which they will settle as rural slums or through episodic migration in urban areas or abroad.

In a future where rural areas will be re-vitalized and mass consumption of cheap products prevail, we may see

- the development of large scale core agro-industries transforming a limited number of key products (grains, meat) where risks can be limited surrounded by a plasma of smaller farms supplying the core agro-industry.

In a future where rural areas will be re-vitalized and consumption favours diversified local products, we may see

- The growth of rural Agri-continuums where food production and transformation will take place in smaller diversified enterprises highly connected to local markets, operating in an environment providing connectivity, and employment opportunities also outside food production. Farmers will have several jobs and will be directly connected to markets and consumers through high-tech ICT.

Of course, these different futures are not mutually exclusive globally and locally. Some will co-exist, most already co-exist. The societal choice about the future we want we have to make is not about selecting one of them. It is about deciding which proportion of them we want, and making it happen.

I would be happy to hear from you about what ICT could/would contribute in these different cases. What future development of ICTs could change the proportion of these different?

Comment

The previous contribution has indicated from a different vantage point earlier in this discussion, some disruptions of Agri-food chains that would lead towards some of the emerging objectives for agriculture globally such as reducing poverty, bringing sustainability and resilience.

The Asian farmer and producer is a smallholder, largely poor in all resources, land, water, finance, labour, concurrent agricultural knowledge etc. She has unique problems to her farm and in her family's livelihoods. She is looking for customized solutions with options she can choose from for all her problems. The same is the case for many actors in Asian Agri-food chains. Most chains, as noted in this discussion, are in various stages of development under whatever category they are put. They also have very different and unique information needs.

Today's ICTs after the development of the IBM Personal Computer (PC) has largely been modular in their design, development and sourcing. Different technologies developed by different sources are today used in to develop the ICT hardware. And many of these technologies can be assembled in different ways to serve customised needs. Similarly,

software also has been largely modular with specific objects available in libraries that can be assembled for different purposes.

The free and open source movement has brought about new ways of assembling hardware and software so much so that it has now become to overshadow proprietary software. We now have literally thousands of "apps" useful for agriculture (See: http://aged.illinois.edu/sites/aged.illinois.edu/files/resources/Apps-fo... http://www.croplife.com/editorial/15-best-new-agriculture-apps-worth-dow...).

There is a similar story in connectivity with a variety of new ways in which data and information can be communicated among their users using ICTs.

There can easily be a match between the needs, as Robin indicates, of Asian farmers, producers and actors in Agri-food chains and the way hardware, software and connectivity is today and in future will, be available so that it can be customised appropriately. In my opinion, the "Apps" approach linked to customisable hardware for agricultural use can be one of the major pathways we may now need to follow for ICT use in Asian Agri-food chains.

The major constraint in this approach is our agricultural research and data generation systems. We have been, in our formal agricultural research followed a reductionist pathway that has focussed not only on a single crop (or sometimes even a variety) but also on one aspect of it, for example, nitrogen requirement or pest and diseases affecting it. We have very little to offer at the total farm, farming and production systems level. We may have individual objects of information but we have not yet looked at how to make it useful and meaningful to the farmer and other actors in Agri-food chains. This is a massive challenge in integration of data, information and information systems whose best solution may lie only in restructuring and transforming agricultural research in Asia and other developing regions of the World who will have to evolve and develop their Agri-food systems to meet their own needs.

Comment

There are four broad categories of Agri-food chains in Asia depending on the major actor/group of actors in the marketing and distribution chain. These actors are important in defining the current and future roles of ICTs in Asian Agri-food chains. These include the public sector, the producer organization/cooperative (Community) sector, the private sector dominated by the supermarket and the fast food restaurant chains and the free market. In Asia, in various regions, these four categories are changing and evolving at different paces. There are several examples in this evolution where hybrids such as public and private sectors or community and private sector or all three sectors have started to operate together telescoping into each other at several entry and exit points in the chains. There are a variety of driving forces bringing this change. Rapid economic growth, equally rapid urbanization and widespread public concerns of food safety appear to be the most important driving forces. 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.

ICTs have started to play an important role in this intensification.

The first is in informing and knowledge support for farmers, producers and actors in Agri-food chains. A wide variety of ICTs are involved in this role. Earlier it was the analogic radio and TV, now it is the connected digital computer, the cell phone, Smartphone or tablet or a hybrid of all the phablet connected through mobile cellular telephony and the Internet. These use a variety of communication channels, the World Wide Web, E-mail, social media, SMS, MMS, voice mail, audio and video streaming for sharing information. It must be mentioned that the new digital technologies have opened up bi and multi directional, instant, active and passive communication and led to formation of networks of communication and established of communities who share information of mutual interests. The sizes of these communities differ. An interesting issue to note is that most of these communities are self-organizing and only need a starting nucleus of activities that attract and coalesce these virtual communities. In future, these communities will tend to interact and integrate more closely through "information clouds" and "Big Data" processing leading to possibly very different insights of agriculture, food, its production, distribution and consumption.

The second is in farm production and processing. A large variety of ICTs will play a direct role, such as through soil nutrient and humidity sensors or an indirect role, through being embedded in farm and processing machinery in Agri-food chains. The discussions so far have indicated the various ICTs already available for farm production and used for processing. For Asian farmers and farming systems, which is overwhelmingly resource poor, small-holder based, the key issue is of their inclusion in the use of these ICTs in their own farm production. If intensification of Asian farming is inevitable, it will lead to the need to intensify use of technology and ICTs. The size of Asian farms will be a major constraint for intensified use of technology by individual farmers. How will Asian farming be intensified? Will it lead to physically bringing the land together, as is now being done in several countries, with movement (displacement) of these farmers to urban areas, further evolution of producer organizations to aggregate, cooperate and use technologies collectively or through the private sector, who while recognizing individual ownership of land, will contract at various levels the farming and/or farming operations, the procurement of farm inputs and purchase of farm products in closed chains. This type of operations are already seen in USA, Canada and Europe and are spreading in South America, Africa and some parts of Asia. These farming and production system transformations will change Asia societies both rural and urban, affecting the physical and social environment and threaten cultural heritage largely sustained by rural communities.

The third area is quality and safety certification assurance. The issues of food safety and concerns of ethics especially of exported agricultural commodities production, marketing and consumption is a major driving force for change in Asian Agri-foods now. It will grow in the future. ICTs will play a key role in managing and assuring safety and quality of foods through enabling implementing and monitoring "good agricultural practices" in their production, providing traceability, maintaining cold chains for perishable foods and labelling the commodities. The issues of using ICTS in quality and safety assurance in Asian Agri-food chains will be closely linked to use of ICTs for informing all actors in Agri-food chains and their use in farm production and processing. These include aggregation of farmers and farms and costs of information management in the entire Agri-food chain vis-à-vis to balance them with cost of food to large urban populations.

The implications for Asian Agri-food chains from these developments are that data, information, knowledge and skills will increasingly flow more rapidly in larger quantities within and outside these chains. These flows

will be influenced through policy, regulations, supporting Institutions, standards, creation of infrastructure both physical and for digital connectivity and communication and investment in information content. This may lead to more transparency and openness in these chains but also strengthen counter vailing forces against transparency and openness. They will form closed Agri-food chains controlled through flow of agricultural commodities, finance and information in specific channels.

It will be for Asian societies to decide how they want their Agri-food chains to evolve in future? What policies, regulations, supporting Institutions, standards, creation of infrastructure and of investment in future development of Agri-food chains would they want? How will they influence the role of ICTs in these chains?

This is what we all interested in the future role of ICTs in Asian Agri-food chains must now consider. I urge you all to please comment and offer your insights in the discussions so far.

Comment

The thinking of ICT for Asian Agri-food chain:

1. Chain Information Systems completely automated or executed by people can be used for business activities such as picking, packing, labelling, making a bill of lading, invoicing and dispatching.

2. Tracing technology (RFID, GPS, scanning,) can be applied for Asian Agri-food chain management to guarantee the Agri-food safety and traceability.

The focal point of Asian Agri-food chain development:

1. An increase of guarantees related to food quality and safety;

2. A redefinition of value propositions, roles and processes of actors in the Asian Agri-food chain network;

3. An increase of international cooperation in supply chains whist maintaining a high flexibility in partner selection;

4. A speeding up of processes via rapid fulfilment techniques and parallel processing;

5. An increased use of the potential of new information capturing and processing capabilities;

6. A consolidation of product and information flows within organizations, supply chains and Agri-food chain network;

Comment

I was considering what ICTs available as of today could be used in smallholder farms of Asia.

