



Report of the regional workshop on  
sustainable intensification of mixed crop-  
livestock farming systems in Northern Ghana,  
Tamale, Ghana, 27-28 August 2012  
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The Africa Research In Sustainable Intensification for the Next Generation (Africa RISING) program comprises three research-for-development projects supported by the United States Agency for International Development as part of the U.S. government's Feed the Future initiative.

Through action research and development partnerships, Africa RISING will create opportunities for smallholder farm households to move out of hunger and poverty through sustainably intensified farming systems that improve food, nutrition, and income security, particularly for women and children, and conserve or enhance the natural resource base.

The three projects are led by the International Institute of Tropical Agriculture (in West Africa and East and Southern Africa) and the International Livestock Research Institute (in the Ethiopian Highlands). The International Food Policy Research Institute leads an associated project on monitoring, evaluation and impact assessment.



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# Introduction

## The Workshop

The Council for Scientific and Industrial Research's (CSIR) Animal Research Institute (ARI) convened a 2-day Inter-Regional Workshop on Sustainable intensification of mixed crop-livestock farming systems in the three northern-most regions Ghana, namely Northern, Upper West and Upper East Regions. The Workshop was held in the context of the implementation of a wider Project "*Sustainable intensification of cereal – based farming systems in the Sudano-Sahelian zone of Ghana*" funded within the RISING initiative by the USAID. The Workshop, focusing on crop-livestock systems within a broader agriculture-livestock integrated system in the region, attracted value chain actors in the livestock, crops and their integrated sectors. These included experts in production, health, processing and marketing in public and private sectors. Researchers, extensionists and technicians from national institutions and regional/international centres as well as non-governmental organisations (NGOs) participated in the workshop. The Workshop was to bring together these experts to provide inputs into the determination of the path that the development of crop-livestock systems has taken in the three regions, the *status quo* of enterprises in the crop-livestock domains, what challenges are facing the sector's value chains that may constrain the further development and intensification, and what opportunities there are to exploit to hasten development. The International Livestock Research Institute (ILRI), a key stakeholder in livestock and closely related sub-sectors in developing countries, especially in Africa, having been contracted by the International Institute for Tropical Agriculture (IITA), the USAID contractor for the RISING Project, contracted and partnered with CSIR-ARI to execute the eventual crop-livestock component of the Project in Northern Ghana.

Forty four (44) persons participated in the "***Analysis of constraints and opportunities for the sustainable intensification of mixed crop livestock systems in Northern Ghana***" Workshop held in Tamale, Ghana, on 27-28 August, 2012. Participants represented ILRI, the CSIR-ARI, Universities, development/extension institutions, including the Ministry of Food and Agriculture ( MoFA), NGOs, and private services providers and farmers' groups.

## Objectives of the Workshop

The objectives of the workshop were:

- To identify biophysical, social and economic constraints, opportunities and entry points with specific focus on livestock, to sustainably intensify crop-livestock systems in Northern Ghana.
- To analysis causes of success and failures of livestock value chain development interventions in Ghana and in the sub-region.
- To identify the most promising interventions with highest potential for success in Northern Ghana to boost targeted livestock value chains.

## **Output/outcome**

It was expected that at the end of the workshop, the following would have been achieved

- A compilation of some recent data from the plenary presentations that can be used as baseline information for the purpose of diagnosing the existing and emerging crop-livestock systems in the three regions.
- Documentation of priority constraints and opportunities for the intensification of crop-livestock systems in Northern Ghana.
- Documentation of lessons learned from past projects and identification of priority research questions and R4D areas that will form the basis for the second phase of the project.
- Priority interventions for specific adoption domains.

# Background

The U.S. Agency for International Development (USAID) is supporting multi-stakeholder agricultural research projects to sustainably intensify key African farming systems as a pathway to attain food security and to combat poverty in sub-Saharan Africa. In West Africa, this research project focuses primarily on maize- and rice-production systems in Northern Ghana but is intended to result in spill-over effects in other similar agro-ecological zones. The overall objective of the Feed the Future Initiative is to improve livelihoods through sustainable increased productivity of maize-legume and crop/tree/livestock systems in the northern Guinea and Sudan savanna zones of Ghana and Mali.

Increasing population (3.0% growth rate) and severe climate change effects are sufficient drivers calling for the need to put in place tested and proven systems for increased productivity sustainably to address the food and nutrition requirements. The three northern regions of Ghana are the most poverty stricken and hunger spots in Ghana (GLSS, 2000) because of a number of reasons. Low input-outputs farming systems found in the northern regions are able to secure food for the population for only 3-5, 4-5 and 6-7 months for cereals (maize, sorghum, millet) and 5-7, 4-5 and 6-7 months (groundnut, cowpea, and soybean) in the Northern, Upper West and Upper East Regions, respectively. Limited integration between crop and livestock production systems and continuous monoculture has led to decreasing soil organic matter contents, parasitic weed infestation, reduced soil biodiversity, higher risk of erosion, and significant nutrient losses that in turn has resulted in reduced yields per unit per ha. The deterioration of the resource is exacerbated by low levels of mineral and organic fertilizer usage due to high cost and inadequate purchasing power.

In northern Ghana the livestock component assumes greater importance as a major source of livelihood and income for many households as well as in food security initiatives of farm families and whole communities. Rural poultry, sheep and goat rearing and small scale dairy, particularly are known to best serve the interests of women and poor households.

Practical technological and institutional solutions are required at the smallholder farm level to pave the way for the sustainable intensification of crop-livestock systems for improved livelihoods. In that regard, National R&D organizations (CSIR-ARI, University of Development Studies and Ministry of Agriculture (MoFA) and ILRI are combining their efforts to conduct R4D activities in Northern Ghana in order to identify and pilot test sustainable farming practices and to effectively deliver and scale out research outputs to end users.

## **Approaches to the conduct of Workshop to achieving goal and outputs**

In order to achieve the outputs set, an approach of using carefully selected key presenters to deliver focused papers on topics of interest at four Plenary Sessions supplemented with two Scientific Sessions and two Break-out Sessions. Each Break-out Session, constituting 3 Working Groups was assigned a specific topic to analyse, debate and form conclusions and recommendations to be delivered to the Plenary. Scientific sessions were designed to bring out shorter presentations based on results from laboratory-based, on-station or on-farm research and farm-household level surveys to enrich the discussions and recommendations.

## **Approaches to collating and synthesizing information presented at the Workshop to inform stakeholders**

In order to bring coherence to the several key presentations made at the Plenary, the outputs from the Scientific Sessions and the consensuses reached in Working Groups, a dual approach of providing brief summaries of key presentations reported in narrative and a synthesis of the discussions and contributions at each Session (including those emanating from Questions and Answers sessions) was adopted in this presentation of outcomes from the Workshop. From the Summaries of individual presentations and Synthesized discussions, relevant information are extracted to generate the four Outputs expected from the Workshop.

# Results and Summaries – Day 1

A total of 8 invited key papers were presented at the two Plenary Sessions on Day 1 and Day 2. Ten shorter technical papers were presented at the two Scientific Sessions on Day 1 and Day 2. Two Group Sessions took place, one each on Day 1 and Day 2. Three Working Groups were created for each day. Reports from each Working Group were presented at the Plenary, and discussed. The Sections below give Summaries of presentations at the Plenary and Synthesis of the presentations as well as those from Questions and Answers following the presentations. The Papers presented at Plenary and at the Scientific Session are being published as Proceedings of the Workshop (Dei *et al.*, forthcoming).

## Summary of individual Plenary Presentations Working Group Discussions

### *Summary of Plenary Presentations on Day 1*

A summary of each of the presentations made at Plenary Sessions on Day 1 of Workshop, is presented below, followed by a summary of discussions that followed the presentations.

### Opening Session Presentations

#### a) K. Agyemang (KA)

##### Topic: Workshop's Facilitator: Why are we here?

The Facilitator introduced himself and requested Prayers to be said according to the Muslim tradition and the Christian tradition. Participants were asked to introduce themselves briefly. KA announced the Agenda for the 2-day Workshop. Background Papers to be used as Resource Materials distributed earlier to each participant were announced. KA then called on Dr. Abdou Fall (AF) to present the Objectives of the Workshop and the Expected Outputs from the Workshop, as shown in the Terms of Reference (ToR) for the Workshop (Annex 1).

#### b) Abdou Fall (AF)

##### Topic: Workshop Objectives and Expected Outputs

AF gave the Objectives of the Workshop and the Expected Outputs as follows:

##### **Objectives of the Workshop**

- To identify biophysical, social and economic constraints, opportunities and entry points with specific focus on livestock, to sustainably intensify crop-livestock systems in Northern Ghana.
- To analysis causes of success and failures of livestock value chain development interventions in Ghana and in the sub-region.
- To identify the most promising interventions with highest potential for success in Northern Ghana to boost targeted livestock value chains.



## **Expected Outputs**

- Documentation of priority constraints and opportunities for the intensification of crop-livestock systems in Northern Ghana.
- Documentation of lessons learned from past projects and identification of priority research questions and R4D areas that will form the basis for the second phase of the project.
- Priority interventions for specific adoption domains.

After the presentation of the Objectives and Expected Outputs, KA introduced the Chairperson for the Day 1 Session of the Workshop in the person of Mr. S. A. Adongo.

### **c) Mr. S. A. Adongo (SA), Chairperson for Day 1 of Workshop**

#### Topic: Chairperson's Remarks

In his remarks the Chairperson thanked the organizers of the workshop for giving him the opportunity to chair the session. SA stated that the topic for the workshop was so dear and touching to researchers and farmers alike, especially the rural populace, because they are invariably engaged in crop and livestock production. SA was of the opinion that the intensification of mixed crop livestock systems should be embraced by all because it is a way out of poverty for the northern sector of the country. He urged the organizers and participants of the workshop to try to implement the deliberations and outcomes the workshop.

After the brief remarks by the Chairperson, the Director of CSIR-ARI was called to give the official Opening Address.

