An International Consultation on
Integrated Crop-Livestock Systems for Development
The Way Forward for Sustainable Production Intensification

Technical Workshop, Sete Lagaos, Minas Geráis, Brazil, 23-26 March 2010

Consolidated summary of contributions submitted during the electronic Consultation

1 February to & 7 March 2010

.oOo.

Summary Week 1/Theme 1

February 1-5, 2010

Building off of the background paper provided at the website http://www.fao.org/agriculture/crops/core-themes/theme/spi/iclsd, Theme 1 focused on **promising integrated crop-livestock systems and innovations that merit mainstreaming and scaling, and tactics for implementation**. This week's discussion was rich with interventions and reactions and responses. There were some 50 enthusiastic contributions bringing insights from countries in the Middle East, Asia, Latin America, the Caribbean, Africa, Europe, and North America. The following brief summary is meant to highlight the range of points that were brought into the discussion. The summary is not exhaustive and can not adequately capture the full richness of the discussion. That said all of the individual interventions can be found on the website as well as all of documents, photos and links that were submitted by participants. Further, the reflective thoughts of Andrew McMillan also provide a useful synthesis (Contribution 44).

This document is organized according to the questions that were used to prompt the discussion.

1) Do you believe that integrated crop-livestock systems are an answer for sustainable intensification? Do they have a place in our strategy for feeding 9 billion people in 2050?

There was a resounding yes in response to this question, which was almost always accompanied by various qualifiers and expanded ideas.

These integrated crop-livestock systems:
must build off of their interdependencies; be managed for efficiency; take into consideration the application of technical principles; implemented for a profitable enterprise; allow for chemical fertilizers essential to increasing productivity, and using manures and organic matter as integral to the sustainability of any cropping system; ensure sustainability upon which the fate of human survival is dependent; have a clear market focus moving beyond the goal of food security at the household level; are defined by trajectories that are regional, agroecologically specific and influenced by different scales (examples of South Asia where the bulk of meat and dairy comes from integrated systems yet these integrated systems are not well enabled in Europe); can be optimized to improve rural economies and agricultural-environmental impact; are recognized for their heterogeneity; require vastly different approaches for research and development better linked to policy, institutional and social dimensions that enable small holder market participation; provide resource efficient farming systems that dictate that resources be shared among components of a diversity of production systems; play a role in sustainable intensification and that should be a priority over area expansion; are here to stay while recognizing that they are in transition with different paths of intensification driven by internal and external factors; are a sustainable option as they mimic natural processes; and provide flexibility and resilience; scaling up to the landscape level are necessary steps to development; provide potential for adaptation and mitigation of climate change; require innovations to manage transitions; are potentially more robust in the face of global change and crises; are the systems upon which poor farmers are dependent; and must follow the Modern Sustainable Highly Productive and Profitable Agricultural model (MOSHPPA); among others.

2) What have we learned about integrated crop-livestock systems since the 1980's?

Colleagues offered up a broad range of existing examples of systems from various agroecologies

and scales and with different component emphases and each with their opportunities and constraints. Examples included: crop-tree-livestock systems in Nepal, Bhutan, India; small holder farming systems in semi-arid Zimbabwe; small scale dairy in India and Tanzania; alley cropping in West Africa and Indonesia; use of fodder legumes of *Calliandra calothyrsus*; Zero tillage systems in tropical Brazil and Canada with cover crops; systems with high densities of trees in (sub-humid-humid) Southern Africa including conservation agriculture with Faidherbia albida (CA/Agroforestry/Evergreen Agriculture) in Africa; conservation agriculture in Madagascar; dual purpose crops such as cow-pea (West Africa) and potatoes (East Africa); integration of cotton, corn, sorghum and legumes with animal management in Burkina Faso and Mali; dairy systems on Reunion Island; zero tillage soybean utilizing *brachiaria* grass in the Cerrado of Brazil; Crop-livestock-tree systems using eucalyptus and teak; alfalfa in rotation with grain in Canada; Spanish 'dehesa'; "faxinal" system of Southern Brazil; no-till cassava in Paraguay. Colleagues identified that there are multiple ways to integrate crop and livestock systems - crop farmers can rent out their pasture rotation to livestock owners rather than own the livestock themselves as well as landless livestock keepers can link with crop producers – integration does not have to be at the farm scale but can be across the community. Different scales make a difference – smallholders often have an advantage over large scale enterprises for dairy, but not so for pigs and poultry

3) **What are the key benefits that arise from these systems? economically, environmentally, and socially? From a production standpoint, what are the gains in terms of functional biomass, multiple purpose production?;**

Among the environmental, economic and social benefits related to integrated crop-livestock systems, the following were shared:

- From an *environmental perspective* colleagues noted the importance of the ecological resilience, ecosystem efficiency and recycling, building organic matter, carbon and water storage, the reduction in dependence on external inputs, reduction in pollution and erosion (CA/ground covers), the interdependence of cropping and livestock systems, and the increase in biological diversity as well as overall bio-diverse productivity.
- The systems are *socially* of value in rural areas as they are typically practiced in small-holder operations (where they are very much acceptable) but have not been promoted/enabled in larger scale farming systems, yet they exist. The systems often build upon traditional and indigenous knowledge. Livestock are considered an indicator of wealth. The systems also bring a diversified diet and increased nutrition to the household. Sustainable systems can decrease migration pressures.
- The systems are considered *economically profitable* and serve as a risk-averse strategy that enhances overall farm resilience in times of low crop yield, additional income from livestock products, reduced external inputs due to optimizing recycling of manure, tree and crop residues. It was expressed that economics will drive and the other co-benefits will come with the use of these integrated systems.

4) How are these innovations being scaled up? What are the mechanisms for sharing knowledge (Farmer Field Schools, Farmer Cooperatives, Farmer interest groups or associations)?

Colleagues generally highlighted the role and importance of innovative farmer leaders, women, community organizational/institutional strengthening, strong producer groups, farmer field schools, farmer participatory research, introduction to youth in schools, and training for community based expertise (e.g. community animal health workers), and efficient information technologies. It was noted that single technologies (e.g. alley cropping) are not likely to be scaled

up without allowing for strong farmer involvement in the local discovery and adaptation processes, and integrating market, institutional, and policy dimensions with technological aspects. There need to be simultaneous engagement at a landscape level through collective action and farm level intensification through technology integration.

Further, it was suggested that a Global Crop Livestock Initiative could be put in place including an inventory/database of references and activities.

5) What are the key constraints to implementing integrated crop-livestock systems? What about constraints to scaling up/out?; 6) How best do we integrate these sustainable intensive production systems into a landscape scale approach?