The ICTs that are currently impacting agriculture 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, NFC and other new technologies
- Telematics
- Variable rate Irrigation/Fertigation and prescriptive planting
- Weed, Biodiversity and Pest Management through Integrated systems

Using the SMART Farm objectives, my view is for:

Informing and knowledge support for farmers, producers and actors in Agri-food chains

1. Using a Smart Phone/Tablet with 3G/4G and Broadband Wifi Internet Connectivity through WiMax type technologies:

a. Farm advisories for what to grow, where to grow, when to grow, how to grow, farm optimization for sustainable productivity and profit using knowledge based systems and models offered using audio and video streaming and how-tos etc. through cloud based services

b. SMS and MSS based rural advisory systems

c. Farmers and Agri-food chain actors social networks for information sharing
d. Market information services with prices and forecasts for prices and demand for commodities including what to market, how to market, when to market
e. Financial Services such as on-line banking, insurance, mortgage
f. Farm management systems for planning and monitoring including financial management, input management, farm operations, harvesting and on-farm processing
g. Geographic Information Systems with cadastral maps for virtual farmer aggregation for input supply, coordinated crop production, farm logistics including sharing of farm tools, machinery and equipment, logistics for transport, market prices and forecasts for demand, preferences etc.
h. High resolution maps for field and plot level planning and monitoring of land levelling, irrigation and prevent soil degradation
i. Weather (through automated local weather stations), Pest and Disease and Disaster warnings and management information
j. Crop monitoring and health diagnostics for water and soil nutrients, pests infestations and diseases at field level using knowledge based systems, photometry using cameras in Smart phones/tablets and mounted on micro drones/UAVs.
k. Wearable computers and "Google glasses" for just-in-time information on individual plant and plot-level problems

Farm Production

a. Soil humidity and nutrient sensors linked through local farm level sensor networks operating variable irrigation/fertigation
b. Identity devices and wearable computers for livestock for physiological, health, nutritional and production monitoring
c. Automated and autonomous farm machinery for seeding, tillage, weeding etc
d. Farm data systems needed for Good Agricultural Practices (GAP) and traceability systems
e. Near Field Communication labels for information on farm inputs such as fertilizers, pesticides, growth stimulators

Quality and Safety Certification Assurance

a. Farm data systems (as listed above)
b. RFIDs for labelling produce at Farm/Plot level

Risk Reduction

a. Weather, Diseases and pests forecasting and early warning systems with possible interventions

b. Insurance
c. Market price and demand forecasts

There would be questions about costs and whether small farmers can afford these.

Let me give some approximate costs:

1. Smart phone/Table: USD 100

2. Wifi Router for 90 mtrs radius: USD 120

3. Sensors linked through Wifi: USD 125

4. Broadband Internet Connectivity: USD 30

5. Micro UAV/Drone: USD 1200

The issues as I see it are:

1. The technologies that may be needed though available have not been adapted to make them useful for small farmers. Research and innovation is needed.
2. The costs can be reduced through
a. Government policies, such as through reduction of telecommunication costs, development of infrastructure,
b. Empowering farmers to aggregate through cooperatives, producer companies etc that provide data and information services
c. Mass production

Comment

The list is covering almost every aspect. Regarding IT support I have found that conducive environment through policy support is also very crucial. And along with that the role of public sector in supporting the whole system through modern technology is important. Finally ensuring access to the market of the MSME's are a must for an ecosystem that can sustain itself through a win-win scenario.

Comment

High-tech Helping Farmers in Shandong to Get Rich

Background

The Integrated Service Platform of Information and Communication Technology (ICT) Application in Rural Areas and Agriculture of Shandong (hereafter as "the Platform") has been the foundation and key of the provincial government's effort to be the leader in developing ICT in

agriculture and rural areas. It’s a critical part of the work of Science and Technology Information Institute, Shandong Academy of Agricultural Sciences. The Platform has been upgraded, such as the 12396-hotline service, the live broadcast for farmers, the remote video system, the mobile phone service, the official website (http://www.qlsn.cn/), the large-screen presentation system, and the network system. The operation of the Platform has been redesigned and improved; the Platform has been elevated to a higher level.

On Nov.27th, 2013, Xi Jinping, the General Secretary of the Communist Party of China, the President of the People's Republic of China visited the Platform in person. Xi’s visit brought us much pride and encouragement. We will continue our efforts of improving the service systems and operations and aim to provide comprehensive information service for the solution of ‘three rural issues’, which are agriculture, rural areas and farmers, especially farmers at basic levels. We will provide customized service for farmers at basic levels regardless of the time, location or the terminal they use. In this way, we can really contribute to the development of agriculture, rural areas and farmers, help farmers to get rich by ICT application and realize the prospect of “experts joining farmers in farming”.

Since last year, our work in developing the Platform has been focused on the following two aspects and progress has been made. One is the on-the-job training for information workers at grassroots service sites; the other is the improvement of the 12396-hotline service system.

1. On-the-job training for information staff at basic level

1.1 Establishment of demonstration bases

In order to bring the provincial-level integrated service platform into full play, we’ve established information service sites at village level, introduced high-tech equipment such as computers, offered remote video service, and organized experts to provide long-distance training sessions and diagnoses through the remote video system.

We have established demonstration bases of ICT application in agriculture and rural areas in prefectural cities, such as Liaocheng, Linyi and Binzhou, as well as in municipal cities, such as Yucheng and Zhanhua. We have delivered frequent guidance at these demonstration bases, provided on-

the-job training for information workers there and actively participated in their activities.

1.2 On-the-job training for information staff

We have organized experts at all levels and information staff at basic level all around the province to provide science and technology trainings and information service for entities related to 'three rural issues', which are combined with the implementation of the goal of being a leader in ICT application in agriculture and rural areas and bringing the integrated service platform into full play. We have followed the directives of the superior departments and provided over 20 training sessions in cities such as Zibo, Linyi, Jining, Yongfang, which covered more than 1,000 technical personnel. Information workers that received trainings have mastered basic computer skills, learned how to collect and report information, operate and manage the service site. They can consult with the experts directly through remote video about problems farmers faced with in farming practice so that farmers will develop the awareness of applying science in planting and breeding gradually as information workers provide IT support for farmers.

2 Improvement of the 12396-hotline service

The non-profit 12396-hotline service offers information of ICT application in agriculture and rural areas to people all over China, which is established by the Science and Technology Bureau and Industry and Informatization. The 12396-hotline service branch in Shandong is supported by a group of about 100 agricultural experts. Based on the farmers' demand for information and application of science and technology, those experts provide all-around service to solve problems farmers faced with in farming and advise the policymakers.

2.1 Various services

(1) Telephone counselling service

Calling 12396, dial "0", you can consult with the agricultural experts directly.

(2) Two-way video consultation

With a camera and the network, you can video chat with the expert. And you can put the problematic crop under the camera so the expert will help you to solve the problem. Any smartphone will do.

(3) Online consultation

You can post your question on the column of "online consulting" of the official website. As soon as the experts see your question, they will post their answer for your reference.

2.2 Improvement of integrated information service platform

With the investment and engagement of Shandong Unicom Corporation and other telecom carriers, we've established the "12396" voice call system last year. It can receive 64 concurrent calls. And it offers operator service, and the services of automatic answer, automatic call forwarding, multiparty calls, and analysis of incoming calls. It can be acceded through SMS, the webpage view or the video. At present, the 12396-hotline service receives over 100 calls on a daily basis. By meeting clients' needs, it has become a service brand, prompted the communications and exchanges between farmers and experts, farmers and the market, farmers and the government, and elevated the service level of application of ICT in agriculture and rural areas in an all-round way.

2. 3 Construction of the studio for "12396, Voice of the Green"

Closely following the guidance of being a leader in ICT application in agriculture and rural areas, we've established the provincial integrated information service platform, the 12396-hotline service, and the program of "12396, Voice of the Green" jointly with the rural channel of the Shandong Broadcast and TV Station. We've changed the traditional approach of one-to-one telephone conversation between an expert and a farmer. As the news media broadcast our program live, agricultural experts' suggestions and solutions are spread to thousands of households. Thus now it's the one-to-many service.

Currently, the dual-band coverage has reached every corner of Shandong and even the neighbouring provinces. People can listen to the radio and watch our program on the TV at the same time. Every Monday, people can dial 12396 at noon to consult with our experts. 60 programs have been broadcast so far. Meanwhile, the exchanges and communications between farmers and experts, farmers and the market and farmers and the governments are entering a new stage with the advancement of social networks, such as Blog, Weixin, and QQ groups. The newly completed

studio has achieved the broadcast-video standards in both outcome and scale. On Mar.24, 2014, the Shandong Broadcast and TV Station, the Shandong Internet TV Station and the Qilu Website broadcast the "12396, Voice of the Green" for the first time at our institute. The sound effects were good, and the cameras switched unnoticeably and successfully among the host, the experts and the instructor. The listeners barely noticed that the location of the studio was changed. Thus we were quite excited that we "moved the studio of the provincial radio and TV station into our own office".

3 Future development

The integrated service platform of ICT application in agriculture and rural areas of Shandong is moving towards the cloud service. Specifically, we will establish an information service platform at every village, a comprehensive information service application system including all basic-level agricultural institutions and agriculture-related enterprises; focus on the accurate search and query of agriculture-related information, the precise subscription of information and targeted information push. With the multiple channels and terminals, such as the Internet, the smart phone, SMS, MMS, the call centre, and the cable TV, customers can receive customized information service timely, conveniently and accurately.