### **d) Dr. N. Karbo (NK) - Director, CSIR-ARI**

#### Topic: Opening Address

Addressing the participants, NK explained that the representation of individuals from diverse institutions indicates how people understand and appreciate the need to intensify mixed crop livestock systems. It implied that the challenge is enormous and demands collective efforts through team-work of participants. Participants were further encouraged to put out their best in presentation of papers and deliberations on issues relevant to the workshop. NK welcomed all participants to the workshop and wished them fruitful and productive deliberations.

### **e) Dr. Abdou Fall (AF)- ILRI representative for West Africa**

#### Topic: Opening Remarks

AF stressed that lands and natural pastures are getting depleted due to increase in crop cultivation resulting from increasing human populations. Livestock production is affected due to feeds being inadequate in quality and quantity. The way forward is to intensify the mixed crop livestock systems already in practiced by farmers. AF encouraged participants to try to analyse the constraints and opportunities regarding this intensification.

## **Invited Papers Presentations**

**f) Speaker 1: Dr. K. Agyemang (KA)**

**Topic: Opportunities and constraints for the intensification of crop-livestock systems in northern Ghana.**

In his presentation, KA indicated that his presentation was not based on a recent direct surveys of crop-livestock systems on Northern Ghana but rather was partly based on findings from studies reported by Karbo and Agyare; Blench; Tarawali to identify which of crop-livestock (C-L) scenarios are on the ground or developing in Northern Region. He proceeded to provide some definitions and Concepts of C-L systems. KA examined the Challenges, Constraints and Opportunities identified in those Reports and matched these Constraints and Opportunities with what might be expected from agro-ecological zones (AEZ), demographic factors, land use and input use considerations. He further grouped the Constraints and Opportunities by categories (e.g. Biophysical, Policy, Institutional, etc.) and suggested ways of overcoming these countries and how to exploit the opportunities. For the purpose of his presentation KA took "Intensification of Agriculture" as the use of more labor, improved technology such as genetic stocks and traction, and more inputs such as fertilizers and chemicals in order to gain more output from a unit of land and subsequently posited that intensification of crop-livestock systems therefore, involves interventions targeting components of the natural processes of evolution in ways that will make crop-livestock systems more productive. KA enumerated what was in his view were recent developments in Northern Ghana that provided the right technical, socio-economics an policy environments for Crop- Livestock systems intensification in the region. He listed current Government perspectives as the unacceptably high poverty levels in the region, governments response in planning to accelerated development and growth in key sectors including Agriculture sectors and the government's identification of the area as a "bread-basket" zone for sustainable development. KA went on further to mention what in his view has been the response by Ghana's Development Partners. KA said there has been a considerable funding support being channeled to the area targeting sectors , including NRM, Agriculture and Livestock subsectors. KA indicated that these developments have huge implications for Crop-Livestock integrate farming systems in the area. KA gave a brief summary of structure, description and farming practices in the region as farming being the prime occupation of vast percentage of population, Crop farming considered major occupation for subsistence, shifting cultivation having given way bush-fallow systems and fallow periods declining from 10 years to 2-3 years with continuous cultivation becoming common in a mainly rain-fed agriculture systems. According to KA in these systems, crops namely, maize, sorghum, millet; pulses and oil seeds, tubers are considered staple. Livestock raised in the region comprise cattle, sheep, goats, donkeys, horses, pigs and poultry. KA noted that approximately 75% of national cattle herd is in the 3 regions; 37% of sheep and 42% of goats and 23% poultry of the national flocks are also to be found in the three regions.

KA's analyses led him to the observation that various forms of crop-livestock associations are developing in Northern Ghana and are at different stages of development. It ranged from "opportunistic" collection of manure from the range for home use to fairly systematic, planned nutrient cycling practices involving manure, urine, crop residues, compost, etc. Crop-Livestock farmers are occasionally accessing rudimentary research-based technologies and extension messages but Research and Extension services towards crop-livestock systems are generally considered weak. Policy promotion of crop-livestock systems as viable production system dates back to 1930s but not much followed the policy statements. Similarly, active research on the subject (eg manure use) only took hold with donor funded Projects in the late 1990s.

Constraints to intensification of crop-livestock were categorized as Biophysical ( Low moisture content due to erratic rainfalls and frequent dry spells which negatively affect plant growth; declining soil fertility as a result soil mining and weak soil fertility management; *Species and breeds of livestock ---Trypanosomiasis occur in many pockets in the region; tolerant breeds not widespread and often not preferred* ), Technology and market constraints (Lack of farm implements for animal traction; under utilization of animal feed technologies to improve feed availability and quality; Lack of information on the optimal combination of organic and inorganic soil ameliorants ; Poor or wrong targeting of crop-livestock systems; Slow response of research and extension institutions to needs of crop-livestock subsectors in terms of service delivery), Socio-economics related constraints (Land tenure arrangements that do not favor investments in land improvement; small land or plot sizes which do not permit the generation of inputs for exchange; high labor demands for sourcing inputs such as feed and transport of feeds ).

Suggested mitigating policies include slowly phasing out of subsidies on in-organic fertilizer and mechanization over time; improved land tenure for mixed farmers; improved extension to inform and motivate on crop-livestock integration, and stimulating non-farm rural employment. Market and Technology Opportunities included intensification of agriculture which is currently going on through many projects in the region and favor crop-livestock systems; demand for livestock products expected to increase as rapid development of the 3 regions attracts new residents, a large percent of products expected from intensified production in peri-urban areas; Rapid development of higher learning and research activities initiated by Government and Development Partners will increase technology outputs, e.g. crop varieties in support of C-L systems.

#### **g) Speaker 2: Prof. S. Osei (SO)**

##### Topic: Past, present and future of ruminants and non-ruminants small holder production for intensification.

In his presentation, SO noted that in Ghana, as elsewhere in the countries in the sub-region livestock is primarily a source of livelihood and provides manure, draft power, direct source of employment, indirect source of wealth, and very useful in socio-cultural practices of the people. OS drew the attention of the Participants to the fact several attempts have been made in Ghana to develop the livestock sector. The major livestock species in Ghana include ruminants (cattle, sheep and goats), monogastrics (pigs, poultry, etc) and non-ruminant monogastrics (donkeys, grasscutter, rabbits, etc) and these can be found in the Northern Region of Ghana. SO said that inspite of the various livestock development projects meant to bring skills and facilities to livestock producers annual domestic meat production increased only slightly over the years. The trend for milk production was similar to meat production. SO however observed that breeding of livestock in small holder farms under natural rangelands and natural mating has increased. With respect to marketing, it was the observation of SO that there are no centralized livestock markets or marketing agencies hence most livestock are transported by middlemen to southern Ghana for sale. He was of the view that the demand for livestock products will continue to increase. He remarked that the future of the livestock industry can only be promising when strategies are mapped to facilitate its development. SO went on to spell out briefly what strategies will be needed to meet the demand for livestock products. The strategies include: a) Increase in farm (herd, flock) size, b) Increase animal productivity, or c) a combination of increasing farm size and individual productivity. SO further listed how the strategies can be implemented through the

following: Organize the environment; Improve feed resources; Educate the farmer; Provide research and extension support; and Government involvement through increased public investment in agriculture.

**h) Speaker 3: Dr. N. Karbo (NK).** NK presented the topic in place of Prof. W.S. Alhassan who could not attend the workshop due to unforeseen circumstances.

Topic: Best-bet innovations for sustainable intensification of crop livestock system in northern Ghana.

NK established that best-bet practices exist in the crop-livestock system of northern Ghana that may be used for system intensification. The need however is to also invest in the human resource capacity for skills and knowledge access for this to happen. NK stressed education is important. NK suggested that the adoption of best practices for sustainable crop-livestock intensification may be guided by systems knowledge and understanding of existing topo-sequence and will therefore vary from one agro-ecology to the other depending on growing populations, land space, household demography, labor availability and quality and livelihood decisions. NK proposed a way forward as the following steps: a) there is the need to take Research and Development of crop-livestock integration systems further, b) there will also be the need to improve upon Natural Resource management in Crop-livestock integration, c) re-characterisation of the Farming Systems with a view to establishing baseline data on types of crop-livestock systems in northern Ghana for intensification, d) the wet season intensive system of tethering livestock with 'cut and carry' browses needs to be studied and improved and, e) there will be the need to develop input market for crop-livestock integration and intensification along the value chain

**i) Speaker 4: Dr. K. S. Awuma (KSA)**

Topic: Description and diagnosis of crop-livestock systems

KSA focused his presentation on the Ghana context of crop-livestock systems and narrowed it down to the Northern Ghana context. For the Ghana context, KSA categorized the mixed crop-livestock systems as - Arable crop-livestock system:- food crops such as cereals (maize, millet, sorghum and rice) and legumes (cowpea, ground nuts, soybeans) with the livestock component consisting of poultry (domestic fowls, Guinea fowls, turkey etc) and ruminants (sheep, goats, cattle); a variant of arable crop-livestock system:- alley farming/ agro-forestry-crops-livestock system; Plantation tree crop-livestock system: - ruminant livestock (cattle, sheep and goats) raised under plantation crops such as oil palm, coconut, citrus and rubber have been carried out in the forest zones for some time now.