- *Segregation of components and disciplines (hyper-specialization).* Farmers, scientists and development professionals recognized that our approach to agriculture tends to separate our crop production systems and our livestock production systems (and expertise) and that this has closed a window on systems and holistic thinking and subsequently undermined the success of integrated crop-livestock systems. Enhancing communication among disciplines was emphasized and ensuring that scientists are working directly with farmers. Rethinking participatory approaches, adaptive research, co-learning, and co-experimentation beyond plant, animal, field bases were suggested.
- *Regional Differences.* It was recognized that many systems are moving away from integration and in the direction of specialization (e.g. China, Vietnam) while it may actually take further (drastic) limitations from climate change or energy crises to encourage robust integrated systems in Europe.
- *Access to resources and productive inputs.* Land tenure is a critical constraint in terms of both farmer investments in improvements on land that is not guaranteed as well as movement of livestock (example from South Yemen). Further, benefits from integrated systems must be substantial enough for producers to adjust their systems to incorporate livestock or other infrastructure needs. Access to markets, knowledge, credit and seeds and in some cases subsidies were also highlighted. Conflict among land uses (including bio-fuel production) and issues of trespassing were raised. Once land is under irrigation in dry areas, it tends to be put under crops, relegating livestock to hill sides.
- *Policies*. Support tends to promote the status quo and international markets and taxation are promoting cropped areas (e.g. Argentina). Policies must shift from sectoral to integrated decision making. At present, there are no organized public-oriented initiatives to foster these systems.
- *Competition/tradeoffs of use of Crop Residue*. Crop residue has multiple uses. There continues to be a competition for crop residues (whether used for ground cover, soil improvement and nutrient cycling) or as fodder for livestock (‘feed the soil or feed the animals”), cooking, fence, thatch, biochar, etc. Further choices of crop varieties may be based on grain or quantity and quality of crop residues for feed in these systems.
- *Labor*. There are potential labor constraints in the management intensive systems.
- *Limitation of natural resources.* In many cases, water is the limiting factor and existing land degradation (and subsequent low forage quality) is also considered as a constraint.
- *Livestock in ‘the balance’.* Livestock are not looked upon favorably in society because of the potential of environmental issues. It was noted that it is important that whole farm systems are analyzed for net green house gas emissions/sequestration.

Summary Week/Theme 2

February 8-12, 2010

Building off of the background paper provided at the website http://www.fao.org/agriculture/crops/core-themes/theme/spi/iclsd, Week 2's discussions focused on supply and value chain dynamics and the actors associated with promising crop-livestock systems.

In our background paper, we identified a focus on: **input and output market linkage development for promising integrated crop-livestock systems and associated input and output supply chain processes and public-private service providers for different production systems and diverse markets** (including constraints and opportunities in input supply chains covering production inputs of seeds, agro-chemicals, farm power, equipment and machinery, veterinary services, advisory and innovation systems on good farming practices, marketing infrastructure and organization forms etc; constraints and opportunities in output supply chains covering animals for meat, milk and other dairy products, hides and skins from cattle and small ruminants, and meat and eggs from poultry, and meat from pig; and opportunities for processing in integrated production systems etc). That description is a mouthful but certainly did not deter our readers from responding.

This week's discussion included some 20 contributions that came from experiences in Australia, India, Mali, Sierra Leone, Uruguay, Kazakhstan, Canada, Sudan, Brazil, USA, Bangladesh, Niger, Chile, Colombia, Zimbabwe, and Ecuador among others that indicated regional and global applications. Many of the interventions were relevant to the previous week's theme (innovations) and others are readily segueing to next week's theme (policy and institutions). The following brief summary is meant to highlight the range of points that were brought into the discussion. As we noted last week, the summary is not by any means exhaustive and can not adequately capture the depth of the interventions. That said all of the individual interventions can be found on the website as a blog along with the documents, photos and links that were submitted by participants.

This week's summary is organized according to the questions that were used to prompt the discussion (as much as possible). A number of addition inputs are highlighted as well.

- ***Do integrated crop-livestock systems offer an advantage when it comes to incentives/rewards for good practice such as payment for environmental services or access to special markets? If so, what is your experience with these?***

There were not specific examples of incentives that are in place but there were examples of what integrated systems could offer. The Inland Valley System (IVS, West Africa) warrants incentives in that it can reduce the use of marginal fragile uplands and the inclusion of multi-purpose crops can which leave crop residues for livestock and reduce conflict. Payment for environmental services could be considered for protection of natural forests, increased soil organic matter and biota, and erosion control.

- ***Are there market (local, national, international) dependent value chain constraints (e.g. lack of local processing facilities, food quality/safety regulations, market access, etc.) that need to be addressed? Which are these and how have they been or might they be overcome?***

Urbanization and income growth has influenced the demand for livestock products in South Asian countries yet poor livestock keepers may not benefit from this given a lack of access to

inputs, technology, credit, services and product markets. Lack of credit and insurance to support livestock are often not available. Markets that are not near by drive up marketing and transportations costs (reducing the price by 15% in some cases). Through Operation Flood, small holders can participate in commercial dairying through addressing production and institutional and marketing constraints. This applies also to growers' associations, cooperatives and contract farmers. Contract farming in was noted to increase profits over non-contract farming in India.

In Sudan, there is a growing domestic and export market for live sheep and meat and this has brought crop farms into sheep raising which in turn finances the crop production. Livestock becomes the financier. Livestock is also seen to create a financial buffer against crop failures.

Constraints to overcome, identified by the Panchayti Raj Institutions (PRIs), include better linkages for farmers with markets, insurance and banks to overcome associated vulnerabilities. Further as livestock production increases, there is an emphasis on indigenous breeds, feed and fodder resources and inputs such as veterinary services to equip livestock producers.

Constraints in southern USA include: lack of information needed for managing sophisticated/complex production systems; lack of field infrastructure (fencing water sources) and supply and delivery linkages; lack of information related to chemical usage for crop, animal and human health and safety; need to balance year round forage supplies and labor; and need to develop market for alternative meet production (grain fed vs. pasture fed).

Constraints in Sierra Leone include: lack of knowledge on caretaking (housing, nutrition, and health care); lack of vaccines and persons that can vaccinate; and lack of feed either as fodder (tree sources particularly) or intensive feed. Farmer field schools with animal technicians are being used to try to address these. Inclusion of pictures in training packages for farmers and extension staff are critical.

In the Inland Valley Systems (IVS) crop-livestock enterprises in West Africa, the constraints identified included soil moisture and the availability of animal draught power to cultivate the soils. Often farmers can pool their resources to put draught teams together.