The development of the integrated service platform of ICT application in agriculture and rural areas of Shandong still remains a daunting task. We have been making progress each year but we also clearly realize that we still have unresolved problems. Institutional problems are mostly pronounced for we have not integrated all our resources well so far. As farmers are our targeted customers, their differentiated conceptions due to different scientific, cultural and economic levels have subdued the effectiveness of the Platform. Moreover, specialized funds are insufficient in this constructive work. However, we will improve our thinking and work methods, overcome all problems and speed up our efforts so as to make due contribution to being a leader in ICT application in agriculture and rural areas.

Comment

The Pashmina fiber is product of Chagu and Changtgangi Goats being reared at one of the world's most challenging environments. The habitat of Pashmina producing goats i.e. Ladakh region is having very low oxygen, The area of evolution possess meagre ground vegetation, little herbs and

fodder trees are at scars, temperature remains below -30 °C for about 6 months and is covered with snow. Survivals of Changthani goats on such adverse climate indicate the hardiness and high adaptive value of the breed in cold desert. The area is not having good Cell phone connectivity, electricity, roads etc.

The Pashmina is produced in Ladakh region and quality weavers live in Kashmir region near Srinagar. The distance between two places is approx. 500 KMs in hill tract, the highway remain closed for 6-7 months in an year. As a result, Pashmina producers, are bound to sale raw fiber between the period when the roads are open. Once Pashmina fibre is processed at Srinagar, the value addition is often by more than 10 folds and once product is prepared the value addition is some time up to thousand folds.

The ICT can play significant role in capacity building of Pashmina producers for processing the raw pashmina in making the quality yarns and sale pashmina products at Ladakh region so that earning of goat keepers are enhanced who otherwise live in extremely poor condition and for good 6 months of the year they are cut off from most of the world because the area remains non motor able due to snow. Providing ICT facilities in such conditions is herculean task also.

Comment

The previous contribution draws attention to another dimension of Agri-food chains. Those that are not in the mainstream by their remoteness or the commodities they produce. Similar issues are seen with Ilama and Alpaca production in the Andes of South America.

Here ICTs can play a vital role in aggregating producers in producer organizations, in breeding and animal improvement programs, pasture management and health management in addition to online marketing of locally value added products.

We need to look at innovative uses of ICTs in such chains to help producers.

Comment

The United Nations has declared the year 2014 as the International Year of Family Farming with an aim to raise the profile of family farming and smallholder farming by focusing world attention on its significant role in eradicating hunger and poverty, providing food security and nutrition, improving livelihoods, managing natural resources, protecting the environment, and achieving sustainable development, in particular in rural

areas. The goal of the 2014 IYFF is to reposition family farming at the centre of agricultural, environmental and social policies in the national agendas by identifying gaps and opportunities to promote a shift towards a more equal and balanced development.

As we all know, together with appropriate technologies, machinery and policies that are essential to support the small-holder resource poor farmers and farm families, the availability of the right information at the right time in the right way is of paramount importance to small and marginal farmers.

The role that ICT can play, in this regard, as an instrument of change is potentially transformative. Smallholder farmers, particularly women involved in agriculture, have a huge advantage when the right ICTs are induced into the agriculture value chain. The access to the right information at the right time gives them the capacity to make informed decisions that would affect their livelihoods and thereby play a major role in ensuring food security.

With all of us facing a flood of information, culling out the right information and presenting it in the right way at the right time is now increasingly a challenge. The sheer volume of data generated on a daily basis is referred to as "Big Data" and they hold great importance for agriculture. Analysing rainfall data over a period of 50 years or the pest vector over a given period of time could give valuable insights into issues such as climate change, weather patterns and disease and pest infestation patterns and would also assist us in taking informed decisions. The reuse of data is an emerging thought and this is yet to be harvested by the ICT4D experts for agriculture and allied fields.

Sharing innovations, lessons learnt and good practices with the wider community would help us address the above challenges more effectively and efficiently. This would in turn facilitate a more effective Agri-value chain.

Comment

Small scale farmers often lack resources to own ICTs as also low literacy levels discourage them to utilize ICTs in Asian developing countries. But these limitations are being overcome rapidly through mechanisms like Village Information Centres (VICs)/ E-Chaupals/e-Kiosks, Community Radio stations/FM Channels / mobile voice messaging etc increasingly used in India. The farmers will have an increasing access to information enabling them to produce good quality Agri-food products demanded by

the consumers as also in finding remunerative markets for their products. Demographic surveillance in mobile populations (migratory livestock keepers) would also be possible using mobile phones. The ICTs would be used to develop surveillance & monitoring systems to improve livestock production planning and provision of human and animal health care. The interest taken by Indian Institutes of Technology (IITs) and other institutions hitherto ignoring agricultural sector due to poor returns as also lacking glamour, are entering this sector. This is a good sign that agriculture is attracting attention of the high profile institutions. Also, many highly qualified, techies are turning towards farming. Such moves would help modernize agriculture-improving the quality & Agri-food value chains. The Agropedia & Agrivoc including voice messaging services developed by IIT under NAIP has been helpful.

Precision livestock farming which utilize ICTs to great extent will have a larger role to play to improve livestock sector in coming years. It will help minimize wastage & improve product quality; both are the requirements for improving the performance of the livestock sector in terms of quality & quantity.

Value chains are key structures that facilitate linking producers to consumers and have traditionally been the weak link. The United Nations Food and Agriculture Organization estimate that annually 1.3 billion tons of food is lost or wasted. While the losses occur mainly in Asian agricultural value chains for reasons such as infrastructure including availability of storage facilities, improper storage and transport practices etc.

A key driver of future Agri-value chains would be the necessity of ensuring food safety and traceability. ISO has developed about 1,000 standards specifically for food to deal with subjects ranging from agricultural machinery, logistics, transportation, manufacturing, labelling, packaging and storage.

ICTs facilitate the movement and consumption of safe food through the use of emerging/ established technologies under the Global Standards One (GS1) such as bar codes, electronic business standards, global data synchronization and radio frequency identification (RFID) etc.,

Following established GAP would go a long way in making the future Agri-value chains more efficient and ICTs provide the risk-management and brings in the trust factor between the consumers and the producer. Many small business would flourish in the ICT-enabled future Agri-value chains

as this would facilitate many small-family farmers group themselves into cooperatives. Governments would be able to implementing targeted pro-poor policies which would be made more effective in the future Agri-value chains.

Comment

Agri food chains will be more competitive leading to better quality products to the consumers at cheaper rate. The ICTs will make more informed choices to producers & consumers. By 2020-2030, we can assume that the stakeholders in the food chains in Asia are the producers-retailers- consumers will focus on better quality products including organic quality gaining ground. The certification, traceability, Good Agricultural Practices, HACCP and other quality enhancing measures will be known to more people in coming years. On these aspects, ICTs & ICT enabled information centres & Kiosks would play a big role.

Comment

Farming the way it is being done now- itself will witness big changes in coming years. May be fragmented small scale holdings in countries like India are consolidated and crops/livestock raised more under contract Farming/cooperatives, where mechanization would be possible to meet the challenges of labour shortages. The agriculture would be governed more by economic considerations like cost benefit ratio. The processes such as seeding, milking, feeding the cattle etc. would witness an enhanced use of computers & ICTs. Personal Digital Assistants (PDAs) would be used by the farmers as well as the extension workers. The extension worker would use PDAs primarily to gain insights on the latest technologies being employed on the farms as well as the state of the different farms. With the help of PDAs the farmers would get quick solutions to their problems and the extension worker can keep abreast of the latest developments in his areas of interest. The farmers would directly upload the output of their Farm computer to their PDAs which would then be accessed not only by all the farmers but also by the extension worker who can then in turn suggest improvements on the current model and also provide solutions. The extension workers thus will have access to a huge database of the crops & animals being raised in different regions, yield, technologies being used etc. enabling them to provide solutions based on the analysis of these results and also to formulate policies for extension work. This network would also provide the facility of teleconferencing among all the stakeholders eliminating the need for the time consuming process of knowledge dissemination through

face to face contact. With a single click, the extension workers will not only have access to a huge cloud database of farming activity on their computer/PDAs but also will have access to the 'Farm computers' to which they can send requests for teleconferencing/interaction with the individual farmer as well as groups of farmers. Each extension worker would work only in a certain region of this network and uploads the latest technologies, feeds, fodder and practices relevant only to his region of the network. This information would obviously be available to other regions in the network as well. The need for the extension workers to go to different places in order to spread knowledge of the latest best practices is likely to be reduced or even totally eliminated. As such-the farming will change so will change the extension workers, where ICTs would play significant role!

Comment

ICTs including social media are influencing human behaviour which in turn may have implications on our dietary choices particularly in shifting the consumer preferences. For instance, Meat eaters in western countries are turning vegans and becoming more animal welfare oriented. This trend is already extending to Asian countries due to health scares as well as animal welfare considerations. More aware population due to ICTs & social media might influence consumers choices leading to change in production activities, finally affecting entire Agri-food chain. When cruelty in animal slaughter is shown in YouTube and other means, it affects the viewers in certain ways and at times it outweighs the benefits of animal protein. May we call it a humane, animal friendly food chain we can foresee in future!! the trend to modernize animal slaughter houses, cage free poultry/free range /pastured/backyard poultry production, ruminant grazing, certified products including whole chain certification ensuring traceability, labour friendly food chain could be some possible scenarios in Asian developing countries, wherein, ICTs & social media will have big role to play especially in making people aware & knowledgeable to make informed choices!!

