

FEED THE FUTURE INNOVATION LAB FOR LIVESTOCK SYSTEMS



Proceedings of the **2018 Global Nutrition Symposium**

The Missing Link: Increasing Availability of Animal-Source Foods Through Greater Production & Marketing of Quality Feeds

> Harmony Hotel Addis Ababa, Ethiopia January 24-25, 2018







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Sustainably intensifying smallholder livestock systems to improve human nutrition, health, and incomes

Disclaimer

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Introduction to the 2018 Global Nutrition Symposium

The <u>2018 Global Nutrition Symposium</u> explored the challenges, the opportunities and the positive impacts of quality feeds as a fundamental issue for livestock production. At this second edition of the symposium, participants from Ethiopia and across the world reviewed and debated best ways forward on improving the availability of essential, high-quality feeds for smallholder farmers.

Although the focus of the 2018 Global Nutrition Symposium was on livestock feeds, the "Nutrition" in the Global Nutrition Symposium continues to refer to human nutrition. As underscored by our stakeholders in six countries, quality feed is perhaps the most important determinant of livestock productivity in developing country smallholder systems. Therefore, livestock feed is a key factor driving the availability of animal-source foods, which has direct impacts on human nutrition. Worldwide, poor animal nutrition caused by inferior or insufficient feed reduces weight gain and the production of milk, meat or eggs, which in turn decreases revenue from livestock production. Poor livestock nutrition also compromises animal health and contributes to increases in greenhouse gas emissions.

Lack of sufficient quantities of high-quality feed hinders smallholder livestock systems from reaching their potential to meet the increasing demand for animal source foods. As human and livestock populations soar, land use for urban and other development expands, and climate change takes hold, natural pastures shrink in both absolute terms and per livestock unit. In many environments, changing climates and overuse have also reduced resource quality with poor quality grasses and shrubs dominating over the native vegetation. Yet the majority of livestock in developing countries rely on natural pastures and resources as their main source of feed. For instance, natural pastures provide 78% of all livestock feed in Ethiopia and 80-84% of sheep and goat feed in Burkina Faso. Cereal straws, which form the bulk of supplemented livestock feeds in smallholder systems, are well known to be poor in nutritional quality and therefore constrain productivity. High quality forages, supplemental concentrates, and byproducts that can substantially increase livestock productivity are often under-exploited in such systems, for reasons ranging from unaffordability and lack of land to lack of awareness and knowledge about their importance and use.

Negative impacts from the lack of quality feed are direct, dramatic and varied at different levels. At the individual animal level, inadequate or unbalanced diets impair animal health, reduce growth rates, and decrease milk and egg production. In offspring, these impacts can be profound and lifelong when they occur during pregnancy. At the herd level, poor immunity due to undernutrition can result in greater disease incidence and reduced performance. At the household, community and national levels, low livestock productivity and poor animal health can severely curtail incomes, and the subsequent reduced consumption of animal source-foods contributes to childhood stunting. Moreover, limited feed resources can become a security issue at local, national or regional levels, as shrinking pasture resources fuels conflicts within and across borders and ethnic groups. Globally, poor quality feed consumption and the resulting low productivity contribute to increased rates of greenhouse gas emissions and the perception that livestock production is harmful to the environment.

Opportunities to improve the supply of quality livestock feeds, and hence increase livestock productivity and improve human nutrition through greater availability of animal-source foods,

abound for the public and private sector as well as their research and development partners. The 2018 Global Nutrition Symposium focused on analyzing and further developing these opportunities based on lessons learned from key stakeholders in the livestock feed and animal-source food value chains. The Symposium also examined the supply of quality feeds from all sources, including natural grasslands, cultivated forages, crop residues, concentrate supplements and agricultural by-products. Finally, the Symposium considered how to increase the supply of quality feed through market-driven solutions and institutional arrangements, and evaluated past experiences and the future potential of diverse mechanisms in different social and agroecological livestock systems settings.