In the case of Northern Ghana, KSA stated that climatic conditions do not favor tree crops plantation development except mangoes. In terms of arable crop-livestock system as seen in the Northern Ghana, the systems operate in most rural communities and partly in some urban and city areas as compound farming. KSA explained that where homesteads are far apart land areas around homes are cultivated with crops such as cereals (maize, sorghum and millet) and food legumes such as cowpeas groundnuts. Livestock (local domestic fowls including Guinea fowls) and ruminants (sheep, goats, cattle, etc) keeping is part and parcel of lives of the people and therefore, an integral part of rural livelihood. KSA gave the functions of animals in Northern Ghana financial security - "walking bank", insurance against food deficit, social functions such as payment of bride prices and in religious activities/rites, draught power - traction in land cultivation, transportation for humans and goods. KSA went

further to describe the animal management practices, especially during cropping, feeding systems encountered in Northern Ghana where straw residues from legume based production systems are very important. According to KSA Some technologies in feeds and feeding such the conservation of leguminous crop residues caught on well with farmers to the extent that a thriving forage market has developed in Bolgatanga, the regional capital of the Upper East region. KSA listed some benefits from crop-livestock integrated systems, among them increased production of better or higher quality foods for all, resulting in a healthier population; diversification of income sources i.e. from both crops and animals; soil fertility maintenance hence maintain soil productive capacity and better soil water holding capacity due to higher aeration and organic matter content. KSA also noted some disadvantages, among them farmers requiring to have double expertise; risk of increased crop diseases and crop damage by livestock; possible cause of erosion due to compaction and overgrazing from increased number of animals and continuous labor requirement.

Opportunities identified by KSA for the development of crop-livestock systems in Northern Ghana include Population growth and urbanization with demand for food of animal origin:- red and meat, milk and eggs which those practicing small to medium scale mixed crop-livestock farming have opportunities to supply. Challenges on the ground or emerging include international-free trade policy that has led to the influx of cheap frozen meat and meat products on the market. KSA posed some questions “ In Ghana, is the crops-livestock system program high on the Government’s agricultural policy agenda? “ Is there the commitment to provide the financial and human resources needed at the right time to implement the program successfully? KSA identified pressure on land due to urbanization and reduction in compound farm land sizes as well as land tenure system and its attendant issues in land acquisition as challenges. Lack of effective extension services to disseminate information on the appropriate crop-livestock system for specific areas and lack of adequate qualified personnel at MoFA level is a huge challenge, according KSA. Some solutions identified by KSA were development of appropriate crop-livestock systems suitable for specific localities through adaptive research, therefore requiring strengthened research-extension linkages, a strong research base required to develop crop varieties that will provide sufficient grains for human consumption and biomass for livestock use; identification and multiplication of livestock species that will be useful in the crop-livestock system. KSA added that farmer education will be very essential for the successful implementation of any program dealing with intensification. Rangeland improvement through introduction of forage legumes to improve the nutrition of the range animals hence a better quality animal manure were named as a route to improving nutrition and productivity. Effective extension services must be established to better improve delivery. On policy, KSA recommended that the influx imported frozen meat and meat products must be controlled in order not to kill farmers’ enthusiasm to increase production.

#### **j) Break-out Working Groups (Day 1)**

In order to encourage greater participatory diagnosis of the constraints by the Workshop participants, three Working Groups were formed with specific Terms of Reference. One Group worked Natural Resources and climate change. Two Groups worked on constraints and opportunities in the Ruminants and Monogastrics value chains. For the Monogastrics, both bio-physical and institutional constraints were identified in the value chain. These include, a) feed - poor availability and quality, b) housing – inadequate, poor housing, high stocking density, c) animal health – weak preventive and curative measures and low availability, d) insufficient institutional knowledge and inadequate technology, e) weak and sometimes unsustainable linkages between agencies (research, extension, educational

institutions), e) Unsupportive Government Policies towards livestock sectors, f) difficulties faced by livestock farmers in securing credit from banks and financial institutions, g) inadequate storage, packaging and transportation facilities and h) high production cost. The Group identified opportunities in the Northern Ghana regions which when exploited sustainably could respond to some the constraints and challenges. Among the opportunities identified are a) increasing demand for feed and of quality feed, b) emergence of several sources of available agro industrial by-products for feed production, c) increasing demand for animals and animal products, d) increasing interest by the youth in monogastric livestock production and e) climate change leading to reduction in rainfall trends decreases crop production so farmers can use livestock production as an adaptation. The Group identified future directions of research which could reduce or eliminate some the constraints in the value chain. These were: a) research on non-conventional feedstuffs, b) research into feed formulations for the various species, c) research on causes of keet mortality and how to reduce mortalities, d) research into appropriate housing for monogastrics, and e) breeding research to improve size of local Guinea fowl. The Working Group on Natural Resources and Climate Change focused on definitions and concepts on climate change and the parts played by livestock which is a key component in crop-livestock systems. They identified some constraints in the biophysical and institutional domain, among them weak research/extension linkages, weak local institutions and conflicts arising from alien herdmen-transhumance uncontrolled migration.

## **Synthesis of Presentations and Discussions**

### *Synthesis of results and outputs from Plenary presentations, Scientific Session and Working Groups' analyses and discussions*

Discussions centered mainly around the questions raised after the various plenary presentations and also on the clarifications sought by participants and the presenters. The questions/issues can be roughly grouped under 1) how is the livestock sector performing and the state of crop-livestock integration in the three regions, 2) for the constraints identified who is going to eliminate them and how and, 3) are the opportunities identified likely to be utilized and who should take the initiative?

## General discussion

### **Performance of the livestock sector and the state of crop-livestock integration in Northern Ghana**

It was established from the presentations that a vast majority (>75%) of the nation's cattle is physically located in the three regions while nearly 40% of small ruminants flocks are to be found in the three regions. The demographic data and the farming systems description referred to the various presentations suggested that the herds and flocks are distributed among several households as shown by the average herd and flock size per household. The observation that most of the livestock were found in rural and peri-urban settings, where nearly every household is involved in crop farming, mostly in cereal crops (sorghum, millet, maize) and legumes (groundnuts, cowpeas) and other pulses led to the general conclusion that the various references to the existence of crop-livestock systems in the three regions is plausible. This broad agreement was however to be qualified as clearly some of the descriptions, such as the situations where poorer households with only few animals opportunistically collect livestock droppings from the range and nearby communal areas to fertilize their crop farms, depicts more of a crop-livestock "interaction" rather than crop-livestock "integrated" system. The existence of a range of crop and livestock associations, as opposed to a "unitary" crop-livestock system across the three regions was accepted by participants to mean that the intensification process being sought and promoted must be targeted differently depending on many factors, some related to bio-physical while others are market-related. When the input use classification system presented by Speaker 1 (KA) which recognizes five (5) categories based on which inputs are used and where they come from, namely, Mixed systems making use of communal grazing; Mixed, making use of crop residues; Mixed, making use of cut and carry of feed; Mixed, making use feed entirely from the farm;, and Mixed based on exclusive use of external supply of feed, the systems found in the three regions were largely judged to be those of mixed (crops and livestock) systems making use of communal grazing (Category I) and those of Mixed system relying heavily on crop residues from farm and adjacent areas (Category II). The maturation of these two systems as found in the three regions were judged as being medium to high and medium for Category I and Category II, respectively. The other Categories, Mixed, cut and carry (Category III), Mixed, feed (cultivated pastures, crop residues, processed feed, etc) from farm (Category IV) and Mixed, external feed (purchased, contracted production, etc. (Category V) were not of frequent occurrence and their maturation levels were considered only as low.

The existence of a range in maturation of the various systems in existence was seen as an opportunity to apply different types of technologies (in feeds and feeding, processing and storage, transportation systems, mechanized operations) to intensify the systems. Based on land use classification system the identified crop associations in the three regions were mostly Agro-pastoral in arable areas and full Crop-Livestock System (integrated) judged to be medium and low maturation, respectively. The category of true pastoralists interacting with local crop farmers for exchanges of commodities was found not to be common as the interactions have generally been of confrontation and animosity arising from crop destruction and other social vices allegedly done by alien herders and animals. As the majority of livestock owning households are practicing Category I and to some extent Category II systems, using some resources from the rangelands and natural grasslands, there was an interest in how those resources can be improved, in spite of the fact that there seem to be abundant of these resources. It emerged that there was a concern among some stakeholders that the available rangelands are either being taken by land encroachers or

being destroyed gradually by bushfires. Hence, more efforts should be made to improve upon the available rangelands.

These rangelands are typically used by cattle. On the other hand small ruminants, sheep and goats, are kept and managed closer to homesteads and feed mostly on native pastures and shrubs in the vicinity. Some grazing and feeding systems practiced in the region, such as tying ropes around animals' necks to feed within a certain pre-selected perimeter impose inadequate nutrition on the animals. Sometimes the time for grazing is also too short to derive adequate nutrition, the shortness of time sometimes related to inadequate household labor and high cost of rented labor. This problem was recognized by the livestock sector and feed supplementation programs were introduced in the 1970s through the early 1990s as a possible solution. In the three regions where cotton is widely grown, small ruminant supplementation with cotton seed was considered a viable, profitable and promising, option as a number of cotton companies were processing cotton locally and generating the cotton seed as a byproduct. System diagnostic studies in recent times have revealed however that currently most cotton companies now prefer to export their cotton due to favorable international market conditions, hence there is little or no cotton left to be processed locally which implies there is no cotton seed to supply to livestock farmers. It was the opinion of some participants that it was not advisable to rely solely on one technology, which may become obsolete because of changing socio-economic situations such as what had happened to the cotton seed-based strategy. New technologies need to be developed and disseminated to farmers through the extension system. The issue of availability and the quality of extension agents were raised by some participants. It was the opinion of some participants that training for extension personnel was inadequate. This assertion was substantiated with the statement that with the exception of University of Ghana, most universities in Ghana do not have an Extension Department to properly train students who when join the extension service of government and NGOs disseminate research findings to the farmers/industries. According to some participants the often heard statements to the effect that research scientists should make their research findings and recommendations available to farmers are misplaced as the researchers in most cases are already too busy doing research and so cannot double as extension agents to engage in dissemination of their research findings.