Comment

To me, the principles of IT Support are quite straightforward; the difficulties refer to the system organization and the focus of its content (see also the previous contribution):

a) provide Information (between Enterprises, between Enterprises and authorities, towards consumers and from consumers)

b) assure alerts in case of Food safety concerns,

c) support flexibility in the organization of sourcing and sales (allowing dynamically changing trade relationships)

d) Support the Integration of SMEs with suppliers, customers and markets.

Anything else?

Comment

ICTs in value chains helps in identification of defects and tracking of the goods. With GIS support in sync with other production data support and market intelligence, the produce can be marketed easily and effectively.

Comment

Yesterday, our new PM Mr. Modi had launched National Digital Literacy Mission in which all the Panchayats would be connected with broadband and people will get Digital Literacy. Now some of the organisations are using SMS services for broadcasting information/alerts. But still there is a wide gap of usage and implementation of ICTs. Traceability implementation needs a monitoring body and may be its not effectively monitoring. Need to know why?

Others may comment on this issue.

Comment

I'm in-charged of *Smart Farm Initiative Project in Thailand*. The Smart Farm project is under National Electronic and Computer Technology Centre (NECTEC), National Science and Technology Development Agency, which the main target of my project is how to implementing ICDT in agricultural industry. We are work closely with Rice Department, Department of Agriculture, Department of Agriculture and Extension under the Ministry of Agriculture and Cooperatives (MOAC). Smart Farm as a new approach for modern agricultural business in Thailand, we are developing a new management approach with new technologies, ICDT as a tool, information services and utilization of knowledge. The Smart Farm Initiative is also under National plan as Smart Thailand 2020 as a part of stronger economy challenges.

Why farm need to be smart?

In Thailand, these are the constrains that we need to think ahead; aging society, lack of skill labours, labours shortage, young generation is out of farm, higher cost of production, and globalize markets, all of these push us to think about the future of food security and safety of the nation.

NECTEC Smart Farm Flagship framework:

Vision: Better Quality of Life (for all, farmers and consumers)

Mission: ICDT in value chain management, agriculture risk reduction under climate variability, knowledge engineering.

Values: Information as a Services, Knowledge as a Services, Location Based Services

The components of Smart Farm; for ICT enabling;

1. *ICDT package for farm production* (reduce cost of production-ICT package for farm (data) management- using appropriate information technologies and farm robotics).....future target for Smart Farm or intensive/precision farms

2. *ICDT package for quality assessment* quality in terms of production and products (Mobile GAP Assessment System, tractability,,,,building brand and trust for local produces)....future target for Food Safety Assurance System

3. *ICDT package for agriculture risk reduction* (climatic variability)- shift production calendar, mitigation program for production cluster.....future target for the Nation Food Security

4. *knowledge engineering* (empowerment of agriculture knowledge workers; Smart Farmers/Smart Officers, human sensing?, location based information services)....future market for Smart Farmers/Smart Officers... self-developed area based KM

Technology approaches:

The technologies that we do apply in the project consist of; sensors network, image processing, photonics, UAV for agriculture purposes, mobile application/web services, simulation model, phenomics study, voice recognition, spatial analysis and e-Nose. The sample of my work is in file attached.

We do have many collaborative projects with partners under MOAC and private sectors in the implementing of ICDT for food chain management. I, myself, is also involve as a chair of Agriculture Working Group of APAN (www.apan.net/meetins/nantou2014/) and AFITA board member, wishing we will have a continue sharing in the group discussion and hoping the best result from the up-coming AFITA session.

Comment

Most "SMART" farms as per available information are designed for large farms. Thailand has a mix of farms of varying sizes.

Can colleagues of the e-discussion also share information on "SMART" farm initiatives and their experiences?

How would we develop a "SMART" farm for the resource poor, smallholder Vietnamese rice farmer referred to in the previous contribution using currently available ICTs? What over the horizon ICTs are needed for this type of a "SMART" farm using ICTs?

Comment

An Interesting Article:

Out with the body, in with the brain

About SMART farms

http://agrinews-pubs.com/Content/News/MoneyNews/Article/Out-with-the-bod...

Open Data

Comment

In India we have a policy on Open Data. All public institutions especially ministries have to make their data open. As of now the data related to agriculture include varieties, production, and to some extent marketing.

Now we see that only private players are active in value chain. I have doubt if these private would share the data. Do we need to trade with them by proposing protected commons approach? Mean only the consortia would be able to Access data? like the weather information which we now Access on all our gadgets, we would only see the trends? How to convince private to (Contribute data)?

Comment

You do raise a point that has merit but it needs to be looked at very carefully.

Data and information must not only be "open" as being available or even accessible. They need to be relevant, trustworthy, timely, useful and use-able by users. Users must also have the capacities to use them effectively to meet their needs. Those advocating open data must also consider that just opening data without enabling its effective use in a fair and equitable way for all who need to use the data will only cause further inequities.

It is not really true that only private players are active in value chains. In India, the Government of India through the Food Corporation of India, State supported Dairies, various marketing boards for agricultural commodities, APEDA, State Banks, Life Insurance Corporation etc is the largest player in its Agri-food chains. It is also the largest producer of data and information related to agriculture. This is the case of most Asian countries. It is their obligation to open data and enable its effective use equitably.

Also, the private sector is not only the large multi-national corporations. The farmer is also a private entrepreneur in an Agri-food chain. So who is "we "and who are "them" becomes very confusing.

Consider this; we have public roads and public transport such as buses and trains. This is paid for by Governments from the taxes it collects from the public. It is the Governments obligation to provide public transportation. There may be a small fee for the user but in general it is a

public utility/service. Now consider a privately owned vehicle. Would anyone have the right other than the owner to make use of it? Should someone, possibly the Government, make a rule that every private vehicle owner has to allow anyone to make use of the vehicle? It is being done in some countries, mainly by positive/affirmative reinforcement. If you travel on a highway in a private vehicle you can only use the fast lane if you have one or more passengers. So, we might have to evolve such means but we have many issues that still remain to be debated to arrive at appropriate solutions.

One of these key issues is Farmers rights of the farm data and information she generates. Who owns this data and information? In all ways, it is owned by the farmer. How many times do scientists even mention, in on-farm field experiments, the contribution of farmers? But this is a very small issue compared to what can be done when ICTs are used through sensors, embedded in machinery, data from them collected on a cloud and analysed through big data predictive analysis. Those who have access to this data and are able to analyse them will be able to control the farmer in ways that have not been imagined so far.

So the issue needs to be critically analysed before we make judgments and decisions about open data in agriculture.

Comment

I like the car example very much as it clarifies some of the issues in data ownership. Just a few add-ons from a European perspective:

1. Some time ago, a Major certification organization joined ranks with a retailer for collecting farm data that should facilitate tracking/tracing etc. It was a complete failure because of farms' reluctance to cooperate "... we don't know what our data will be used for..."

2. A Major European IT/Future Internet initiative dealing with Food chains had as a basic requirement that all data had to stay with the Initial owner who keeps the right to allow or refuse use. Without this requirement adoption would not take place.

3. A Major retailer pays farmers more who provide production data (Global G.A.P. Statement: "... products where Claims can be supported by data will cost more in the future..."

4. In the long run (scarce resources) farmers (at least: land owners) will be more powerful than they are today - that will allow them to trade data as a second source for income. We might see an Information market

developing parallel to the product market. One might look at the "book and claim" initiative which already points into this direction.

Comment

The previous contribution adds a very useful product from farmers in the future; data and information. This would be in addition to food and agro-industrial commodities including new biotech/nanotech products, energy through biomass and renewable source (wind, solar), better environment including clean water and air and preserving cultural heritage.

In my opinion, in the Asian context, it would be very important for farmers to aggregate, as they should for all farm inputs and outputs, when they deal with the use and selling of data. Collective data from a community would be much more useful for the community and as a saleable commodity that data from an Individual farmer in Asia and other regions dominated by smallholder farmers and producers.

For this to happen, current producer organizations would have to extend their functions and capacities. They would in addition to their current functions need to be repositories and trust centres for data and information and have capacities to manage it.

Small Farmers

Comment

I have looked at the Australian movie: interesting - but what's about the (e.g. Vietnamese) small rice farmer? Will we see (and supported by IT developments) a further separation between high technology farms/chains serving the global market and low technology farms/chains serving local markets?

Comment

What about the small rice farmer?

One of the issues the use of ICTs in agriculture and farming (as is the case with many other agricultural technologies that purport to be scale neutral but are not) is exclusion of certain categories of farmers and producers. These are usually the resource poor, small holders. While the world consider them being resource poor only from access to land, water, energy, finance etc. it never considers that they are also information and

new knowledge poor and cannot cope with the change in their political, social, technological and physical, such as climate and pollution, environment perpetuating their poverty.