One intervention featured the multiple dimensions of integrated pasture-tree and pasture-crop systems in the Ecuadorian Amazon. While they constitute the main production approach much expansion has been carried out through unsustainable practices that play a role in deforestation and climate change and have also instigated value chains in the region. The intervener queries whether intensification the way to reduce deforestation in the Amazon knowing that integrated systems can reduce environmental impact and green house effect. Intensification of pastures can reduce animal numbers and large areas of degraded pastures can be put in agroforestry. The diffusion of agroforestry technologies include climatic conditions, economic growth of urban centers, presence of agro-industry, manpower availability, capital and credit, producer organization and incentives. Education is critical and the State and international cooperation have an essential role to transform to alternative systems "with shade" and develop markets for environmental services (and carbon) that come from the forest. This intervener also emphasized that the commercial economies have negative effects on the marginal sector – thus preferential attention should be given to institutional structure, research, extension and the farmer promotion.

Two colleagues provided diagrams of the inter-related supply chains of crop and animal production systems (graphics should be viewed in blog).

- Sims highlighted the inputs (products and services) that each provides to the system (from livestock, agroforestry, and conservation agriculture) as well as the outputs for

value chains (food crops, fibre products, meat, wool, eggs, vermicompost, honey, etc.). This system highlighted the complementarity of CA and AF – for efficiency of natural resource use, provision of favorable production environments, profitable production systems and environmental protection and management.

- Twomlow offered up another graphic (adapted from Thomas 2003) that depicted biophysical constraints and interrelationships with production systems, households and communities with the natural resources management as the central feature. The crop-livestock project elements increased the inputs and flexibility of production systems, which in turn contribute to NR sustainability. Constraints are identified in production systems (e.g. drought, low productivity of rangelands, low diversification); household community (e.g. low investments, infrastructure, cohesion); and socioeconomic factors that influence community and production systems (lack of credit, subsidies, insurance). Interventions are required to strengthen institutions, empowerment of communities, provide conservation techniques, and enhance crop-livestock systems.

Integrated systems have enabled improvements in quality of meat and milk at competitive costs – this is derived from combining perennial and annual forage species, management tactics, pasture fertilization and animals with high genetic potential. Pasture finishing is satisfying requirements and markets. In South Brazil, over the last 10 years, area under crop-livestock systems has doubled and the integration of forage and cover crops have increased the profitability (net income) while diminishing risks.

It was noted that the global economy is influenced by crop-livestock systems (noting an example where Chilean farmers directed their crop-livestock systems toward European markets until quotas were imposed and the integrated crops livestock systems became less viable. This example was used to show that beyond innovative systems (breed, traceability, welfare for specific markets), government and political support must be associated with the innovation in order for the integrated systems to be improved. Further, farmer training must be done by well motivated and paid professionals that can address the reality of these systems.

- ***Who are the input supply chain and output value chain actors and how do they inter-relate? Who drives the chains (farmers, input providers, markets, government, etc)? How equitable are the benefits to different actors along the input supply chain and output value chain? Are there examples of input chain and output value chain actors working together to gain more competitiveness and sustainability or stability?***

It was noted that private sector should be the main actor in supply of inputs and purchasing, transporting, storing and processing of outputs from the systems. All actors need to make a living (partial or full) from the supply chain activities. The public sectors' role is to fulfill extension, training and PES.

In India, working with clustered groups of villages who wish to work for the common cause (building on the PRIs and self-help groups and women self-help groups) increases the representation of women and more marginalized members of society and assists with the implementation of project interventions and direct linkages with relevant line agencies. Cluster approaches can sustain projects even when donor funding is absent. Action research on crop-livestock-fish integration has also worked with the Directorate of Research on Women in Agriculture to insure women's perspectives are addressed in technology development.

- ***Might we see a shift toward greater local/national sustainable markets in light of decreasing availability and increasing costs of transport fuel, climate change, food insecurity, etc.?***

The main challenge will be from feeding the growing urban population and most of the food will come from medium and large farms which are in continuous grain accompanied by land degradation. The key role of pastures by fixing and recovering soil carbon balance will be crucial given increasing nitrogen fertilizer and petrol prices/shortages.

The IVS in West Africa is typically situated near large cities and towns and pressure toward intensification will increase with increasing numbers of people who are migrating to cities. Food security will be an important driver as well as meeting the demands for richer consumers.

A historical view of livestock integration in Uruguay demonstrated that ley farming took place in degraded grassland ecosystems introducing legumes and ultimately rotation of perennial pastures with grain crops. By the 90s, 90% of grain crops were in rotation with pasture one out of four years. Most recently these well integrated systems on larger scale farms have been undermined by continuous soybean production despite rising meat prices. The integrated systems continue on medium and small farms.

Integrated systems are on the rise in India to reduce farmer dependence on grain crops and allowing for additional sources of income.

Markets were noted as playing a large role in driving the intensification/specialization of crop-livestock systems and these are diverse across and within regions. A table showed the intensification gradient (extensive to intensive) by elements of integrated systems (feed, power, finance, market orientation, evolution, costs, innovations) – provided by Bruno - source Erenstein and Thorpe, 2009. Increasing overall demand for livestock products, urbanization, niche markets at diverse scales are emerging and within changing environments that must be addressed (e.g. equity, conflict over resource use, land deals and environmental challenges).

In Asia, projections suggest that demand for maize will be faster than for wheat because of the demand for livestock and poultry feed as well as increasing demand for food (rapid population growth, rising price of wheat and rice) and bio-fuel. This is expected to be a main driver toward shift in food consumption patterns in poverty stricken areas – driven by increased demand for raising livestock.

A new article in Science magazine offered up by colleagues in the CGIAR (Herrero *et al*.) was shared which uplifted the importance of mixed crop-livestock systems for food security. Two quotes here: "According to the CGIAR analysis, the world's one billion poor people (those living on less than 1$ a day) are fed primarily by hundreds of millions of small holder farmers (most with less than 2 ha of land, several crops, and perhaps a cow or two) and herders (most with fewer than five large animals) in Africa and Asia. Furthermore, mixed crop-livestock systems could be the key to future food security; two-thirds of the global population already live in these systems, and much of the future population will occur there. Already mixed systems produce 50% of the world's cereals and most of the staples consumed by poor people". And, "Faced with population growth and climate change, small holder farmers could be the first targets for policies to intensify production with carefully managed inputs of fertilizer, water and feed to minimize waste and environmental impacts, supported by improved access to markets, new varieties, and technologies."

Additional Inputs:

Gender equity. Several colleagues pointed to the importance of gender issues and analysis and women's role in farming systems (historically and with women's self help groups in Asia).