Hence there is the need engage more extension agents for dissemination of research results. It was suggested that one way researchers can close the research-extension-farmer gap is for researchers to increasingly shift some of their on-station based research to on-farm research which will expose their experimental trials to farmers through demonstration and participation. Some on-station research activities reported during the scientific session namely, "Effects of enzyme (Xzyme) supplementation on the performance of laying hens fed diets containing different levels of cassava leaf meal" by Zanu H. K. and "Effects of Pito-mash supplementation on the performance of layers" by Denteh P. showed the possibilities these feed sources may have on poultry production but their practicability should be tested under farmer conditions. Under farmer conditions breeds of interest may be quite different from what researchers are working on, and in this case, the necessary adaptations should be researched into with farmers' participation. In the three regions under consideration the Guinea fowl, which is very much adapted to the climatic and environmental conditions, is gaining acceptance as a significant source of poultry meat and in response some value addition enterprises are springing up in the three regions. Thus, research on nutrition and health on poultry should begin to target Guinea fowl. A paper presented at the scientific session "Guinea fowl rearing and contribution to poverty alleviation in Tolon District: Comparison of productivity between communities with water resources and those without



water resources” by Konlan S. P., sought to bring home the growing interest in the Guinea fowl in the three regions, their contribution to human diets and to the local economy.

As with cattle and small ruminants, poultry and pigs contribution to the economy are expected to increase if the supply (production) side is matched by the market demand side developments. Participants showed their awareness in the concept and practice of value addition and the various roles actors in the value chain can play in making production efficient and making products available to consumers at affordable prices. With the value chain development approach to livestock and related commodities the roles of the private sectors become even greater and more important. Although it was understood from the discussions that while the vast majority of the livestock producers are individuals using their livestock capital, cash, feed resources and self and family labor, the private sector in the health care, extension, and marketing are still not at the level where it should be because of roles played by Government Agencies. It was the view of a section the participants that the sector would truly make progress if the livestock sector is fully privatized and people who are engaged in enterprises within the sector see it as a business rather than hobbies. In this regard, according to the proponents of privatization, the expected development would be even faster if trained personnel in livestock enterprises ( including processing and marketing) , to graduate level, are empowered to become active participants to the extent that they would become successful businessmen or women and in the process employ others in their businesses.

### **Constraints to the development and intensification of crop-livestock systems in Northern Ghana**

From the Plenary presentations it emerged that although the Government of Ghana and the colonial administration recognized the potential benefits of mixed crop-livestock integrated systems in some parts of the country, a coherent policy was never put in place so that even at the moment efforts towards this direction can best be described as *ad hoc* and uncoordinated. As a consequence there are several bio-physical, institutional and policy constraints attendant to the crop-livestock integration sub-sector and also in the Natural Resource Management (NRM) domain.

Of the biophysical constraints the issue of low moisture content due to erratic rainfalls and frequent dry spells in a region otherwise classified as sub-humid was of much concern as they impacted negatively on plant growth. Continuous and persistence plant growth on food crops, as well as on natural pastures and rangelands, are key in sustaining crop-livestock systems. For areas where declining soil fertility as a result soil mining and weak soil fertility management has been observed poor rainfall compounds the problem as nutrient uptake by plants from added fertilizers and manure is impeded by lack of soil moisture. In a region with low use of irrigation for staple crops (sorghum, millet, maize, groundnuts) and nearly nil for pastures, good persistent rainfall during the growing season is critical. It was established during the Plenary presentations that without the presence of livestock in the system, there will be no crop-livestock integration.

Therefore, the occurrence of many pockets areas harboring tsetsefly and tsetse-transmitted Trypanosomiasis in many pockets in the region where tolerant breeds are not widespread and often not preferred was noted as a major constraint to the development and maturation of crop-livestock integrated systems in the region. Other livestock diseases, including all major four categories: endemic, epidemic, zoonotic diseases and food-borne diseases reported to be present in the region was also identified as a constraint. A paper

presented at the Scientific Session “Constraints to the health of livestock and production in northern Ghana” by Ayensu M., confirmed the presence of these diseases and underscored their negative impact on the livestock industry and hence, development of crop-livestock systems and their intensification.

Some of the issues and biophysical constraints were also raised in the Working Group on Natural Resources, which identified land, vegetation, water, animals, soils (poor soil fertility in particular) as the elements in the crop-livestock systems framework that warrant attention in management. Human activities and practices which tend to heighten the constraints to the framework elements named above and also contribute to climate change were identified by the group as deforestation, poor soil management practices, over grazing, bush burning and misuse of agro chemicals. Some of the consequences from climate change that have direct impact on crop-livestock system performance were mentioned as rising temperatures and high evapo-transpiration as they affect the components, soil, water, crops and livestock.

Technology and market constraints attracted quite amount of discussion especially in the domain of use of farm implements for animal traction which was deemed to be inadequate, especially when almost all the participants identified animal traction for farm operations as one of the cardinal principles and practices of crop-livestock integration. There was a near unanimous acceptance that there is an under-utilization of animal feed technologies to improve feed availability and quality in the country in general but in particular in the Northern. It was felt that unless this problem is appreciated the sector stands to lose the opportunities in massive crop residues from the re-emerging rice sector. In spite of the non-use of the available technologies, some which are on-shelf, there were some concerns that there was generally a slow response by research and extension institutions to the needs of crop-livestock subsectors in terms of service delivery. It was noted that to-date there are no research programs targeting crop-livestock systems, and the public extension systems do not have program targeting the integrated systems. Extension Manuals in use are mute on what messages are to be conveyed to farmers practicing integrated systems and how to handle requests from such farmers. Slow response by research and extension institutions to needs of crop-livestock subsectors in terms of service delivery was believed to link to the absence of research and extension support to guide the development and intensification of crop-livestock was partially blamed for the poor or wrong targeting of crop-livestock systems. Siting of such systems in wrong places, for example in inner-town or urban areas was reported to often cause problems with municipal and local authorities, and in the longer run affect the performance of the systems, although there are some factors that motivate farmers to operate from such locations. A paper presented at the Scientific Session entitled “Assessment of losses in livestock production as a result of lorry/road accidents on the Tamale-Savelugu stretch of the Tamale-Paga highway” by Alenyorige sought to emphasize the point on wrong or poor targeting of crop-livestock systems. Data on mortalities in livestock presented was much higher than expected. Fatalities in humans were also high. Such loss in human lives and damaged properties could bring negative publicity on livestock-raising in wrong places, and hence affect crop-livestock systems development. The aforementioned was not the only social-related constraints as land tenure arrangements that do not favor investments in land improvement was seen as a constraint to integrated systems. Small land or plot sizes which do not permit the generation of inputs for exchange was also linked to weak and outdated land tenure arrangements. High labor demands for sourcing inputs such as feed and transport of feeds was mentioned as posing a constraint to sustainable intensification. The Working Group on Natural Resources identified weak research/extension linkages and weak local institutions (especially staff strength) as institutional constraints, in addition to alien herdsman-transhumance (uncontrolled

migration) that fuels conflicts and disrupt emerging crop-livestock systems. Some options to mitigating some of the noted constraints in the technology, market and institutional domains are a) improvement of soil cover through the use of alternative crops for mulching, and introduction soil management techniques such as conservation tillage, bench terracing, b) improvement of feed production and quality to reduce the pressure on grazing areas and improve internal nutrient transfers. Technologies to do so include: introduction of fodder shrubs and trees to reduce soil erosion and improve soil fertility, c) strategic supplementation for specific classes of animals (lactating animals) to improve the efficiency of limited amounts of available feed.

With respect to policy constraints, the most glaring one was the lack of crop-livestock integrated systems-focused policies. Of the existing agricultural policies some of them were actually seen as inimical to the development and maturation of crop-livestock systems. Among the negative policies that were noted to constrain crop-livestock integration development and have also shown to often limit the beneficial impact of crop-livestock integration are the provision of subsidies on inputs (fertilizers, feed, fuel, mechanization, etc.) which thus serve as disincentives for the development and use of on-farm products such as crop-residues, animal draught power and manure. Other policy pressures that may contribute to negative development on crop-livestock integration are import-export policies and inappropriate land tenure systems. In mitigating some of the constraints in the policy domain, the following options were mentioned : a) slowly phasing out of subsidies on inorganic fertilizer and mechanization over time, b) improving land tenure for mixed farmers, c) improving extension to inform and motivate on crop-livestock integration, and d) stimulating non-farm rural employment.

It was noted that the Guinea and Sudan zones confer several opportunities for the development and intensification of crop-livestock systems. There was a near consensus that many of the constraints identified from the presentations and working groups can be converted into opportunities with proper planning and interventions. For example, the poor soil fertility, high prices of inorganic fertilizers and labor cost identified earlier as impeding the development of crop-livestock systems on one hand, are on the other hand forcing poor farmers to rely on alternatives such as manure and animal traction.

Institutional and social opportunities were mentioned as evolving in Northern Ghana. It was said that there is an emerging dialogue and discussions on land tenure arrangements and women participation and on other socio-cultural issues which may be signaling changes in attitudes on land issues that could favor crop-livestock development as access to land improves. It was noted Development Partner funded Projects in the 3 regions are targeting other approaches to Extension to smallholder farmers through capacity building. The new generation of extension cadre is likely to bring about new ways of extension delivery, which can benefit crop-livestock production systems. These broad themes of opportunities were in agreement with the specifics identified by the Working Group on Natural Resources identified the following opportunities: a) increasing demand for crop and livestock by growing human population, particularly around certain urban centers, b) consumer preference for meat increases, c) soil improvement and nutrient recycling, d) favorable government policy towards livestock development as a poverty alleviation strategy, e) creation of employment from the livestock industry, f) existence of the Savannah Accelerated Development Authority (SADA) to upscale crop-livestock integration schemes.

## **Day 2**

Opening: The workshop started with prayers from both the Muslim and the Christian faiths. The Workshop was called to order by the Facilitator

**a) Dr. K. Agyemang (KA)- Facilitator**

Title: Facilitator's Opening Remarks

KA introduced the program for Day 2. KA also introduced the Chairperson for the Day 2 business, in the person of Dr Naaminong Karbo, the Director of Council for Scientific and Industrial Research – Animal Research Institute (CSIR-ARI).