It is not that ICTs cannot be designed to support the resource poor small holder farmers. There are several innovations that prove that this can happen, for example, providing information through cell phones using SMS. New technologies such as sensors, high resolution maps with cloud based GIS linked farm decision support systems and photometry using commonly available cameras with filters can all be used for and by these farmers to make their farming more precise, resilient and sustainable. The issues are reducing costs, bringing availability and access and in investing in innovations and research that really benefit these farmers.

Comment

I think we should talk of more about consolidation of different things; be it holdings, cropping/rearing, hiring/acquiring of technologies/machinery and finally marketing for more inclusive picture. Because, owning a small plot does not empower a small farmer (or say labourer, because maximum share of his consumption expenses does comes from wages) either physically/financially or emotionally. When they move in a group they can be equipped themselves all kinds of technological interventions, even ICTs. There are so many organizations/agencies to deliver information/support, only they need to develop themselves to receive and imbibe them in their production system and marketing of produce.

Comment

You are absolutely right. The effective use of ICTs in Smallholder Farming Systems in Asia now requires aggregation. Most use of ICTs in farming are directed to make more efficient/profitable use of available resources as it is essential to compete in markets. The cost of using ICTs must, as a transaction cost, be less than the increase in "profits"/ benefits from its use. It is one of the reasons why ICTs use is not so easily adopted by subsistence farmers as they cannot in economic terms offset the investment with tangible gains in ICT use.

Aggregation is essential for smallholders to reduce the costs of using technology. With market oriented agriculture, it is also essential for logistics and collective bargaining/marketing. There have been many cases of farmers/producers not cooperating and aggregating as it forces them to part with control of their assets and of independent decision

making. Farmers aggregate when it becomes imperative to bargain collectively such as for market participation.

ICTs can help aggregate farmers aggregate "virtually" at various levels, from input, farm logistics, sharing equipment to marketing. This therefore will not require physical aggregation as done in collective farming or also cause the fear for loss of assets. New approaches and Institutions for aggregation may emerge with use of ICTs. These could be cooperatives and producer companies that also have data and information management functions in addition to aggregating commodities. The others could be data repositories and trust centres.

Comment

The inter-linked transformations script by Reardon and Peter, captures the complexity with much clarity and emphasis the need of informed vision, I would add shared vision as well. Appreciate that your shared it with us.

It is remarkable to note that many of us foresee ICT as a potential problem solver. The features in the ICT pack viz., internet, mobile, other communication, connecting and monitoring devices can be of immense value for process optimization in the Agri-food chains at all levels and for all stakeholder's- producers to traders to consumers. This seems like an arena of consensus. There are two points I would like to raise in that context-

(a) Considering that the diversity of farming and agricultural production systems in Asia, we should look into options to have a some sort of standard frameworks at the regional level- member countries agree to some standard common principles.

(b) It is also apparent that the stakeholder's receptiveness, accessibility and acceptability of ICT tools vary in different regions.

Understanding this pattern can help identify which technology can help in what process and for which group. How to leverage for the existing networks? or Do we need to strengthen the capacity of the stakeholders before the new interventions are prescribed? How do existing institutions like community centre or cooperatives or Panchayat systems in case of India can be fundamentally equipped to take on this new role, in terms of skill and resources (human-technology).

Comment

Following the discussion all along has been very interesting. The Agri-food-chains in Asian agriculture will certainly be the driving force of world agricultural development and growth. ICT will help to import Asian Agriculture to the world in terms of social networks and other emerging technologies. ICT was first industrial-based, then personal-based. Today ICT is user-based in terms of content and usage. That is a plus to the Asian population.

Comment

I have been seeing all the comments on ICTs for the last so many days. This approach is really very innovative and a demand of time as well.

If we talk about India, on one hand we have surplus of food that we are short of space to keep the wheat which gets spoiled due to mismanagement and on the other hand we have thousands of populations who don't have sufficient food. Keeping these two aspects in view, if we have the Agri-food chains, it is going to directly benefit the farmers. In India, the farmer is not getting the proper benefit of the his product in time. With the advancement of technologies in the Agri-sector, the farmer specially the small scale farmers and other commodities involved are surely going to be benefited. The climate change is putting a shift in crop production from time to time and with the implementation of ICT and Agri-food chains, this problem will be solved to a greater extent. Whenever, new policies are to be framed, the farmers should always be kept in mind. The feasibility and possibility of any new invention must be the criteria which finally benefits the society. The other factors which will also improve through Agri-food chains will be adulteration. The poor farmer does not know much about a specific hybrid or variety and is being cheated sometimes but in future we expect that he gets pure seed and indirectly the productivity is improved. Once the contribution of agriculture towards GDP in India was maximum which is gown down due to less investment or improper management of investments. It's a requirement of present day to improve this situation and I hope through ICT in developing the Agri-food chain, various issues like food shortage, providing pure food, sufficient food and within the economic zone of consumers and feeding the whole country with enough food etc. will be resolved. Hope for the initiation.....

Food Safety and other issues such as Non-Tariff Import Barriers

Comment

Implementation of Global GAP and IFS standards, promotion of these standards in developing country will help to improve the quality and sustainability of food chains. In asia very little focus is on safe food.

This need to be enhanced at all forums wherever the scientists get a chance to influence policy. But this is a dilemma that our policy makers don't have scientific background and also they hesitate to consult with scientists who spent the precious duration of his life researching on that certain topic.

Comment

Prevalence of diseases especially the infectious ones like Foot & Mouth Disease in livestock may impact agriculture trade & influence production activities in developing countries. If such diseases are controlled, may give boost to exports consequently an incentive for more production. The developing countries are now taking note of these issues. For example, India is trying hard to control FMD, after successfully eradicating Rinderpest .The non-tariff barriers to Agri-trade also impact food production & trade in developing countries. Non-tariff barriers including all the political and economic measures adopted by food surplus or developed nations, apart from tariffs, curb imports or distort exports, which have implications for food industry in developing countries. Many developing countries currently are not able to export the food products because of these barriers. It can be expected in years to come these constraints shall be overcome. Further, as said above, the better coordination among scientists, policy makers & industry is required to understand the complexities of food production & exports.

Comment

Some thoughts:

1. Future chains will be more complex and require higher flexibility as (due to various reasons) regional sourcing will increase while global sourcing will continue to persist --> requires advanced IT support

2. Ethics will play an increasing role, requiring improvements in tracking/tracing, trust, and (maybe) parallel logistics chains.

Example:

a) Major European retailer reduces sourcing of soybeans from South-America because of the GMO issue and engages in developing appropriate sourcing in European countries.

b) Response by SA partners: no problem, we will sell to China.

c) Response by retailer: In the long run, China will not accept food, Europeans refuse to eat.

Traceability

The thinking of ICT for Asian Agri-food chain:

1. Chain Information Systems completely automated or executed by people can be used for business activities such as picking, packing, labelling, making a bill of lading, invoicing and dispatching.

2.Tracing technology(RFID,GPS,scanning,…..) can be applied for Asian Agri-food chain management to guarantee the Agri-food safety and traceability.

The focal point of Asian Agri-food chain development:

1.An increase of guarantees related to food quality and safety;

2. A redefinition of value propositions, roles and processes of actors in the Asian Agri-food chain network;

3. An increase of international cooperation in supply chains whist maintaining a high flexibility in partner selection;

4.A speeding up of processes via rapid fulfilment techniques and parallel processing;

5. An increased use of the potential of new information capturing and processing capabilities;

6.A consolidation of product and information flows within organizations, supply chains and Agri-food chain network;

Comment

ICT technology in the fresh produce supply chain three functions: order processing, product transportation and distribution, inventory and warehouse management. Development of ICT for agricultural information tracking, tracing and laid a good technical foundation. Personally feel that the main role of ICT in the fresh produce supply chain is retroactive, retrospective includes planting base, wholesalers, logistics companies, retailers and consumers. Plantations involve basic data collection, farmers, when planting, when harvesting, when medication, medication names. Appearance of fresh produce will change in the transport and distribution process, it must be consistent traceability.

Comment

The EU had banned Mango imports from India. The reason they cite is that the Indian mangoes are highly infested with insects (fruit fly). Here in this I feel that had there been an intervention with ICTs in this value chain from production to export, this would have not happened. The ICTs can be used to warn and make efforts to get rid of pest attacks. And all the produce can be identified with source and infested ones could have been discarded.

Comment

India has the capacities to implement traceability systems for fruits and vegetables. See:

1. http://www.rediff.com/money/2007/jun/22grape.htm

2. http://www.youtube.com/watch?v=Wp1O1otpf8s

3. http://www.apeda.gov.in/apedawebsite/Announcements/Traceability_System_HortiNet.htm

However why is it not used for Mangoes which are also an important export product for India? Also, Whether the system meets International standards or is it developed in isolation of International standards?

Why cannot India have a system with standards similar to EUREPGAP? China is developing a system similar to EUREPGAP which is termed ChinaGAP.