Alley Cropping Lessons Learned. It was stressed that participatory approaches will not succeed if it does not meet the farmers need. The intervention noted that beyond scarcity of labor, the farmers did not see the direct benefit such as lack of commercial return from alley cropping e.g. environmental benefit alone is not sufficient. However the commercial value of livestock in small holder systems over the past 10-15 years has increased the interest as there is a practical application of tree legumes for livestock (citing *Leucaena* with grain crops in Australia).

Benefits. Increasing organic matter and biological fixation of legumes to support crop nutrition is a clear benefit. The intervention highlighted that fertilizers are much less effective at reversing land degradation. Another intervention noted that precious bi-produce of manure may exceed the value of meat or dairy animal products particularly on subsistence farms.

Area-wide integration. We were reminded of the fact that integration can take place on farm within the same management unit. Rather functional integration can readily be across a community or landscape.

Carrying capacity. Promoting integration of livestock calls for understanding the capacity for providing forage and essential feeds from the land base. Further, imported feed impacts livestock production as well as manure chemistry which has environmental outcomes. In nutrient poor environments, improvements in livestock productivity enhance manure quality and have a positive impact on crops and pastures. Assessment of tradeoffs must be carried out.

What did we learn? One intervention stressed the fact that we need to review what we did learn in the 70s, 80s and 90s as some of ideas emerging were core decades ago. However, there may well be socio-economic conditions that have changed which may augment the capacity to implement these systems now. A literature search to map new directions is needed and brought forward in multiple messages.

From land degradation to sustainable production. A case from Kazakhstan was presented to demonstrate different methods for converting abandoned land into pastures. Some successful outcomes pointed to the practice of sowing annual forages instead of follow to produce green forage, hay and grain as well as the 'green conveyor approach for the production of annual forages as well a perennial ones to prolong availability of forages. Crested wheatgrass and sainfoin was a successful mix in Central Kazakhstan (legumes were difficult in the north) and in Canada alfalfa can replace the sainfoin.

Crop residue. Several contributors raised the issue of conflict over the use of residues. Integration of livestock requires the provision of fodder production through partial harvesting, separate fodder banks, or improved fallows. The intervention from Sudan noted that 'crops and horns never co-exist' as in this country the migratory, semi-migratory and agro-sedentary systems are present.

More Examples of ICLS. Additional examples of integrated crop-livestock systems included honey bees in Ghana and Rice-Duck cultivation in Japan, Korea, Philippines and Vietnam – a win-win for sustainable crop intensification.

Getting the meaning. One colleague noted that there are many wrong ways to intensify agriculture and that we need to be clear that agricultural intensification protects (rather than

increase) productivity and prolongs good yields, reduces yield variability and production costs, while increasing food security and respecting the natural capacity of the environment and addressing cultural differences. The intensification of CA needs to integrate crop with livestock to preserve and strengthen diversification. And, a final quote "Seems difficult? Nobody said it would be easy!!"

Summary Week/Theme 3

February 15-19, 2010

Building off of the background paper provided at the website

http://www.fao.org/agriculture/crops/core-themes/theme/spi/iclsd, discussions during Week 3 focused on those policies and institutional supports that must be in place to enable the adoption and spreading of innovations and practices associated with promising crop-livestock systems for food and nutritional security.

This week's discussion included some 22 contributions that came from experiences in India, Burkina Faso, Iran, Zimbabwe, Canada, Sudan, Brazil, the USA, Chile, Bolivia, Cameroon, Ethiopia, and Ghana among others that indicated regional and global relevance. The following brief summary is meant to highlight a range of discussion points. As we noted in previous weeks, the summary is not intended to be exhaustive and cannot adequately capture the depth of the interventions and shared materials. All of the individual interventions can be found on the website as a blog along with the documents, photos and links that were submitted by participants.

This week's summary is organized according to the questions that were used to prompt the discussion.

- ***From your perspective and in the context in which you are working, what are the top one-two (1-2) institutional and/or political constraints that undermine the uptake, implementation or spread of integrated crop-livestock systems?***

In response to this query, a number of constraints were mentioned and several were reiterated time and again. Participants spoke to: disincentives or the lack of support to adopt new technologies or innovate or lack of demonstrations effective to motivate farmers to change; disincentives towards the commonly integrated farming systems, which then led to their disintegration and specialization in the recent past and which still continues; the predominant institutional view that a quick-fix approach can overcome any problem; lack of information, social support networks, physical resources, marketing support, insurance and financial credit limit (lack of understanding of lenders); challenges stemming from the lack of suitable alternative markets within a reasonable distance as well the weak association between different components of the value chain; issues around large landholdings and land tenure/ insecurity that prioritize specialized crop farming for local consumption and export or threaten pasture areas or livestock keepers trying to trek animals.

A constraint mentioned repeatedly was around the compartmentalization of crop/agriculture and livestock activities (breeding and agriculture) within government ministries and departments, extension agencies, researchers leading to a lack of a systems perspective/approach ("systems specialists") in research and development including differential intervention needs. There is still a lack of participatory approaches among extension staff and insufficient attention to linking forward to markets and coupling technologies with income-generating commodities.

Further colleagues spoke to a lack of political will/support from top leaders or public initiatives that foster the understanding of importance of integrated crop-livestock systems in enhancing the livelihood of resource poor farmers; institutional and policy silos between producers (different groups), conservation organizations, agricultural NGO, private sector investors, district and national government agencies, among others.

What can/might be done to address these constraints and who (or who together) can make that happen?

Colleagues offered up a number of recommendations to address constraints. Opportunities were raised around: raise political support and financing for integrated crop-livestock strategies that contribute to resolving larger ecosystem-level challenges and opportunities, like watershed restoration, habitat restoration for threatened biodiversity, and carbon sequestration; more influence from researchers and government extension encouraging farmers to adopt alternative production systems. Awareness raising and education were highlighted in terms of strong farmer-led organizations (e.g. conservation tillage alliances, those innovational agricultural schemes) with educational support networks (e.g. extension and research teams working towards similar goals; technical teams to bank managers; and changes in curricula) that could provide a great deal of technical and social support to encourage change and resulting benefits (e.g. in and around these schemes and in the suburbs of large cities) as well as better communication, transparency and confidence are necessary between the producers and processors. Incentives were raised around market conditions including credit; production contract, incentives for quality, good agricultural practices, animal welfare, soil health, are also required.

To address issues of compartmentalization, it was suggested to move toward one platform for all the service providers related to crops and livestock (systems) and innovation platforms that bring diverse actors together for joint action. The institutional dimension to provide incentives for innovation needs effective networks and alliances to put technology into use, recognizing that innovation occurs, emergent behaviours arise, and these represent changes to social institutions. It was suggested that at various levels, there could be better dialogue and join work among different disciplines and stakeholders. Partnerships need to be built among the stakeholders for that better coordination and communication is prerequisite that build upon honest and visionary leadership to bring about change.