**b) Dr. N. Karbo (NK)**

Title: Chairperson's remarks

NK accepted to chair the program and urged participants to share their experiences in crop-livestock farming systems as far as constraints and opportunities for the sustainable intensification of mixed crop-livestock farming systems in Northern Ghana are concern.

**Invited Papers Presentations**

The first Plenary Speaker took the floor.

**c) Speaker 1: Prof. Francis Bacho (BF)**

Title: Gender perspectives and trends in livestock production and marketing in northern Ghana: Challenges and opportunities for intensification

BF stated that his presentation would be contributing to addressing the larger questions namely, "is sustainable livestock intensification possible in Northern Ghana?, and how could this be achieved? BF put his focus on a) Gender perspectives in livestock production and marketing, b) Challenges; and c) Opportunities for intensification. BF defined livestock intensification as usually entailing some scientific means of increasing productivity and total production through application of more inputs: improved feed, medication, housing, reduced mortality levels and high yielding breeds with high market value.

BF referred to one economic view concept which states that economies of intensification is central for its long term profitability (Devendra, 1994), and argued that the concept was not complete in the sense that it missed out some basic considerations such as: Who will be the real beneficiaries of increased production? How will ownership and control of productive resources, e.g. land be affected? Which groups will lose out in the intensification process as a result of resource re-allocation and the accompanying ramifications? BF based much of his presentations on results from field surveys carried out in four ethnic group areas in Upper East Region in Northern Ghana (Kasena, Grune, Builsa, Kusase). From the results BF identified some emerging trends/issues as: Both men and women in Northern Ghana are involved in a mixed bundle of small scale subsistence livestock rearing; men tend to produce more livestock than women; Women rear virtually all the types of livestock as their male counterparts; women tend not to keep donkeys, which are crucial productive assets in the small holder households.

BF reported that in those four location in Upper East Region, livestock is not aimed primarily as an economic activity but more for household security and revealed that although in principle men and women own livestock separately, the household head (usually men ) have major say on the uses of livestock. BF went on further to state that in principle, the male head of household also assumes overall responsibility for the care, safety, housing of especially large animals, e.g. goats, sheep, cattle, donkeys, ruminants and insisted that women livestock raising and ownership would need to be understood within this

institutional context. BF listed some challenges including: Transforming the perception of livestock from a household livelihood security activity to a market oriented activity; Institutionalized gender relations and incentives for sustainable intensification and Issues of real ownership and control and incentives for sustainable intensification, the possible ecological problems of intensification, and Economic oriented production and the prevailing land tenure system. BF conclusions and recommendations were that d) In Northern Ghana both men and women take part in a mixed bundle of livestock raising in small numbers, b) livestock raising is meant primarily to secure the household in terms food, social obligations, spiritual/religious purposes, etc., c) a nexus of socio-cultural factors govern the production, ownership and marketing, d) discourse on livestock issues tend to ignore these socio-cultural factors and will need to be considered seriously, e) Interventions in livestock will need to look at the case by case larger context.

#### **d) Speaker 2: Dr. Abdou Fall (AF)**

Title: Review of livestock management interventions including options for adaptation to climate change and other livestock commodity value chain innovations for sustainable intensification of crop-livestock systems.

AF began his presentation with some statistics on mixed crop systems in West Africa. According to AF, some 448 million people in West Africa (WA) would be dependent on crop livestock systems by 2050. AF asserted that changes occurring in WA crop livestock systems are driven by rapid population growth and urbanization that has led to a booming demand for livestock and livestock products, increased competition for natural resources, climate change (warmer and more variable), increased trade and exchange of knowledge and products and that sustainable intensification based on enhancing production efficiency and productivity has social and environmental dimensions. AF listed some options for sustainable intensification of mixed crop-livestock systems in West Africa. These included: Enhancing production efficiency through optimizing the contribution of feed and forage resources to animal productivity and therefore the profitability and efficient natural resource use of livestock; Market development and Risk mitigation as sustainable intensification will entail developing the capacity of small holder farmers in mixed crop livestock systems to adapt to climate change and to reduce disease risk through better disease prevention and control measures. AF enumerated some key principles for sustainable intensification, a) demand from domestic, and regional markets, b) Market demand-pull and an enabling policy and regulatory environment that are essential pre-requisites for subsequent technological innovations and institutional arrangements for delivery of input, services, and products to markets, c) Clear understanding of incentives for public and private sector delivery systems (or combinations), particularly in increasingly liberalized domestic markets. AF cautioned that there are no silver bullets. The pragmatic way is to identify best bet practices through experimentation of different models complemented with results based monitoring and evaluation.

#### **e) Speaker 3: Dr. Paschal Atengdem (PA)**

Relevance of institutions and partnerships in promoting dissemination and adoption of technologies for crop-livestock system intensification in northern Ghana.

PA started his presentation by referring to the “Technology debate” which dealt with demand for technology, appropriateness, adaptability and education for change. PA went further to provide a status quo, “What exists now” and talked about the Census of participants and alluded to the professional divide in the crop-livestock integration debate

and actions. PA presented a Matrix of Vision, Mission and Functions of MOFA Directorates as a model of partnerships and posed the questions: “How do MOFA Directorates coordinate activities/ strategies at the farmer level?”, “Who delivers educational services and information to farmers on (livestock; poultry; crops; the farm as a business)”, “How and where do directorates get their staff from?” “How is the staff trained or upgraded?”, “What is the ratio of professional staff to farmers (requiring services)?”

PA pointed it out there are some Challenges to integration of crops and livestock and suggested that in order to overcome some of the challenges it is about time that institutions concerned Think “Farm” >>>>Plan “Farm”>>>Target “Farm Family”. PA stressed that Farm Family Livelihoods should be central to Crops-Livestock systems. In prescribing his “Way Forward”, PA was of the opinion that change can only come through change from person-culture to system-culture and thinking. The center for crops-livestock systems planning, thinking, implementation should be located closest to the key players – the integrated system (e.g. Farmers in Northern Ghana already living with this system). In view of the role of livestock in the developing of crop-livestock integrated systems, and the tremendous health issues confronting livestock in Northern Ghana, a full-fledged institution training animal health personnel should be brought closer to farmers. The upgrading the Pong-Tamale College on animal health to a Veterinary college would go a long way to improving animal health services in the region.

#### **f) Speaker 4: Mr. S. A. Adongo (SA)**

##### Lessons learning through presentations of past successes and failures

SA began his presentation by stating that since agriculture is the main livelihood venture of people in Northern Ghana most interventions in poverty reduction and food security have been in the area of agriculture. These interventions have been numerous in number and varied in content and scope and have been carried out by over one hundred (100) NGOs in addition to those implemented by Government and Development Partners. SA asserted that the results, outputs, outcomes and impact of these interventions have not been holistically assessed but on discrete basis the story is very variable. SA further claimed that the impact desired has not yet been realised but added that the situation could have been worse if these interventions had not taken place. SA lamented that as researchers and developers they still did not know what and how to do in order to obtain the desired impact. SA went on to list areas where there have been interventions in Northern Ghana, namely, 1) Increased availability of, access to, and utilization of food, 2) Improving production and productivity of livestock and poultry, 3) Increased utilization of irrigation, 4) Increased/improved rice production, 5) Increased utilization of fertilizer and chemicals, 6) Better use of land and natural resources, 7) Increased production/productivity of root and tuber crops, 8) Incorporation of tree crops into the farming system, 9) Development of staple food crops, and 10) Developing market oriented agriculture – Value Chain. In the estimation of SA all projects have indicated some level of success. According to AS, from what the project designers state, success may be in areas such as: a) Beneficiaries reached, b) Percentage of fund utilised, c) Percentage of infrastructural projects established, and d) Number of varieties released. SA was of the opinion that although the said deliverables are supposed to be achieved they cannot be said to be the ultimate goal of the interventions. SA found it rather unfortunate that as soon as the project was completed the situation was back to where it was before, because project activities do not function any more. SA asserted that stand-alone livestock projects are better able to withstand the shock of project completion than stand-alone crop projects.

Among the lessons learnt SA listed a) Use multi-disciplinary team to assess feasibility of proposal, b) Proper and appropriate engagement of all stakeholders and partners, c) Ensuring that funding agency will not strategically delay disbursement – inflexible, imported technology, employment for nationals, etc., d) Beneficiaries/Farmers should be involved in research and technology development, e) Technology should be responsive to climate change, f) Market-based to achieve sustainability, g) Ensuring proper alignment of policies and time frames, h) Project should have specific focus and not be so broad to lend itself to any interpretation. For a way forward, SA proposed a) strengthening formal and informal research, extension, processing and marketing organisations, b) develop and/or extend sustainable and appropriate technologies and c) developing collaboration and partnership models for relevant technology generation, transfer and adoption.

# Results and Summaries – Day 2

## Summary of Presentations on Day 2

### *Summary of Plenary presentations*

#### **g) Break-out Working Groups**

In order to encourage greater participatory analysis of successes and failures and to identify potential interventions three Working Groups were formed with specific Terms of Reference. The groups and their respective assignments were: Group 1: Analysis of success and failure of crop – livestock interventions in Northern Ghana, Group 2: Best bet interventions in natural resources management: How to enhance the interface between crop, livestock and soils, and Group 3: Analysis of the Northern Ghana dairy value chain. What are the developmental challenges and researchable issues?

In analysing the successes and failures Group 1 analysed four past developmental projects that were implemented in the region. These were: a) Community Livestock Health Workers (CLHW)- to provide basic Veterinary and Animal husbandry services to a rural community, b) Guinea fowl Value Chain- to enhance the capacity of Guinea fowl farmers, c) Livestock Development Project (LDP)- Credit-in-Kind scheme- One of the components of LDP which failed, and d) Catchment Area Protection of LACOSREP 1.