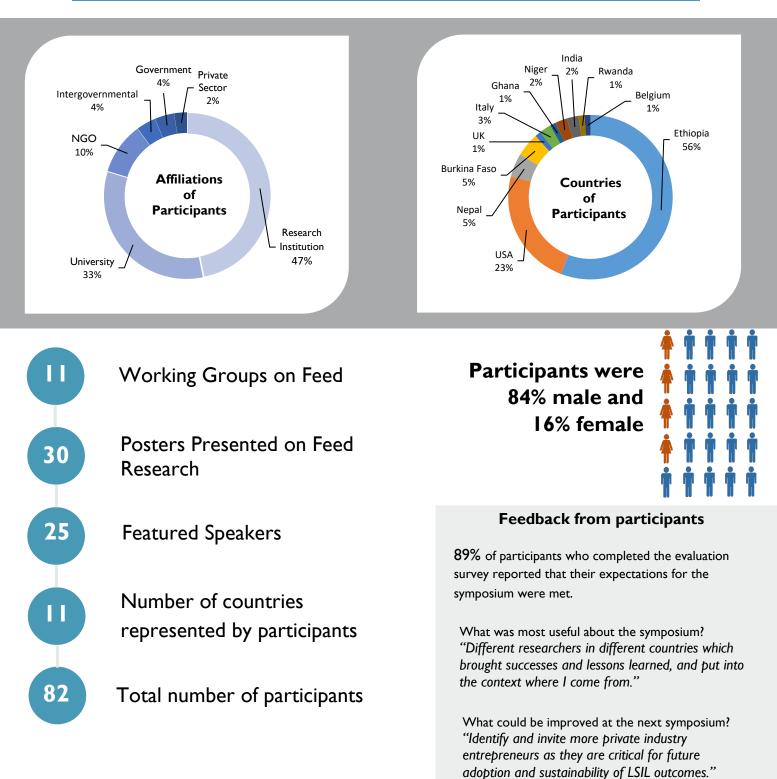
Acknowledgements

The 2018 Global Nutrition Symposium in Addis Ababa, Ethiopia was organized with two key national research organizations that have significant experience in improving quality feed supply and livestock productivity: the Ethiopian Institute for Agricultural Research (EIAR) and the Agricultural Transformation Agency of Ethiopia (ATA). As in 2017, the main organizers were the Feed the Future Innovation Lab for Livestock Systems at the University of Florida and its main partner, the International Livestock Research Institute (ILRI), which has a wealth of experience in improving all aspects of livestock production in developing countries.





We would like to extend our thanks to the speakers, presenters and participants who attended the 2018 Global Nutrition Symposium to exchange ideas and build partnerships in order to further the sustainable improvement of animal source food production, marketing and consumption. We especially appreciate the combined support of USAID and the Bill & Melinda Gates Foundation—without them, this event would not have been possible.



The 2018 Global Nutrition Symposium By the Numbers



Session 1: Opening

Lack of high quality feed was identified as the greatest constraint to livestock production and animal-source food consumption during inception meetings in the six core target countries of the Feed the Future Innovation Lab for Livestock Systems. Consequently, with funding from both USAID and the Bill & Melinda Gates Foundation, the Livestock Systems Innovation Lab manages and implements research for development projects aimed at concerted improvements in the supply of quality feed in Ethiopia and Burkina Faso; USAID funds additional feed-enhancing research projects in Rwanda, Niger, Cambodia, and Nepal. This second, 2018 Global Nutrition Symposium marks the beginning of the joint funding of the Livestock Systems Innovation Lab by both donors. It brings together researchers, development practitioners, and policy makers to critically assess knowledge, tools, practices, and products that are needed to develop a roadmap for increasing the supply of quality feed.