To address specific institutional issues around pastoral systems, one colleague suggested delimitation of large areas for livestock keepers, better and more complementary ways of managing pastoral resources and fodder; as well as ensuring that decision makers realize the importance of mobility for animal feeding and the protection of pastoral spaces.

Another intervention noted that increased energy costs could actually promote the shift towards more local food production systems and another suggested the usefulness of constructing a typology of crop-livestock systems for each country for better targeting of technology and development. One intervention summarized that farmers organizations and an appropriate political environment are key elements.

If you had 5 minutes with a/your Minister of Agriculture (or Livestock, Finance, etc), what message would you want to deliver? What about 5 minutes with the head of national or international farmers' organizations? Any thoughts to share with a relevant private sector representative (inputs, processors, buyers, etc.)?

Below, we have placed the 'messages' according to the audience.

Messages for the Ministries:

-The economical and environmental benefits of ICLS (with examples and case studies including political benefit), and that dissemination depends on long-term investments in technical knowledge/assistance and financial access/stimulus.

-From the perspective of the sustainable national development, the reversion of the big large and unproductive agricultural lands is the most important strategy to reduce the poverty and to guaranty the environmental sustainability. This strategy will allow the intensification of the land use and, in the medium term the development of crop-livestock integrated systems of production.

-What is your planed strategy to maintain farmers on their landscape while increasing productivity in quality and quantity, without deteriorating the environment?

-Policies can affect the balance between production and environmental quality. Strategies should be considered that emphasize the long-term sustainability of a region by balancing production and environmental quality, not just focusing on the short-term needs of a selected portion of the population.

-Extension officers need more than technical skills - they are well placed to act as facilitators of innovation by bringing in private sector players, market actors etc to stimulate innovation - but they need to be capacitated and mandated in this direction.

-Put an environment / pollution tax on industrial systems and provide incentives for mixed systems in peri-urban or hinterlands. Use the tax for building infrastructure to link hinterland producers with urban /demand centres.

-Bulk supply of inputs to farmers through farmer association would save on cost of inputs. Bulk purchase of produce by processing industry again through farmers association would save on marketing and transaction costs.

-Dans les zones de savanes subhumides de l'Afrique de l'Ouest, on aurait tout à gagner en renforçant encore plus l'intégration de l'agriculture et de l'élevage. L'agriculture bénéficie de la présence de l'élevage à travers la traction animale, la fumure organique, l'épargne/trésorerie sur pieds et l'élevage bénéficie de l'agriculture à travers les résidus de cultures (ressource fourragère de saison sèche), le recul de certaines maladies comme la trypanosomose....

-Put additional funding into research, education and extension on conservation agriculture and low input crop production systems. We as agricultural producers have been encouraged for years to rely on chemistry to provide solutions to our production practices and we have paid a huge price for this method of production. If government support programs were designed more to support beneficial innovation in our production practices and our public research and extension dollars should be directed at conservation agriculture and integrated pest and fertility management techniques. (The message would be similar for the farm organization leadership.)

-Crop-livestock integration is important as a way forward to environmentally friendly and sustainable agricultural system which should be promoted, made top priority of Government's agricultural policy and cause MoFA and its technical departments to provide position papers for consideration (justifiable documents for his/her consideration must be included).

-Faced with the pressure on space and with the number of animals involved, transhumance seems to be a guarantee for (i) the sustainability of the agro-pastoral systems of the Mbororo stockbreeders and thus (ii) the supply of livestock products to urban consumers, whose needs increases each year. This mobility makes it possible to develop in the course of years a diversity of the agro-climatic situations and natural recourses. In order to be sustainable, however, these systems based on mobility must be better managed. The practice of pastoralism as a socio-economic activity and way of life must be guaranteed. This passes through the sensitization and

the popularization of the laws and regulations for the determination of the status of spaces of pasture and the tracks of cattle and the promotion of a policy of regional planning. Stockbreeders must take part in decision-making relating to land.

-Assure market for small and marginal farmers, Credit Card for taking loan from banks for purchase of inputs required for integrated crop-livestock innovations to landless and poor people. Promote agro-processing and input delivery at cluster level through SHGs/CBOs.

-Link integrated crop-livestock system with Food for Work programme.

-Incentives to deforest are major that those to preserve, and only the legislation can do little to help to stop the intensive expansion of forest destroy. This condition limits the intensification of the systems of production, and obviously, limits the development of agricultural systems more friendly with the rural development and the preservation of our lands forest. Integrated crop-livestock systems are one of them that have the major efficiency in the utilization of the factors of production, and it may have important potential to increasing the food national safety.

-A change in the parameters of measurement of the Economic and Social Function of the land (FES) must incorporate the productivity of agricultural or livestock activities. And this may be the route for the break of the extensive unproductive systems and give step to more efficient systems in the use of the agricultural or livestock factors of production. The smallholding and the unproductive big large agricultural lands have given place to the stagnation of the development of the crop-livestock integrated systems of production. Moreover, that condition was the principal topics for the irrationality management of our natural resources, stimulated the degradation of soils and permitted the increasing of illegal market of lands. In the other hand, these conditions was the principal roots of our social tensions and was the principal limiting to access to the food national safety.

-In Bolivia, the rate of national livestock extraction has a range among 12 to 14 %, the first one is proper of South American camels, and the second is representative of meat bovine production. This value is together of Paraguay's value the lowest in the world. It is lower than the world average of 20 %, than that of the CAN of 16 %, than that of the MERCOSUR of 18 % or than that of the EU 15 of 36 %. In other hand, the performance or yield of the canal, this is minor to 52 % and the sacrifice age, product of slow rates of growth, is near to 4 years. Certainly, to improve these parameters of production should be one of the policies of the sector; the low production performance has a linear relation with the equitable access to the land and with two tied factors: the reduction of the poverty and the environmental sustainability.

Messages for Farmers' Organizations:

-Farmer organizations could work together so that the agricultural systems of a region are diverse and vibrant, rather than manipulated by a dominant few at the expense of others.

-What are the minimal conditions required to implement an ICLS? And secondly, which are the bottlenecks you visualize on the system?
- Organize meetings/workshop of their members where experts including myself could address the larger group on the crop-livestock system set up, implementation and benefits. From there they could be a pressure / advocacy group for government's support for the programme.**Messages for Private Sector:**Private agricultural industries could offer a suitable suite of alternative technologies to meet the diversity of needs within a region.