Scoring was on a scale of 1 to 5 (5 = best and 1= worst) for seven (7) attributes of project design, implementation and impacts, namely:

1. Direct benefits of well being
2. Substantial practice beyond 2 years
3. Community Ownership of Initiatives
4. Early engagement with Stakeholders
5. Appropriate implementation
6. Clear demand and
7. Appropriate design of technology
8. The main outcomes on the scores assigned by the Group after reaching a consensus on each attribute are in **Table 1** below.



**Table 1: Analysis of success and failure of crop – livestock interventions in Northern Ghana (Group 1).**

Type of project/ Descriptions	Direct benefits of well being	Substantial practice beyond 2 years	Community Ownership of Initiatives	Early engagement with Stakeholders	Appropriate implementation	Clear demand	Appropriate design of Technology
<b>SUCCESS STORIES OF PROJECTS</b>							
CLHW: To provide basic Veterinary and Animal husbandry services to rural community.	4 Participants were trained	4 Most of the beneficiaries are still active in the field	5 The beneficiaries came directly from the communities	5 There was strong collaboration among stakeholders	3 The implementation was somehow successful	5 There was high patronage of the services	3 There is still room for improvement
Guinea fowl Value Chain: Established since 2005. To enhance the capacity of Guinea fowl farmers.	4 The targeted groups were well resourced	4 The groups are still engaged in the production and marketing of guinea fowl	4 There was strong sensitization among beneficiaries	5 There was strong collaboration among stakeholders	4 There was strong implementation of the project	5 There was high patronage of the services	3 There is still room for improvement
<b>FAILURE STORIES OF CERTAIN COMPONENTS PROJECT(S)</b>							
LDP: Credit-in-Kind scheme. This was one of the components of LDP which failed	2 The beneficiaries did not benefit in this regard	1 There was little participation therefore its failure in this respect	1 Little attention was given therefore ineffective ownership	1 Very poor engagement by stakeholders	1 Very poor implementation	3 low demand for the project in that aspect	4 The design was good but improper implementation
Catchment Area Protection of LACOSREP 1	1 The beneficiaries did not benefit in this regard	1 It could not survive in this aspect because of low participation of beneficiaries	1 Little attention was given therefore ineffective ownership	2 Little attention was given in this regard	2 Poor implementation	1 Very low demand for the project in that aspect	1 The design of the technology was very poor

**Group 2: Best bet interventions in natural resources management: How to enhance the interface among crop, livestock and soils**

In order to identify best bet interventions and to find ways to enhancing the interfacing among crops, livestock and soils, the Group were urged to first make an inventory of NRM practices, assess selected NRM practices – current status, perceived impact, adoption, spell out how the management of livestock mediated NRM practices can be improved and how conflicts could be mitigated over NR uses. In the Group’s report natural resources management (NRM) practices in the region identified by the Group included: Stone bunding, Regeneration of endangered multipurpose trees, Fodder bank establishment and alley cropping, Composting and farm yard manure for soil fertility improvement, Oversowing of pasture, Community no-bush-burning practices, Local protection and management of tree species, Zai, Ridging, Farm mechanization – donkey, bullock, power tillers, tractors, Use of Vertivar grass, Jatropha, Mucuna, mulch, Charcoal production, and Fuel wood/rafters harvesting. The analyses made by the Group led to the Matrix presented in Table 2 below. In managing conflicts attendant to the use of community owned natural resources the Group recommended the demarcation of livestock routes, enforcement of local bye-laws and community managed, empowerment of community to manage local resources and the introduction of the “no ownership” concept.

**Table 2: Current status etc. of selected NRM practices (Group 2).**

Practice	Current status	Impact	Adoption
Stone bunding	In use and effective	Reduced erosion, increased yield, retained soil fertility	Localized to hilly/rocky terrains
Farm mechanization	In use	Reduced drudgery, improved livelihood	Mixed; Negative effective of urbanization

Practice	Current status	Impact	Adoption
Regeneration of local species forest endangered	In use	On-going	Not yet assessed
Alley farming	Not in use	None	No
Fodder bank	Not in use	None	No

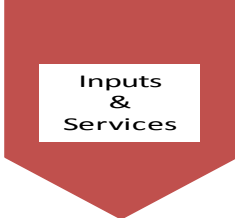
Practice	Current status	Impact	Adoption
Composting and FYM	Variant form in practice	Improved soil fertility and yield	Traditional method
Oversowing of stylo	In demand but has several challenges	Low	Low


No bush burning	In practice	High	Localized
Practice	Current status	Impact	Adoption
Local protection and management of tree species	Practised	High	Local
Zai	Localized		Low
Fodder/browse harvesting	In use		High
<b>Practice</b>	<b>Improving management</b>		
Composting and FYM	Detached kraal to improve hygiene; shaded kraal to give protection to manure;		
Stylosanthes	Multiplication of seed; control bush burning; enforce bye-laws		
Animal traction	Promote ownership of donkeys; training in handling; identifying the right equipment		

### **Group 3: Analysis of the Northern Ghana dairy value chain. What are the developmental challenges and researchable issues?**

In their analyses of the dairy value chains in Northern Ghana, the Group was urged to identify key actors in order to focus the researchable issues. In Table 3 below are the developmental challenges and researchable issues identified by the Group for various value chain components.

**Table 3: Value chain actors, development challenges and researchable issues for the dairy value chains in Northern Ghana**

Value chain components	Developmental challenge	Researchable Issues
 <p><b>Inputs &amp; Services</b></p> <p>Actors:            1. Feed suppliers            2. Extension agents            3. Health care providers            4. Chemical and suppliers/vendors            5. Stock provider            6. Land owners</p>	<p>drug</p> <ul style="list-style-type: none"> <li>➤ Absence of dairy feed millers</li> <li>➤ Seasonal shortage of natural grazing</li> <li>➤ Extension agents are not fully equip with knowledge</li> <li>➤ Very few extension personnel</li> <li>➤ Health care providers are under utilized</li> <li>➤ Farmers inaccessibility of drugs at the rural areas</li> <li>➤ Land ownership and tenure often not well defined</li> </ul>	<ul style="list-style-type: none"> <li>➤ Feeding standards to establish nutritional requirements for dairy production(using local feed materials, feed pelleting)</li> </ul>
<p><b>PRODUCTION</b></p> <p>Actors:            1. Herdsmen            2. Dairy farmers/owners            3. Health care provider</p>	<ul style="list-style-type: none"> <li>➤ Unhygienic milk collection and handling</li> <li>➤ Infiltration of quack health providers</li> </ul>	<ul style="list-style-type: none"> <li>➤ Research into breed improvement(selection and cross breeding)</li> </ul>
 <p><b>Transport &amp; Processing</b></p>	<ul style="list-style-type: none"> <li>➤ Inappropriate mode of transportation of milk</li> </ul>	<ul style="list-style-type: none"> <li>➤ Research into possible collection scheme models</li> </ul>

<p><b>Actors:</b></p> <ol style="list-style-type: none"> <li>1. Vehicle owners</li> <li>2. Herd porters (eg women)</li> <li>3. Feeder roads/highway authority</li> <li>4. Waagashi makers</li> <li>5. Yorghurt makers</li> <li>6. Milk pasteurizers</li> </ol>	<ul style="list-style-type: none"> <li>➤ Herd porters travel long distances to sale points making milk to spoil</li> <li>➤ Poor state of roads and network</li> <li>➤ Inadequate knowledge in milk processing/adherence</li> </ul>	
<div style="text-align: center;">  <p>Marketing</p> </div> <p><b>Actors:</b></p> <ol style="list-style-type: none"> <li>1. Packaging and package providers</li> <li>2. Sellers</li> <li>3. Buyers</li> <li>4. Advertisers</li> <li>5. Cold store providers</li> </ol>	<ul style="list-style-type: none"> <li>➤ Fluctuating prices between seasons and within locations</li> <li>➤ Low advertisement</li> <li>➤ Poor packaging of dairy products</li> <li>➤ Costing of production and processing not done</li> <li>➤ Absence of cold storage</li> </ul>	<ul style="list-style-type: none"> <li>➤ Research into the quality of milk products in the market</li> <li>➤ Research into consumer intelligence (needs, preferences, fears, etc)</li> </ul>
<p><b>Crosscutting issues</b></p>	<ul style="list-style-type: none"> <li>➤ Conflict of interest between livestock owners and herdsmen</li> <li>➤ Emerging and re-emerging issues on dairy production</li> <li>➤ Urbanization</li> </ul>	<ul style="list-style-type: none"> <li>➤ Gathering literature on dairy value chain and their possibility for adoption</li> <li>➤ Research into modules of small dairy production systems (cooperatives, group ownership etc.)</li> <li>➤ Climate change, emerging and re-emerging diseases and adaptive strategies for sustainable dairy production</li> </ul>

## Synthesis of Presentations and Discussions

### *Synthesis of results and outputs from Plenary presentations, Scientific Session and Working Groups' analyses and discussions*

Discussions centered mainly around the questions raised after the various plenary presentations and also on the clarifications sought by participants and the presenters. The questions can be broadly grouped under two headings, namely, a) what is happening on the ground now, and b) what is going to happen in the future, in respect of crop-livestock systems intensification.