Also as I am sure members of this forum will be enlightened to know from you and your Indian colleague agricultural scientists, India's capacities in research, innovation and development of Traceability Systems for its Agri-food chains?

Comment

Implementation of Global GAP and IFS standards, promotion of these standards in developing country will help to improve the quality and sustainability of food chains. In asia very little focus is on safe food.

This need to be enhanced at all forums wherever the scientists get a chance to influence policy.

But this is a dilemma that our policy makers don’t have scientific background and also they hesitate to consult with scientists who spent the precious duration of his life researching on that certain topic.

Comment

(English Translation through Google Translate)

Food safety management is too complicated, involving many fields of expertise. The "logistics network topology, food safety management relational database" applications it is very enlightening. Food safety management is a dynamic process. But within its regional logistics base path is based on the topology of the network nodes in each distribution, forming a mesh topology among its producers, wholesalers, distributors. Suppose, there are 500 food outlets within a certain area, we can according to the direction of its trading relationship and the logistics of each transaction node to build its food logistics "Topology road map." Which is on the highway the car like logistics. The next thing is to manage the "public transport vehicles on the road" (Food Logistics), several people in the car, where he comes from, where to go, where to get off who, and who stand in which the head off, which is the relationship database management problem.

In the future, if we will food logistics information in real-time into our relational database management software, once we find somewhere illegal food (including sampling, reporting, etc.), we can use regional food logistics network topology, these relational databases, using intelligent analysis software, we hope to retrieve management information to accurately clarify "illegal food come from?" Where to go, the number of how many, what their specific logistics network topology path is completed when the logistics of illegal food sales potential food hazards probability is much, so where is the scope of decision-making information, to

Comment

An important issue to tackle the technology working on ground and assesses its potential and limitations. The points do reverberate how process optimization in Agri-value chains can leverage from the existing ICT infrastructure like digital road network based GPS (Global Positioning System) database. The technology will not only benefit establishing demand based distribution chains, also monitoring of demand-supply dynamics at local, national level to begin with. More in this context – to map community collection centres that can serve as aggregate nodes for communities within the buffer radius of 30-50 km etc….Important is that any such initiatives at the regional are shared to explore possibilities of adoption and scaling by others in the regions ...that would need

mechanisms or platform in place ..possibly via existing bilateral or multilateral bodies or by initiating subsidiary nodes under such umbrella institutions e.g. Asia Agri-Value Chain Forum

Comment

The credit (trustworthiness) crisis is the most serious problem in Agri-food trading nowadays in Asia. And Agri-food EC needs a trusted mode to get consumers' belief.

The surveillance of Agri-food is always divided into different stages and is administered by different departments of government, different standards and platforms are adopted, data sharing and communication is difficult.

The traceability of Agri-food is an effective technology, for enterprises, the most attractive thing is products chain management and tracing inside the enterprise, which is called inner traceability. for consumers, it's an effective mean to get the safety information along the whole process of the Agri-food products.

Coding technology is important in traceability, the most important thing is to use the unique coding scheme, like EAN UCC, OID etc., every code in the scheme is unique, so the Agri-food can be identified uniquely in the world, it makes the traceability can cross stages, cross departments and even cross industries.

The code can be carried by RFID, 2 dimensional code like QR Code etc., which can scanned by smart phones, make it very convenient by people.

With the development of HTML 5， javascript, and CSS 3，responsive layout, a set of web pages can be shown in PC, laptop computer ,tablet computer and any smart phone with different screen size, so just one site designed, but it can be used in any system (windows,android, IOS etc.) ,and it's also an economic technology to substitute native app for smart phone.

Web API is another important technology, all the necessary functions now can be encapsulated in components, and can be invoked by other applications. So all the professionals just do their own jobs well, and all the applications can be coordinated and work together. So the traceability technology and services providing enterprise (normally ICT enterprise)will play an important role, they work with government together, and regard traceability cantered technology providing and services as their career,

optimize the user experience continuously, and make their products better and better.

Comments

This contribution is indicative that food safety and quality management and assurance are now two critical areas where ICTs through traceability and cold chains systems would play a central role in Asian Agri-food chains.

A lot of technological innovations are now in the offing. One is illustrated; of laser printing labels directly on fruits is available here: http://www.bbc.com/news/technology-29013841. There are others such as of printable RFIDs and use of NFC that are also available. We also are having emergence of cheaper heat sensors useable at individual packet level and temperature indicative inks.

A key issue emerging in Asia is of integration of Institutions, their policies, regulations, information system and information. This is not only at National level but regional level also. An earlier contribution has stated that Asia urgently needs regional coordination and collaboration in integrating its Agri-foods related information systems and information.

Comment

The laser printing is amazing, but the big complicated machine may be very expensive I think, and the fruit and vegetables must be delivered to the machine to print, maybe the machine can meet the requirement of some special scenario, but I think it's difficult to promote in the market. But It's still a good start, if we can invent a portable machine like this, that's a revolution.

Comment

Maybe we should wait.

My line printer in 1970's occupied a large room and made a racket like an express train. :-).

Comment

I agree with you, the technology is developing beyond our imagination.

The future we may want or get!!!

Comment

The contributions so far has given further depth to the trends, driving forces and disruptions that may come about in our Agri-food systems in future.

They list various plausible pathways for Agri-food systems. In my opinion the most prominent of these pathways are:

1. Large Corporate Driven Food Chains around multinational supermarket chains and fast food restaurants supplying densely populated urban areas

2. Farming cities, Peri-Urban and Urban Farming

3. Rural – Urban Continuums

4. Rural Ghettos resulting from abandonment of rural areas and smallholder farming

The Large Corporate Driven Food Chains would at their commodity supply end have the gigantic Agro-industrial complexes and/or farming cities. The peri-urban and urban farming would be very much be merged into Farming cities that may or may not coexist as also complement the Large Corporate Driven Food Chains. The Rural – Urban continuums appear as a major disruption of current trends but are when examined closely what current rural areas with their farming systems would be if all services such as for health, education, energy, connectivity, governance etc. were made available to them. This would also lead to revitalization of urban area. Rural abandonment would result in rural ghettos and may be a consequence of following the large Corporate Driven Food Chains. Their main function would mainly be to provide cheap labour for the Agro-industrial complexes and farming cities.

What ICT could/would contribute in these different cases? What future development of ICTs could change the proportion of these different patterns in the future?

The answer to the first of the questions would in my opinion be that it would depend on how closed or open Agri-food chains would be allowed to be developed through policies, rules, regulations, standards, norms, standards, finance, capacity development, infrastructure etc. Technology

per se may not play a major role in defining the degree of openness or being closed. They will certainly be used to abet any of the choices the Institutions make for the Agri-food chains the Governments want. In a democracy, 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.

For the second question, I would rephrase it to how can communities use and innovate ICTs to bring about the Agri-food chains they need? In my opinion, the possible ways to achieve these goals would be to consider Institutional, Technological and Community based interventions together holistically. There can be policies and regulations made so that Agri-food chains are not closed by major pivotal actors or corporate bodies but kept open at all levels from input, harvest, processing, marketing and distribution. Institutions and organizations would be needed to support aggregation of farmers and producers, small and medium processors and marketers to compete fairly with the large corporate bodies. Standards should be designed through involvement of all actors in the Agri-food chains. Financial systems, including insurance, should support all actors so that they can avail these services fairly and equitably. And, information flows along Agri-food chains should be made transparent and open. Technologically, open hardware, software and connectivity should be encouraged with democratization of scientific endeavour and technological innovation. This would develop the necessary customized ICTs and their applications users want. At the community level, social media would play a very important role in their members being kept informed. Communities would need appropriate capacities to manage the informatics they would need to support the Agri-food systems they need and decide to have. The communities would need organizations and Institutions such as data and information repositories, trust centres, clouds and analytical tools and apps.

My political bearings would make my choice of the Agri-food systems discussed to be the rural-urban continuum. This system would largely be localized in an appropriate catchment producing most of its food, energy, water with local services such as health, education, physical and digital connectivity, recreation and governance that are as good as in Urban areas. These systems would cut down wastage of all resources and lead to improved quality of life through better environment. For such a system to come develop, Governments must develop the necessary infrastructure

for services, regulatory mechanisms that encourage production of local Agri-food commodities products as per demand and enable their local marketing.

This is being tried out in Japan to preserve rural livelihoods and environment. When I travelled from Tokyo to Kyoto, I could actually see this urban-rural continuum of farms, very small tea gardens and orchards interspersed with factories and residential areas. Train stations and highway resting places along with restaurants had farmer markets where small farmers could bring their products, many of which were niche products, and sell them to both locals and travellers. Even the restaurants were encouraged to use local produce and offer local food specialties. And these farmers used cutting edge ICTs. They would be informed immediately through SMS when the fresh products they had stocked in very small quantities in the farmers markets were sold out and needed to be replenished which they would do on need basis with the freshest of the produce straight from the farms and gardens. They used barcoded labels that indicated whether these had followed protocols whether for pesticides, fertilizers or being grown organically.