The livestock production systems have an average of productivity of 16 kg of corporal mass per hectare. This low production is determined by the application of a system of extensive managing that is reflected in degradation of forage recourses, capacity of carrying low and equal to 0.2 UA bovine per hectare. With this low productivity, the strategy is to access large lands. And, the most important are to access lands of low cost or zero cost. Only in this condition the livestock systems offers utilities.

What policy or institutional support or changes have you witnessed or read about that led to demonstrated success in the uptake, implementation or spread of integrated crop-livestock systems? Are there successes in other fields that might be applied in this situation?

In response to this question, participants named some examples and also expanded a bit on what has to be in place to have successful systems in place.

Examples that colleagues felt could inform the debate included:

The use of sorghum for poultry feed in Asia promoted through an institutional innovation / coalition approach including crop scientists, poultry nutritionists, feed industry, credit agencies, input dealers (including seed), farmers, farmers' federation, poultry producers, and poultry federation.

The Indian Council of Agricultural Research (ICAR) is experimenting institutional innovations under National Agricultural Innovation Project (NATP) for enhancing the livelihood security of rural poor so that it (ICAR) becomes a dynamic innovation system capable of responding to the present as well as the future needs of agriculture research and development. The emphasis is on improving and developing the most suitable integrated farming system models in the less favourable environments and regions and groups through action research so that the livelihood of the rural poor improves through assured food, nutrition, employment and income.

Several technologies refined under Institute Village linkage programme of NATP (such as backyard poultry rearing, integrated farming systems, strategic feed supplementation, etc) are up scaled at sate level through Agricultural Technology Management Agency (ATMA) far wider and faster impact.

Through the Landscape Measures Initiative (www.landscapemeasures.org), Ecoagriculture Partners and numerous partners have begun compiling and further developing tools and methods for analyzing, planning, design and monitoring of such participatory landscape initiatives.

CLFIS is a strategy of sustainable agricultural production which integrates crop, livestock and forest activities on a same area, applying agricultural techniques such as crop rotation, succession, double cropping, and intercropping, searching for synergistic effects among the components of the agroecosystems, contemplating environment aspects, human value, and economical viability. The project uses categories for different agroecological zone in Brazil including: crop-livestock integration; crop-livestock-forest integration; and livestock forest integration.

The regional COAMO's experience (Cooperativa Agropecuária Mourãoense Ltda – Campo Mourão – Paraná) where in 5 years have reached an adoption level of 1980 stakeholders working with ICLS. Its success was based on field demonstrations and knowledge spread by 200 agronomists, trained by a partnership with Universidade Federal do Paraná (UFPR) and IAPAR (Instituto Agronômico do Paraná), and supported by private enterprises as well.

Another is the PISA (Produção Integrada de Sistemas Agropecuários em Microbacias Hidrográficas). It aims to promote sustainable agricultural development having ICLS as one of its main pillars.

Additional suggestions and insights included: a systematic review of the various models that are being experimented with for multi-stakeholder innovation and action platforms, and lessons learned about their development and management (and financing) and to pull together the methods being used in crop-livestock integration programs at landscape scale, and make them more widely available through diverse platforms, including the Landscape Measures Resource Centre; the importance of personal desired of individuals to make necessary changes toward a sustainable rural community; ensuring that universities, research institutions and agricultural government supporters are sympathetic with the System Approach; fully taking on board the coalition approach (with forums and capacity building) where in all the potential stakeholders (players /actors) are brought on a common platform; stockbreeders have to invent new forms of social and professional organization in order to have the capacity to defend their interests, to communicate with the authorities, the better organized communities of farmers and organizations working for development; and policies must be started to advance ICLS through effective regulations and the offer to (small to medium) farmers of alternatives models. Further, one intervention noted that in order to develop sustainability ecological crop- livestock productions is necessary to participate in the markets of just prices the following are necessary: a) prohibition of the use of transgenic seeds; b) prohibition of the production of agro bio fuels; and c) to satisfy, as the first priority, the necessity of internal market, and newly later to satisfy the external demand.

Summary Week/Theme 4

February 22-26, 2010

Building off of the background paper provided at the website

http://www.fao.org/agriculture/crops/core-themes/theme/spi/iclsd, the discussions during February 22-26 (Week 4) focused on the research needed to generate knowledge and innovative practice to underpin farmer adoption and scaling of promising crop-livestock systems for sustainable production intensification. Looking back over the previous weeks, we were keen to identify key research gaps within on the ground implementation, input and market chains and the policy dimensions.

This week's discussion included some 20 rich contributions that came from experiences in Zimbabwe, Brazil, Kenya, the USA, Ecuador, Bolivia, Colombia, Cameroon, and Ghana among others that provided regional examples and/or global relevance.

As we noted in previous weeks, the summary is intended to highlight points made within the discussions. It is not a synthesis nor is it exhaustive by any means. All of the individual interventions can be found on the website as a blog along with the documents, photos and links that were submitted by participants.

This week's summary is organized according to the questions that were used to prompt the discussion. Our thanks to those who brought additional points made in support of the previous week's topics and these will be added to earlier summaries.

To the responses:

A few comments permeated the conversation including:

- *Practice to Policy.* Several colleagues pointed out that the number of interventions to the e-conference declined as the discussion shifted to policy and institutional and raised the questions as to whether this was indicative of the challenges of working fully within both the practice and policy/institutions realms. Further many colleagues noted the critical importance of ensuring that policy makers have evidence to support innovations in ICLS for sustainable outcomes.

- *Inclusion.* Most participants indicated the importance of strong inclusion of all of the relevant actors particularly farmers and pastoralists but also the range of intermediary actors including those from extension agencies, universities, NGOs, local authorities, public-private fora, socio-economic institutions, researchers from various disciplines, state decision makers, consumers, private sector and processors, among many others. The role of farmer's organizations was noted as of primary importance such that they can negotiate with agricultural government institutions and the bank actors, in order to participate in defining politics and financial support to the rural sector. Further, with increasingly public concern about the way the food is produced and its effects on the environment, consumers associations play another important role in to the dissemination of the benefits to implement IC-LS.

- *All dimensions.* In general, colleagues pointed out that a focus on production alone is not appropriate. Rather we need to take into account the social, cultural, and economic dimensions and particularly the issue of managing risk.

- *Communication.* Communication and adequate dissemination were highlighted as critical to getting better results in adoption and scaling than historically have been the case.

- *Multi-stakeholder innovation platforms.* There is increasing interest in establishing multi-stakeholder innovation platforms (e.g. the Sub Saharan Africa Challenge Programme (FARA) and ILRI pilots). The success of the innovation platforms, and their ability to scale-up, will ultimately be determined by the ability to learn how to engage the value chain actors efficiently and cost effectively. It will also require change agents who are skilled facilitators among value chain actors.