### **What is happening now with crop-livestock systems in Northern Ghana?**

The Papers presented at the Plenary Sessions suggested that some activities which qualify to be called “crop-livestock integration or interaction” are going on at some locations in the region. If there was a previous notion that the roles of females in the households in the region conform to some “accepted” recognized norms, the presentation of Bacho dispelled that notion. The livestock ownership patterns reported from four Districts showed that women owned cattle, small ruminants, and poultry, as owned by men. Some important management and financial transaction are however deferred to men household heads. While some participants felt the cattle ownership by women was rather high, contrary to the conventional wisdom, some put the changing pattern at the doorsteps of the many interventions by Government and NGOs in livestock improvement, which have catalysed the change from the keeping of livestock for household use and livelihood security to that of economic activity. Examples were given during the discussion which illustrated the role of government and NGOs played to help women to produce livestock. Government under Livestock Development Project gave 10 sheep each to 4200 people countrywide. About 30% of the beneficiaries were women. World vision and Action Aid both gave sheep and goats to women in Upper East region. In all cases, the women owned and controlled the use of the animals. A case was made that where there appears to be barriers in the promotion of any intervention for sustainable crop-livestock systems, there will be the need to appreciate the socio-cultural settings. In similar ways institutions and partnership arrangements may or may not facilitate the promotion of dissemination and adoption of technologies for crop-livestock system intensification, depending on the relevance of the institutions to the practice of crop-livestock integration. Animal traction was accepted by most of the participants as one of the technologies that are in use crop-livestock systems but the technology face direct competition from importation of, and use of tractors. It was understood by the participants that availability of tractors for hire discouraged the use of animal traction. The use of animal traction for farm operations was said to confront another challenge, the frequent stealing of work animals. There was a call to the effect that Government policy should be directed more to the use of animal traction which is more beneficial to farmers and the crop-livestock system than tractors. It emerged from the discussions that the cyclical promotion of animal traction for some years only for the campaign to be quashed and re-introduction of tractors is the ad hoc and frequent changing of Government's own positions and policies.

The presentation on the “lessons learnt” and the discussions that followed linked institutional memory with good record keeping. In this regard it was felt that legitimate questions could be raised as to whether the frequent changing of Government policies is a cause or at least a partial cause of lack of institutional memory. There were passionate discussions on extension services performance and its role in assuring the uptake of project recommendations. It was stated that all meetings, preparations and project development

with stakeholders would come to nothing if the extension services which are supposed assist farmers are not delivering good services. It was noted that in many instances most relevant information on “closed” projects could not be traced, therefore limiting the assessments of project performance and lessons learnt. This state of affair was blamed on poor record keeping. There was a general agreement that documentation is crucial for institutional memory and very necessary for management and information systems. Based on the experiences of some participants, there was a position that the duration (years) of projects needs to be reviewed upwards. The 4 to 5 years duration was said to be sometimes inadequate, and in some cases two project lives are needed to deliver the desired results. It was advocated that systems and institutions be strengthened. Project with credit components should have institutions in place to ensure the success of the programs. There was a position by a participant that project funding sometimes come with strings attached and urged for a debate on the issue with a view to resolving it. It was recommended that bottom-up approach to project design and implementation be advocated for and that farmers and communities interest must be taken into consideration before researchers and donors’ wishes.

The question of availability of credit to support farmers’ activities was raised as it was felt by some participants that the slow progress being made in the livestock sector, and hence the development of crop-livestock systems was in part due to inaccessibility to credits. This situation was not blamed on only the banks but also farmers and other project beneficiaries. It was mentioned by a participant that the credit components of some projects required that the beneficiaries pay-back. However, most of the MOFA projects beneficiaries did not repay credits made available to them. It was suggested that to forestall such defaults other agencies (for example banks) should be allowed to operate the credit components as a business and allow MOFA to deal with technology extension and intervention aspects of its projects.

### **What are the likely developments in crop-livestock integrated farming in the future.**

The presentations on livestock management interventions, value chains development and climate change and its adaptation evoked some discussions on the future of crop-livestock systems in Northern Ghana. Some participants expressed the dilemma that while livestock production, whether within crop-livestock integrated system or not is being promoted, livestock is linked with climate change through greenhouse gases emitted by livestock. Ways to reduce the emission of gases such as methane (CH<sub>4</sub>) were sought by some participants. One solution to achieve this was giving as the improvement of quality of forage and other feeds offered to ruminants. It was noted that poor, rougher and coarser feeds increase the production of methane gas.

On the question how fast crop-livestock systems will develop or mature in the region, there were suggestions that institutions and organizations responsible for, or interested in, the sector should be strengthened and made to collaborate in their planning and implementation of projects. A specific approach suggested by a Working Group was that Institutions should consider establishing budget lines reserved for possible collaboration in order to reach out to other institutions. An example of how some Projects interacted with local institutions was given as the WAP and AgSSIP projects which had collaboration with local Universities in Ghana. This could be a model for other Projects in the future. As developmental projects tend to be take multi-disciplinary approach, the selection of institutions for collaboration should take this approach.



Specifically, as crop-livestock integrated systems deal with land, soil, water, crops and livestock, together with markets for products, inputs and services the range of collaborating institutions should be large in order to bring about faster and real integration. A Paper “ Integrated rainwater management for crop-livestock agro-ecosystems: Sharing baseline survey information of the Volta Basin in the Tolon/Kumbungu District– Northern Ghana by E.K Panyan” showed the complexities and the range of actors engaged in some area-wide projects. The approach to collaboration should follow the value chain concept and practice, as it offers more opportunities to identify actors in each chain. An example of a livestock subsector/commodity which had seen very little development but which has a lot of potential was cited as the dairy subsector. The development of the sub-sector was noted to have been on *ad hoc* manner. It was reported by a Working Group that previous dairy schemes failed partly because they were bigger (in terms of budget) than could be managed by the existing personnel and institutions. It was mentioned that in recent times some milk processing units that were established by MoFA have failed. It was suspected that low milk supplies to the plants, was a contributing factor. A value chain approach was thought to be the way forward for the future. In using the value chain approach efforts should be made to bring in actors in research and extension (including health care) since these were not adequately catered for in previous development projects. Research into quality of milk and milk products along the value chain was deemed to be critical human health as initial surveys have indicated this need. A paper “ Microbial count and shelf life of locally produced milk under two methods of pasteurization in and around Tamale by B. Alennyore” brought this issue to the forefront as high levels of post milking contaminations were recorded in the samples studied. Similarly, research into feed storage, quality and utilization in targeted systems was considered important. A paper “ How much crop produce and by-products are used as ruminant feed in the Savelugu-Nanton District of Ghana” by Awuni M., threw some light on the need to plan feeds and feeding schedules in order to obtain the best results from crop-livestock integrated systems.

The question of scale should be researched into, as often the target of smallholders alone has not yielded the required results. The inclusion of medium size, commercially oriented farmers in peri-urban areas may actually stimulate smallholder production as input supply, processing and marketing could be facilitated by commercial producers for the benefit of smallholders. These linkages are best achieved through value chain approach which brings these actors at different scales together.

Some discussions centered on a presentation on the role of indigenous knowledge “Sustaining Smallholder Livestock Production in Northern Ghana: The role of Indigenous Knowledge by J. Nachor” were made. While a value chain approach should typically include actors dealing with indigenous knowledge issues, there were suggestions to the effect that indigenous knowledge for example dealing with medications needs to be standardized, verified for efficiency, dosage, active ingredients. It was made clear that there are limitations as to how far crop-livestock intensification can be advanced through indigenous knowledge. The challenge was stated as to how to achieve good marriage between indigenous knowledge and modern science.

## Meeting the expected outputs of the Workshop

- From the various presentations and the synthesis of the contributions from the Workshop participants, information were assembled to respond to the specific requirements are listed below:
- A compilation of some recent data from the plenary presentations that can be used as baseline information for the purpose of diagnosing the existing and emerging crop-livestock systems in the three regions.
- Documentation of priority constraints and opportunities for the intensification of crop-livestock systems in Northern Ghana.
- Documentation of lessons learned from past projects and identification of priority research questions and R4D areas that will form the basis for the second phase of the project.
- Priority interventions for specific adoption domains.

Key data and information for each of the four (4) expected outcomes are provided below:

## **Baseline and systems' diagnosis**

In the context of the Project Northern Ghana was taken to comprise Northern, Upper East and Upper West Regions of Ghana. The Project region is situated between 8-11 degrees N latitude and 0-3 degrees W Longitude. The combined size of the Project region is 97.703 sq. km and represents approximately 40.8 % of Ghana. The area contains 18.2% of Ghana's human population (2010 census). Human population and densities are respectively, 3.346 million persons and 34 persons/sq. km. The densities tend to be higher around certain urban and large towns. The three regions are located in the Guinea and Sudan Savannas and the area is classified as sub-humid, with mean annual rainfall of 1000-1100 mm. The rainfall mode is single season April/May to October, sometimes erratic in nature. Length of growing season is 150-200 days (dry spells of up to 10days) in major season.

Farming is prime occupation of vast percentage of population. Crop farming is considered a major occupation for subsistence living. Shifting cultivation which was a dominant farming method some decades ago has given way bush-fallow system. However, fallow periods have been declining from 10 years to 2-3 years with continuous cultivation becoming common. Agriculture is mainly rain-fed agriculture with some irrigated farming in areas where horticultural crops are grown. Crops grown are mainly cereals- maize, sorghum, millet; pulses and oil seeds and tubers. Land preparation in many areas is mainly by hand tools, although in some areas bullock drawn implements and tractors are used. Livestock raised in the area include cattle, sheep, goats, donkeys, horses, pigs and poultry. Guinea fowls form a significant part of the poultry sub-sector. About 75% of national cattle herd in the 3 regions, 37% of sheep and 42% of goats and 23% of poultry. Animals in the farming systems have several functions, including, financial security -“walking bank”, insurance against food deficit, social functions such as payment of bride prices and in religious activities/rites, draught power - traction in land cultivation, transportation for humans and goods. Livestock management in the Project area differs according to season. In the cropping season, large ruminants are mainly herded by hired Fulanis or fed in kraals. Sheep and goats are often tethered around farms close to compounds.

Surveys conducted in recent times as reported at Workshop (see Bacho's Day 2) confirm the existence of mixed crop-livestock systems at various stages of development as described by Karbo and Agyare. Crop residues use by ruminants and the use of manure for cropping define crop-livestock interactions/integrations in the area. The predominant system is the one whereby crop residues use and the grazing of natural pastures and rangelands are the major source of food for livestock. However, there are several variations, with more than

one method going on at the same time with diverse activities, for example, small sized compound farms intensively using manure from tethered or kraaled animals, collection of cattle and pig manure from the range by farmers without livestock, tethered goats often getting fed through “cut and carry”. Crop residues and agro-industrial by-products are fed while trampled crop-residues and agro by-products are recycled with soil for crop production. These modes of production do fit the broader arable crop–livestock systems as seen in similar agro-ecological zones in West Africa.