The future I do not want to see is of rural ghettos. These would happen if Governments forced indiscriminate urbanization, did not develop basic infrastructure in rural areas and the Institutions did not support rural people to get dignified livelihoods. These rural people would not be included in financial, educational, health and even governance systems. They would be forced to remain information, and as a consequence, knowledge poor and this would lead to perpetual poverty.

Comment

The former President of India, Dr A.P.J Abdul Kalam had a similar vision to that of Japan in the Providing Urban Amenities to Rural Areas (PURA).

More here: http://en.wikipedia.org/wiki/Providing_Urban_Amenities_to_Rural_Areas

Comment

The role of ICTs in driving the development of Agri- food chain is an evolving area which is vital to face the challenges of sustainability, food safety and boost agricultural production locally as well as globally.

Precision farming, early warning and decision support systems, Global Navigation Satellite Systems, GIS, Ground sensors for crop protection, logistic business, e-marketing and home delivery systems, integrated food

supply networks, tele centres, mobile telephonic services including SMS and mobile apps help rapid transformation of agri. food chains and has the potential to make it more productive, sustainable and resilient. ICTs will provide a great role in Agri-food chain providing timely information on all aspects of farming starting from the right seed and its availability for each crop, adoption of best farming practices to provision of optimum choice to consumers based on quality, food safety and economy using smart solutions for delivery. It will be win-win situation for producer as well as consumer accomplishing market transparency and slowly squeezing out the middle men from the value chain. This will in turn help in bringing down inflation of food items.

Areas to be focused in future for developing Agri-food chains using ICTs are:

- In-depth Analysis of Agri-food chain networks in Asian countries bringing out the strength and weakness of linkages between various actors of the Agri-food chains and provide smart solutions using ICTs for interventions in weak areas.
- Intelligent solutions for safe storage and logistic marketing, needs to be focused using ICTs for accelerating the development of Agri-food chains. The example from Japan to preserve rural livelihoods and environment is worth emulating. Why can't other Governments also develop the necessary infrastructure for services, regulatory mechanisms that encourage production of local Agri-food commodities products and enable their local marketing?
- In view of the high level of penetration of android phones especially in India, development of customized mobile apps has great potential to strengthen the production, processing and marketing of agricultural products.
- Embrace innovation system approach and create innovation platforms mediated using ICTs to support aggregation of farmers and producers, small and medium processors and marketers.

Comment

Yesterday I have learnt about Car Sharing here in Rome. People look on their phones if there is any car which they can use it to drive to a place. On map they would find it out and take it by driving themselves. The car has keys in it and is remotely opened for the people who book the car. Then they can leave it anywhere in the city or any place. And it would be taken by someone later.

This shows how the GIS/Google/Open Street maps can be used and combined with the information available to build goods and services.

In the Agri-food Chains, when the information is available in interoperable form, it can be used by the service providers to provide services of for the goods available....

Just for case, if I wanted to buy Idly Rawa which is not common in North India (as many use Rice itself for Idly making), I can know on map a nearby location shop from where I can get it. Its only possible, if the data on the marketing and transport of the Rawa is open and is available.

Comment

There are more instances of technology-mediated extension services in developing countries, many documented on the e-Agriculture platform (www.e-agriculture.org). Not only do ICTs provide a faster way of interacting, they also provide a more effective monitoring and evaluation platform.

The role that ICT can play as an instrument of change is potentially transformative. Smallholder farmers, particularly women involved in agriculture, have a huge advantage when the right ICTs are induced into the agriculture value chain. Access to the right information at the right time gives them the capacity to make informed decisions that affect their livelihoods and thereby play a major role in ensuring food security.

According to Science Daily, a full 90 percent of all the data in the world has been generated over the last two years. The speed at which these data flows makes it impossible to store and analyse them to support future decision-making. Machines and software with the ability to capture/analyse data 'on-the-fly' is what the near future needs. The sheer volume of data generated is referred to as 'Big Data' and they hold great importance for agriculture. Analysing rainfall data over a period of 50 years or the pest vector could give valuable insights into important issues such as climate change, weather patterns and disease and pest infestation patterns. The re-use of data is an emerging thought that is yet to be addressed by the ICT4D experts.

Precision farming, GIS and remote sensing are touted as the most promising ICT interventions for agriculture. The last article describes how a company has been able to use these technologies to establish an agro-infrastructure throughout a whole country for fostering better agricultural development. Many other innovations hold great promise for agriculture,

such as the use of ICT technologies that provide newer ways to handle disaster response. FAO actively surveilled Highly Pathogenic Avian Influenza H5N1 in Bangladesh with the help of ICTs (see http://www.youtube.com/watch?v=eEj0gVV44V0).

The recently published article, by OpenSignal, a London-based app development group, explains how they were been able to use crowd-sourced temperature information for real-time temperature readings in major cities. The same temperature sensors built into smart phone batteries that prevent them from overheating has been successfully tapped to reveal accurate weather data, much more accurately than widely separated stationary weather trackers. This holds great importance as granular information is urgently needed in present-day agriculture.

Various challenges facing agriculture in recent times are juxtaposed by the need to feed the growing population with more information on the stagnation of arable land expansion, increased scarcity of water resources, declining productivity growth affected by lack of investment in agriculture in recent decades, increasing postharvest losses and table waste, various uncertainties such as future crude oil prices, food price hikes and volatility, the negative impact of climate change and natural disasters and biofuel development.

Weekly Summaries and Conclusions

There have been very active discussions on driving forces of Agri-food. A paper by T. Reardon and C. Peter which is interesting in the context of this e-discussion has also been posted.

The discussants have indicated a wide range of the quests for national food security and sovereignty, application of technology and food safety for consumers as driving forces.

We are having difficulty in acceptably defining and describing a generic Agri-food chain. It is this complexity that most of our reductionist science finds difficulty with for analysis.

The participants have considered Agri-food chain as having components such as inputs supply, production, processing, transport and movement, some form of marketing and consumption. These components are considered not as being linearly linked but networked with flows occurring through nodes in the links. One way of addressing the issues in describing

Agri-food chains can be to describe their channels, the direction of the flow and the nodes through which specific commodities, finance and information pass, are produced and/or processed for some form of value addition. With such a framework, we can consider how the driving forces impact upon not only with the whole Agri-food chain but also it's the channels, flow, nodes and commodities.

Currently, the Agri-food chains we have in Asia can broadly be categorized into one of the following four types. The first is of a public sector Agri-food chain that in one form or the other provides some of the farm inputs; either produces the commodity or procures it from producers, processes and distributes it to customers. The flow is controlled by the State and many of the nodes are also of the State. These are not only for food such as wheat and rice but also agro-industrial feedstock such as cotton. The second is the fast food restaurants and supermarkets, who usually have contractual arrangement with farmers and producers and may provide some of the farm inputs, have outsourced or in-house processors, their own organized logistics and outlets for customers. The third is through Cooperatives, which may have roles in providing farm inputs, procurement, processing and distributing farm products to consumers. The fourth is when there are very few nodes between inputs, production, processing, marketing, distribution and consumption such as in subsistence farming and free market oriented agriculture. There are however variations in each of the above types. For example in India, regulatory mechanisms do not permit direct procurement of many agricultural commodities, especially fruits and vegetables in bulk, directly from farmers for sale to consumers. These should only be sold and bought in designated markets.

With these considerations, it becomes clearer that farming and agricultural production systems are now based on how they participate in Agri-food chains and what the main driving forces for Agri-food chains in Asia would be. If it is food security and sovereignty the emphasis may be more of a more public-sector driven Agri-food chain. The Agri-food chains of supermarkets may be driven primarily by profit but inclusive of quality and food safety considerations. Agri-food chains of cooperatives may be driven by remunerative pricing and profit and stable marketing for producers and/or consumers. Agri-food chains in more open markets may be driven by many driving forces.

And this leads us again to the question, what will be the future scenario of Agri-food chains in Asia? It appears that there will a mélange of Agri-food chains depending upon the sub-region we consider. For example, in South Asia, we may have a public sector Agri-food chain for food grains,

supermarket and cooperatives for fresh foods for urban consumers and open but organized rural markets. Would such developments lead to development of large agro-industrial complexes with factory farms as are seen in some parts of China and South East Asia? Or can the driving forces demanding better environments and quality of life force rural-urban continuums? And would these rural-urban continuums lead to new types of Agri-food chains?

We have indicated several political, economic and social goals such as food security and safety, lowering of food costs, improved livelihoods, improved quality, urbanization, export markets, diet change and economic growth as some of the driving forces for development of Agri-food chains. We have also indicated changes in climate and Agri-food chains, agricultural intensification, disease and pests and technological innovations such as in biotechnology and ICTs as driving forces. There was an apparent emphasis on assured food safety as a major driving force for Agri-chains development in the region. This is in some ways different from the driving forces that were also indicated in Europe such as reducing wastage, producing energy renewable resources, bringing efficiency in energy and ethical production and marketing of agricultural commodities.