- If you could secure funding to carry out research on the gaps associated with integrated crop-livestock systems - from your perspective and context - what would you identify as the most critically needed research associated with:

a) On the ground implementation of integrated crop livestock systems? With which actors might you partner to carry this out?

- *Multiple options.* Test a few well-designed ex-ante formulated options that include technical, environmental and socio-economic components. Avoid "packages" but rather opt for the two to three options tried under the same conditions. Don't be closed to rejected options.

- *Build on what we know and what works.* Build on what is known elsewhere that would be relevant for production and environmental conditions and market options. The importance of examining available information or conducting a fresh study on what has been done before (indigenous knowledge), what worked for the rural farmers and why they were involved in a specific production system as opposed to others.

- *Environmental benefits characterization.* Successful identification of the key limiting elements of systems within the region must first be identified and the research hypotheses should center on how best to optimize crop-livestock balance to meet the opportunities offered within a particular landscape/area setting. An ideal research focus would characterize the production potentials of multiple facets of a system approach and determine the suite of environmental benefits that might be obtained, as well as identify the turning points where systems might fail and contribute to environmental degradation if not functioning properly.

- *Economic outcomes.* Economic outcomes must be a key element of the research to continuously modify systems in partnership with producers to eventually obtain a robust set of efficient practices that can be selected for a particular region. Research recommendations should be shared among regions to characterize ecosystem services provided by ICLS to identify unique niche opportunities.

- *Several Country specific ideas were put forward:*
    - *From Canada – evidence of economic benefits.* The most critically needed research to fill gaps in the crop livestock systems in Western Canada would be an economic assessment demonstrating the benefits to farmers over the long term. Most importantly, the policy makers need to understand the importance of innovation and sustainability of these systems.
    - *A series of suggested research activities from Cameroon* included those related to

valorisation of animals and management of soil fertility, fodder, residue, integration of legumes, timing of pastoral grazing release on crop systems, biomass transfers, stock density, better safeguarding of landscapes/great spaces and agreements among state actors for livestock moments.

- *From Bolivia, the focus was on:* a) increasing the crop production not only the grain but also the straws; b) developing nutritional strategies for improvement the utilization of low –quality roughages and straws by ruminants for productive purpose; c) optimizing the availability of nutrients from the fermentative digestion, microbial growth in the rumen and rumen metabolism.
- *From Brazil it was recommended to address the p*roblems associated with the existing harsh climatic conditions and soil quality have been observed in the Mid-North.

- *Risk Management and Innovations.* "Production" is not synonymous with "profit" and/or "risk management". Minimizing risk, and then optimizing production within the risk constraint sphere, will be an approach more likely to resonate with poor farmers. Tom Thurow presented a gradient of conditions around minimizing risk and optimizing production/profit and sensitivity studies are needed of the reliability of the innovation under variable conditions/assumptions over time).
- *Extending the messages.* The potential to have increased production/profit/risk management would be greater had there been better application of what was known 20 years ago about mixed farming systems. Innovations were never effectively disseminated. Rhetoric of extension agencies (often at all levels) must match the needs of diverse clients. Indigenous knowledge was replaced with new knowledge" and that useful risk-averse methods were ignored.

b) The human and social dimensions of these systems? With which actors might you partner to carry this out?

- *The right practices/products for the users.* Are children and women equipped to undertake the activities involved in integration? Is the addition of livestock to on-going cropping or horticultural or gardening system going to increase the work load of a category of household members? Are the benefits worthwhile in comparison with labour inputs? On the demand side, are consumers ready for products coming from integrated systems? Are they prepared to pay additional for what is perceived by producers as better products from integrated systems?

- *Supporting farmers' goals.* This human social dimension should focus on how to promote adoption of truly sustainable ICLS in light of farmers' goals and what incentives and policy support will be needed.

- *Multiple dimensions.* Research questions will be related to those on markets, consumer preferences, household characteristics, environmental issues and concerns. Actors include socio-economic institutions and, public-private fora with interest in crop-livestock agriculture, urban/inner-town production systems, etc.

- Several country specific ideas were put forward including:
  - *From Cameroon* - safe the access and the sustainable exploitation by users, clarifying synergies of and incentives for the diversification of systems – between sedentary and pastoral land users.

- *From Bolivia* - The economy based on used of large and unproductive lands (latifundios) has reduced drastically the forest area, and resulted in inefficient land use (low cost and exportation of soybean or sugar). ICLS should allow for the rational use of the land based on ecological concepts and the democratic access to the poor people to it.
- *From western Canada – good alternative.* A crop-livestock system which can lower cost of production for both the livestock production and crop production is a practical and sustainable alternative for small and medium sized farms in western Canada. Data is needed to prove to policy makers that the current system of support programs need to be changed to encourage farmers to use the crop livestock integration practices that will lead them to sustainability.

c) Enhancing market chains or incentives to production? With which actors might you partner to carry this out?

- *Income matters.* Market constraints and politics have influenced the implementation of specialized crop or livestock systems rather than its integration. Farmers are looking not only to maximize production but also in some way to increase their income.

- *Engaging industrial actors.* The industrial actors like slaughterhouses, food processing companies, supermarkets and others, which are following consumers' expectations, are key actors in the added value chain. They should promote prices contracts (according to quantity and quality required) with the farmers and on the other hand, the government should have a policy of economic incentives to those ICLS, which are demonstrated to be less polluting to the environment.

- *Access to markets (and removing subsidies)*. Enhance access of agricultural products of developing countries to the markets in the industrialized countries, especially those markets associated with organic or ecological products. The developed countries may have to look critically at and possibly remove the agricultural subsidy on their products.

- *Which comes first – markets or production systems?* Should markets drive the type of production system employed or should a sustainable production system influence how markets develop as a response? Can farmer activities to achieve sustainability override market prices, and if not, then how can policy instruments be used to support economic, environmental, and social sustainability? For market chain development to be successful it will require a grassroots movement, innovators in agricultural industry and well informed policy makers.

- *E*cosystem services. It is necessary that markets are developed for environmental services which can increase the income of innovative producers.

- *Storage.* Farmers are often encouraged to increase production with incentive packages, which increase production leading to seasonal glut on the market with a fall in producer prices – overall a disincentive. Appropriate storage is needed.