In summary, various forms of crop-livestock associations are developing in Northern Ghana and are at different stages of development. They range from “opportunistic” collection of manure from the range for home use to fairly systematic, planned nutrient cycling involving manure, urine, crop residues and compost. Crop-Livestock farmers may occasionally access rudimentary research based technologies and extension messages but Research and Extension services are generally considered weak in the region. Livestock numbers, including ruminants and poultry, are increasing but specialized functions such as animal traction for farm work are not that widespread and not developed. Human population pressure on land, especially around urban centres and larger towns has been noted and census figures over 3 decades confirm population growth and urbanization although the rates are below National averages. Some constraints and opportunities have been noted in certain C-L associations.

From the demand sub-component of the systems, there is a growing market development in Northern Ghana. Products from the livestock, and crop-livestock systems sectors are being sold in Local, National and International markets. Locally, in densely populated parts (Upper East Region 150-160 persons/km sq.) crop residues are sold or traded for other goods. Prices of crop residues more than doubled over a 5-year period. Contractual agreements between herd owners and hired Fulani herders revised for cattle owners to own manure for crop production. Some setbacks in the local markets include high prices for animal drawn carts, a major constraint for many households; Zebu bullocks are imported from Burkina Faso, while maximum use of adapted local animals not achieved.

## **Prioritized Constraints and Opportunities in Crop-Livestock Systems in Northern Ghana**

Priority constraints and opportunities observed in the systems in Northern Ghana and presented at the Plenary Sessions are summarized below. Bio-physical constraints, institutional and markets constraints as well as socio-cultural constraints abound. However, how much these constraints are a priority depends on the context in the geographical area.

### *Biophysical constraints*

Declining soil fertility as a result of soil mining and weak soil fertility management is a widespread constraint in large areas within the region and will require a concerted effort to replenish lost nutrients. Integrated Soil Fertility Management (ISFM) approaches are needed in the region. A true ISFM program includes both organic and inorganic fertilizers. Animal manure represents an important source of organic fertilizer. Thus, crop-livestock systems are a part of solution to declining soil fertility.

### *Livestock-specific constraints*

It was mentioned in several presentations that livestock is an essential component for a crop-livestock system to develop. In environments where the livestock species and breeds are not suitable, the development or maturation of the system is impaired. Although there are environmentally adapted livestock breeds in Northern Ghana, the smaller size of these adapted breeds may not be suitable for use as traction animals pulling heavy implements for work. Breed improvement programs that retain the adaptable traits need to be embarked on. Trypanosomiasis transmitted by tsetse flies still occurs in many pockets in the region thus preventing livestock to be raised except where tolerant breeds are present. Evidence on the ground in Northern Ghana show that tolerant breeds are not widespread and often not preferred. A priority program of genetic improvement in livestock and multiplication of tolerant breeds is needed.

### *Animal feeds/feeding constraints*

Low feed supplies and poor quality feeds remain a high priority constraint. Animal health and performance are very much linked with quantity, quality and seasonality of feed. There is also evidence that the quality of manure and urine voided is a function of quality of feed consumed by livestock. The demand for livestock products and quality food crops are hence linked with feed quantity and quality. Programs to improve quantity and quality of feeds and availability throughout the year would provide needed support to crop-livestock systems.

### *Policy and institutional constraints*

Of the Policy and Institutional constraints, the agricultural and social-based policies that bring about subsidization of fertilizer, tractors and fuel for farm use are those that negatively impact the development of organic fertilizers and animal traction, are the ones that need most attention. Advocacy is needed to bring policy makers appreciate the link between subsidized inputs and the development of crop-livestock systems.

Land tenure system and its attendant challenges in land acquisition is a prioritized constraint to the extent that potential farmers face acquisition problems and risk of losing the land after acquisition. Lack of effective extension services to disseminate information on the appropriate crop-livestock system for specific areas, slow response by research and extension institutions to needs of crop-livestock subsectors in terms of service delivery are also seen as an important constrained that need to be attended to through better training and education programs.

## **Opportunities for intensification of crop-livestock systems in Northern Ghana**

### *Biophysical Opportunities*

From the angle of environmental sustainability, not all agro-ecological zones are suitable for livestock rearing, and hence crop-livestock system development. However, the three Northern regions fall mainly under “sub-humid zone”, a zone considered to be suitable for the evolving and development of crop-livestock systems.

Poor soil fertility, high prices of inorganic fertilizers and labor costs are forcing poor farmers to rely on alternatives such as manure and animal traction.

Under climate change scenarios northern most areas (Sudan savannah) may turn drier, to become semi-arid, which is still suitable for crop-livestock systems. Thus, for Northern Ghana the prospects for crop-livestock systems development are good over a longer term perspective.

### *Market and Technology Opportunities*

Intensification of agriculture which is currently going on through many projects in the region favor crop-livestock systems. DFID, USAID, AGRA, DANIDA and others have Projects in Northern Ghana which will have spin-offs for crop-livestock integration. Demand for livestock products expected to increase as rapid development of the three regions attracts new residents, a large percent of products expected from intensified production in peri-urban areas.

Rapid development of higher learning and research activities initiated by Government and its Development Partners will increase technology outputs, for example, the development of crop varieties in support of crop-livestock systems.

### *Institutional and Social Opportunities*

Emerging dialogue and discussions on Land tenure arrangements and women participation and on other socio-cultural issues in the three regions may be signaling changes in attitudes on land issues that could favor crop-livestock development as access to land improve.

Development Partner funded Projects in the three regions targeting other approaches to Extension to smallholder farmers through capacity building. The new generation of extension cadres is likely to bring about new ways of extension delivery, which can benefit crop-livestock production systems.

## **Lessons learned**

Working Group analysis of Projects that were judged successful or failure was able to identify key factors that made the difference of success or failure. The criteria set in order to score various activities or attributes should be refined to improve the objectivity of scoring. It however, remains a powerful tool in learning what went well and what went bad. A presentation at a Plenary Session listed several lessons from monitoring scores of Projects. Among the lessons learnt listed were a) Use multi-disciplinary team to assess feasibility of proposal, b) Proper and appropriate engagement of all stakeholders and partners, c) Ensuring that funding agency will not strategically delay disbursement – inflexible, imported

technology, employment for nationals, etc., d) Beneficiaries/Farmers should be involved in research and technology development, e) Technology should be responsive to climate change, f) Market-based to achieve sustainability, g) Ensuring proper alignment of policies and time frames, h) Project should have specific focus and not be so broad to lend itself to any interpretation. For a way forward, the following were proposed: a) strengthening formal and informal research, extension, processing and marketing organisations, b) develop and/or extend sustainable and appropriate technologies and c) developing collaboration and partnership models for relevant technology generation, transfer and adoption.

## Priority interventions

Priority interventions are needed to overcome the biophysical, policy and institutional constraints. For the biophysical constraints, technology options hold the key to bring lasting solutions. For feeds and livestock health related constraints the following interventions are proposed.

- *Improvement of soil cover* through the use of alternative crops for mulching, and introduction soil management techniques such as conservation tillage, bench terracing,
- *Improvement of feed production and quality* to reduce the pressure on grazing areas and improve internal nutrient transfers. Technologies to do so include: introduction of fodder shrubs and trees to reduce soil erosion and improve soil fertility.
- Strategic supplementation for specific classes of animals (lactating animals) to improve the efficiency of limited amounts of available feed.

For policy interventions advocacy actions could be bring to policy makers to slowly phasing out of subsidies on in-organic fertilizer and indiscriminate tractorization over time; improved land tenure for mixed farmers, and improved extension to inform and motivate on crop-livestock integration, and stimulating non-farm rural employment.

# Workshop Recommendations

## Recommendations directed at the Government of Ghana

- In view of intermittent dry spells during wet season and droughts which constrain crop-livestock farming, Government is urged to extend small scale irrigation often targeting rice farmers to crop-livestock farmers in the area.
- It was recommended that the influx imported frozen meat and meat products must be controlled in order not to kill farmers' enthusiasm to increase livestock production in Ghana.
- In view of the role of livestock in the developing of crop-livestock integrated systems, and the tremendous health issues confronting livestock in Northern Ghana, a full-fledged institution training animal health personnel should be brought closer to farmers. In view of this it was recommended that the Pong-Tamale College on animal health be upgraded to a Veterinary college to service the region.
- In managing conflicts attendant to the use of community owned natural resources it was recommended that demarcation of livestock routes, enforcement of local bye-laws related to livestock movements and the introduction of the "no ownership" concept be implemented in the region.
- It was recommended that Government take positive actions to promote crop-livestock integrated farming by promoting policies that favor crop-livestock integrated farming, such as organic fertilizers in combination with minimum use of inorganic fertilizers benefiting from subsidies on fertilizers. Promotion of appropriate mechanization technologies (animal traction, forage cutters and choppers, transport, etc.) for crop-livestock intensification including selected use of tractors and implements in specific locations for land preparation.

## Recommendations directed at the USAID

- Consider support to crop-livestock integrated systems in the next phase of Project in view of the importance of the sub-sector as emerged from the first phase of the Project.
- Liaise with other development players in the region during the design of the second phase in order to increase linkages and bringing out synergies.
- Crop-livestock Research Programming is crucial for dealing effectively with technology innovation for intensification with the value chain perspective. It is therefore recommended that Savannah Agriculture Research Institute and the Animal Research Institute Station be transformed into Centers of Excellence to handle the complex crop-livestock issues of small, medium and large farm systems towards intensification. Such programmes should be mainstreamed into the curricular of relevant departments of the University for Development Studies
- Attention needs be given to both biophysical and institutional constraints in an integrated research than is currently observed. Participatory action research employing IAR4D principles could speed up technology generation and innovation adoption and scaling up along value chain livelihoods.

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