An interesting insight was that Agri-food chains may develop with different time spans in different parts of the same country. Another point raised in the same context was about economic growth, political stability and how society as a whole learns, have changes in attitudes, knowledge and practice. There was discussion about policy direction and support as essential for Agri-food chains development. There was an interesting perspective that Agri-food chains were "positive entities" and developing them can become a platform for political manoeuvring, a tool of malicious competition, external intervention in production sequences, external economic considerations, and other negative eventualities.

Some very interesting disruptions in Agri-food chains that may lead to their changes and transformation were also pointed out.

What decides development of farming, agricultural production systems and Agri-food chains?

Till the use of fertilizers, based on the discovery of an artificial way of producing urea by Friedrich Wöhler and Justus von Liebeg's studies on plant nutrition, farming and agricultural production systems largely developed on the basis of soil fertility and water availability. The use of

fertilizers freed farming to be driven by other forces such as markets, politics and technology. Alongside this, industrialization created demands for agricultural commodities such as cotton and gave rise to cities with concentrations of large populations that were not involved in food production but which had to be fed.

Of course, politicians and rulers since the beginning of civilization like food to be cheap for consumers. They make policies and rules towards this end. Many of today's farming systems and Agri-food chains are a result of this politics.

Agri-food chains are increasingly being driven by globalized, highly competitive markets. This is seen through large scale emergence of super markets and fast food chains as in developed countries where foods and agricultural products from a wide variety of sources across the world are available. They are replacing traditional markets and avenues of accessing food and many other agricultural products. They are also making Agri-food chains more closed and controllable by single entities.

However, several forces have also started exerting pressure. Foremost among these are the demands for safe foods and those produced ethically. Other forces include the need to reduce wastage, especially of natural resources and energy, make agriculture sustainable, reduce pollution and harmful effects on the environment, produce and trade agricultural commodities fairly and prevent monopolies, produce foods locally as also preserving heritage of the environment, ethnicity and culture.

Some of these driving forces are forcing new forms of farms and farming systems. We now see factory farms, corporate farms and farming complexes producing huge quantities of the same type of agricultural commodities. We are also seeing huge swaths of rural areas, once productive farms, now abandoned or under farmed as farming as a livelihood is not attractive and remunerative with these new driving forces, especially those that bring globalized agricultural markets.

We should also consider that farm inputs are also now a part of complex Agri-food chains. Seeds, fertilizers, pesticides, farm machinery, energy, even knowledge and skills have a variety of sources and very complex paths till they reach farms. And from the farm, food and agricultural commodities again have a complex chain along which they pass and are processed and packaged till consumed.

We may reach an interesting conclusion emerging from examining today's Agri-food chains. Are farms and farming central to the design of these

chains as commonly assumed? And, do they design the construct of Agri-food chains. Or vice-versa, do Agri-food chains design farming systems? And if so, what sort of farms and productions would we have when designed around an Agri-food chain?

The driving forces in future would be, in addition to those now in force and emerging, would also be how technology fashions what we may at present not even call as agricultural products or produced in units that we do not recognize as farms. For example, farms producing "farmaceuticals" or medicines and biologicals for medical treatment or high tensile silk from milk (See http://learn.genetics.utah.edu/content/science/pharming/) and industrial factories producing meat through tissue culture.

The developments of Agri-food chains in Asia are at a very interesting point. Asian countries have to feed huge populations with India and China together making more than a third of the global population. And these populations are still growing. Many Asian countries have comparatively rapid economic development. Because of this, there is growing demand for more high value foods, especially animal products. This makes them major importers of food grains, pulses and animal feeds. Rapid industrialization in these countries creates large migrations of rural people to urban centres that are increasing in numbers and sizes. Each of these countries has and still experiences high food inflation that ultimately eats into economic growth and creates political instability. Many of these countries face huge challenges in assuring safety and quality of their foods. Several of them face issues of large scale malnutrition, obesity and epidemics of other related diseases such as diabetes.

Asian countries, notably China, India, South Korea, Malaysia and Thailand have been exporters of agricultural commodities and in the recent past food grains. They are also now vying for international markets as exporters of processed foods. They will now, in addition to being globally competitive in prices, need to also meet international standards of quality, safety and ethics. In the long run, as their participation in global food and agricultural commodities markets grow, they will also be influenced by the same driving forces that are emerging elsewhere.

Most farmers in Asia are smallholders' issues for them are especially in access and use of ICTs, in Agri-food chains. The needs for aggregation of small holders is key to their participating in Agri-food chains and in using new technologies especially ICTs. It was suggested existing institutions

like community centre or cooperatives can be fundamentally equipped to take on this new role (information management) in terms of skill and resources (human-technology). There was also a need expressed for new Institutions such as Trust centres and repositories for data and information produced by these chains.

It was also suggested that with the diversity of farming and agricultural production systems in Asia, options to have some sort of standard frameworks at the regional level- member countries agree to some standard common principles. An important issue would be how and through which Institutions. Apparently SAARC, ASEAN, APEC etc. can play a role in this vital area.

Continuing with contributions related to smallholder farmers, the SMART farm concept now being implemented in Thailand has been illustrated. Continuing with this it was indicated what ICTs can be used by small holder farmers to participate in Agri-food chains as they may develop in Asia.

A very wide spectrum of ICTs will need to be employed in Asian Agri-food chains as they change and develop driven by forces described above. ICTs will need to make agricultural production and marketing with lower costs and higher quality and safety that is assured and trusted. Asian Agri-food chains will need to integrate ICTs so that they can participate in global markets.

The main challenges for Asian Agri-food chains are in its largely small farmer based farming systems. And this is also a challenge in the uses of ICTs in its Agri-food chains. How can Asia meet these challenges? Can Asia use ICTs innovatively for its agriculture to be both small holder based and its Agri-food chains to be globally competitive? If yes, how?

Participants

Ajit Maru	Italy
Alexandra Cabrera	Philippines
Anita Mann	India
Anthony Connor	United States of America
Antonio Acedo	India
Asad Rahman Nile	Bangladesh
Axel Drescher	Germany
Bayuni Shantiko	Indonesia
Bharath Krishnan	United Republic of Tanzania
Biswajit Mondal	India
Charlie Martial Ngounou	Cameroon
Christopher Brewster	United Kingdom
Cuiping Tan	China
Dean Diepeveen	Australia
Denis GRAS	France
Dhananjaya BN	India
Ehud Gelb	Israel
Eleonora Sirsi	Italy
Ervin Naval	Philippines
Fahd Rasul	Pakistan
Farhad Mirzaei	Iran (Islamic Republic of)
G. Zadid	Bangladesh
GDS Kumar	India
Gerard Sylvester	Thailand
Gerhard Schiefer	Germany
Giampaolo Rugo	Italy
Gianfranco Giannerini	Italy
Honghui Wan	China
Ibrahim Ahmed	
Imma Subirats	Italy
Isabella Rodriguez y Baena	Italy
Itzel - Damaris Rojas	Panama
Jancy Gupta	India
Jeyaram Alagarsamy	India
Jiayi Liu	China
Jieying Bi	China
Job Nmadu	Nigeria
John Dixon	Australia
Katinka Weinberger	Indonesia
Khalil Alsharjabi	Yemen
Lambert ADA	France
Leifeng Guo	China
Madan Poudel	Nepal

mahesh chander	India
Mahesh Shrestha	Nepal
Manjula M	India
Mhamed Sedrati	Morocco
Miguel Herrera	Mexico
Mireille Mclean	United States of America
Mohamed Ali ATIG	Tunisia
Mohammadreza Davari	Iran (Islamic Republic of)
Moses Yiga	Uganda
Natalia Strigin	United States of America
Nengfu Xie	China
Nicoliene Oudwater	United Kingdom
Nidhi Nagabhatla	Germany
ONG FEED	Niger
Onias Ysmael Sanchez Barrios	Venezuela (Bolivarian Republic of)
Peter Horne	Australia
Philip Abrahams	United Kingdom
Pisuth Paiboonrat	Thailand
Prince Arkhurst	Ghana
Rafael Montilla	Venezuela (Bolivarian Republic of)
Raksha Lakher	India
Rattan Yadav	United Kingdom
Ravindran Chandran	India
ravishankar m	India
Retno Astuti	Indonesia
Richard Amansec	Philippines
Robin Bourgeois	Italy
Rosa Akbari	United States of America
Roy Abijaoude	Lebanon
Shahnawazul Islam	India
Sharbendu Banerjee	India
SHASHANK BHARAD	India
Shashank Singh	India
Shubhangi Wankhede	India
Shuchun Pan	China
Simon Wilkinson	Thailand
Singh Satendra Kumar	India
solomon adesubokan	Nigeria
Sridhar Gutam	India
Srinivasulu Rajendran	United Republic of Tanzania
Tang Yan	China
Tannis Thorlakson	United States of America
Thi Huy Hop Bui	Viet Nam
Ulrich Heindl	Germany
Urs Wittenwiler	China
Valeria Pesce	Italy

Vassilis Protonotarios	Greece
VINOTH R	India
Wei Sun	China
Wenjun Ma	China
Xinning Hao	China
Xue Yan	China
Yan Tang	China
Yin Yuan	China
Yin Yuan	China
Yunpeng Cui	China