- *Multi-stakeholder innovation platforms.* Belated recognition that those practices that did not get taken up tended not to add value to the input supply-production-processing-marketing value chain explains the recent increasing interest in establishing multi-stakeholder innovation platforms such as the Sub Saharan Africa Challenge Programme (FARA) and ILRI pilots. The success of the innovation platforms, and their ability to scale-up, will

ultimately be determined by the ability to learn how to engage the value chain actors efficiently and cost effectively. It will also require change agents who are skilled facilitators who are able to help the value chain actors get the information they need, when they need it and in the form that is useful to them.

- *Analysing systems constraints.* There are integrated crop-livestock systems across a range of types (on-farm or area-wide) and scales in different agroecologies. Are there system-dependent input supply chain constraints (e.g. seeds of certain legumes, equipment and machinery for minimum soil disturbance and direct seeding, herbicides, livestock feed for specialized systems, etc.) that need to be addressed? Which are these and how have they been or might they be overcome?

- What are the gaps in evidence required to frame a policy intervention or to influence policies or institutional elements that can advance integrated crop-livestock systems.

- *Clarify policies that work against ICLS.* Research can analyze the current and past government policies that have worked against scaling up of ICLS and the design of "friendly" policies.

- *Research relevant to policy impacts on farming systems.* It is vital that integrated crop-livestock system research be specifically designed to be policy relevant.

- *Systems approach.* It is necessary to understand the System Analysis Approach at different levels.

- Addressing *broad sustainability goals.* Research information on the benefits of crop-livestock integration as a means of reducing rural poverty, rural-urban drift and environmentally sustainable production system could provide the necessary evidence which must be sold to policy maker for a change in policy direction. Nutrition objectives, concerns and considerations need to be more prominently taken into account by agricultural and rural development planners in guiding agricultural and poverty reduction policies and programmes. With only five years left until the 2015 deadline to achieve the Millennium Development Goals, it is clear that a focus needs to be on small and medium scale farmers.

- *Understanding and narrowing the "nutrition gap".* The gap between what foods are grown and available and what foods are needed for a healthy diet – can only occur when national policy makers and members of the international development community recognize that attempts to reduce malnutrition solely via increased production of staple crops are not enough. Agricultural development policies and agricultural development programmes that address food *and* nutrition security are an essential step in reducing malnutrition; they enhance national prospects for improved labour productivity and economic growth, and increase the chances of long, healthy lives for even the most vulnerable.

- *In western Canada – the costs of support programs.* Governments in the developed countries will need significant proof showing the costs to the farming systems that have come as a result of the support programs they have put in place. The programs have guided farmers into specialized systems, which rely almost completely on commercial inputs.

- *In Ecuador – agroforestry.* Agroforestry activities fall between the Ministries of Atmosphere and Agriculture. Political reforms must be examined to promote the Agro-forestry as an integrated system, within a multipurpose strategy of resources, paying attention to the

improvement of the institutional structure for the development of markets of tree products and support to the efforts of research, extension and promotion of farmers.

- How might the research community respond to the structural constraints of carrying out interdisciplinary, multi-institutional and multi-stakeholder efforts? What can donors do to assist in ensuring robust research efforts?

- *Just do it.* There are no easy solutions, but sometimes well-established researchers without regard to potentially political repercussions simply have to "just do it", because it's the right thing to do. Getting the right team for full cooperation under stressful conditions will not be easy. Securing funding for such broad goals is a challenge. Pursue robust research agendas to make progress in getting meaningful results.
- *Think and invest long term.* Research should have a longer-term vision of the possible futures of small scale crop-livestock enterprises and their evolving opportunities and constraints in response to a series of drivers. Most recent forward-looking publications have 2030-2050 horizons. What is our vision of the future of small-scale farms by then? What are the possible pathways out of poverty for small-scale farmers and their families? By 2050, it is imagined that many farming systems will have drastically changed and it is hoped that the next generations will have more livelihood options and off-farm opportunities. Donor institutions or organization including the FAO should be conscious of the work involved and the long-term time span required to carry out research effectively.
- *Let farmers critique.* A new paradigm shift is required where the range of actors is expanded, analyses of the research questions opened up for scrutiny and beneficiaries perspectives sought.
- *Research should help better targeting and setting of priorities.* Which priority systems do we want to support which criteria are needed? Some include: focus on small scale crop-livestock enterprises; addressing food security, nutrition security and poverty alleviation; systems with potential for quick and large returns (markets,…); chance of success (measured by livelihood, macro-economic indicators, environmental impact).
- *Adaptive research should provide the methods, approaches, and tools to put into better use past research findings, existing knowledge and ex-ante analyses. R*ealistic and workable assumptions for scaling-out need to be developed along with fostering institutional changes and integration of 'crop' and livestock related policies at local, national, regional and global levels.

- Please share any other thoughts on this topic or previous topics that will advance our discussions and thinking.

- *Food and nutritional security.* Food systems should be so designed and implemented that they address nutritional needs. The integrated crop-livestock sector offers practical opportunities for achieving this at national, sub-national and smallholder level; increasing the diversity of crops and of the livestock can close not only the production gap or the yield gap by symbiotic mutualism or literal cross-fertilization, but can also close the "nutritional gap" by providing a broader range of nutritious, micronutrient-rich, seasonally available supplies of a variety of diverse foods (including those of animal origin) whose consumption can optimize diets - very relevant both for net rural producers and consumers including smallholders.
- *Summary thoughts - Redirecting ICLS.* The various parties that shape the directions of agricultural development have succeeded in driving it down the wrong roads. These ICLS systems are disappearing very rapidly in developed countries and beginning to follow the same route in developing countries due to market forces and the policies and services put

in place by governments are all pushing towards greater scale and specialization in farming (crops or livestock; large scale livestock operations). One of the reasons is that no one - other than future generations - has to pay for the negative externalities associated with much of the technology on which this "modernization" A second reason for what, on the face of it, would seem to be an undesirable development trajectory, is the now almost universal separation of "livestock" from "agronomy" (reflected in multiple international organizations as well). We are now left with a situation in which the principal guardians of the kinds of integrated crop-livestock systems that we would like to see expanded are farmers who, for one reason or another, have resisted the pressures to abandon them, and who have taken it upon themselves to experiment, innovate and, in some countries, become successful promoters of improved systems.

- *Potential next steps for FAO*. Perhaps one of the best things that FAO can now do is to support the emergence of strong associations experiment, innovate and, in some countries, become successful promoters of improved systems of crop-livestock farmers around the world, helping them to make the case, nationally and globally, for policies and programmes that favour the expansion of integrated systems and encourage the sharing of experiences and innovations. As was the case in the follow-up to last year's workshop on Conservation Agriculture – in which most of the innovations have also come from farmers - a first step in this direction could be the incubation of a Community of Practice that would ultimately emerge as a self-sustaining institution run by its members.