Opening Remarks



Dr. David Sammons Representative of the External Advisory Board Feed the Future Innovation Lab for Livestock Systems



Dr. Faith Bartz Tarr AAAS Science and Technology Policy Fellow & Agriculture Officer Representative of the U.S. Agency for International Development (USAID)



Kristen MacNaughtan Program Officer Representative of the Bill & Melinda Gates Foundation

Dr. Sammons opened the first session of the 2018 Global Nutrition Symposium by providing a bit of context for bringing people together for the second annual Global Nutrition Symposium. At the outset of the Feed the Future Innovation Lab for Livestock Systems a series of inception meetings identified limited access to quality feed as the most important constraint to livestock production in target countries. Dr. Sammons thanked the sponsors (USAID and BMGF) and participants from diverse partners and expressed his hope that participants with diverse expertise will be able to undertake a critical assessments of the knowledge, tools, practices and products that will be needed to develop a roadmap to increase the supply of quality feed for livestock systems in the Livestock Systems Innovation Lab's target countries and around the world.

Dr. Tarr highlighted the important role that agriculture and enabling agricultural policies have in ensuring access to nutritious food, and pointed Ethiopian Livestock Master Plan as an example of such a policy framework. The potential impact of these investments in livestock are quite large, because approximately 2.5 million livestock-keeping households could be lifted out of poverty and there would be additional economic benefits for urban dwellers. Thus, Dr. Tarr concluded that the success of the livestock sector in Ethiopia is critical for the achievement of food and nutrition security as well as national health, human development and economic outcomes.

In her opening remarks, Kristen MacNaughtan extended her thanks to the Livestock Systems Innovation Lab for organizing the meeting. Noting Bill & Melinda Gates Foundation's believe in the transformative power of the livestock sector, she also confirmed earlier comments that lack of quality feed as a key limiting factor to development in the livestock sector. She also emphasized the need to understand critical research gaps that need to be filled by collaborative efforts of donors, researchers, and governments. She concluded by saying that she looked forward hearing about the ongoing and completed research on feed to learn and to discuss how to think through the challenges related to livestock feed.



Dr. Oumou Sanon Deputy Director Representative of the Institute for the Environment and Agricultural Research (INERA)



Dr. Alan Duncan Director General's Representative in Ethiopia, Representative of the International Livestock Research Institute (ILRI)



Dr. Diriba Geleti Deputy Director Representative of the Ethiopian Institute of Agricultural Research (EIAR)

Dr. Sanon extended her thanks to the Feed the Future Innovation Lab for Livestock Systems, and she welcomed all participants of the Global Nutrition Symposium to give heed to the speakers and the information being shared at the event. She set the stage for her presentation, when she noted several reasons for limited success with fodder crops. Dr. Sanon shared the type of fodder crops available in West Africa, adopted technologies, and training and capacity building interventions by various organizations. She indicated that productivity is below optimal, because of complex constraints, with the most important being limited access to quality feed. She also described emerging opportunities that may foster increases in productivity in the livestock sector.

In the opening session, Dr. Duncan welcomed the participants on behalf of the International Livestock Research Institute (ILRI). He said that he was particularly pleased that the 2018 Global Nutrition Symposium was held in Ethiopia as it is one of the core global locations of ILRI and home to one of the largest livestock populations in Africa. He also noted that it was appropriate that the Livestock Systems Innovation Lab organized the symposium as a systems lens has been critical to looking at ways to improve livestock feed. Dr. Duncan also expressed his excitement on the new feed project funded by the Bill & Melinda Gates Foundation, which he considered to be a landmark of an investment in livestock feed.

Dr. Geleti concluded the opening remarks by representing the Ethiopian Institute of Agricultural Research (EIAR. He extended his welcome to the attendees of the symposium and emphasized that livestock feed is a critical issue in Ethiopia. He stated that while there has been almost five decades of research focusing on solving the feed problem in Ethiopia, the problem still persists, while commendable achievements have also been observed. For a better improvement in the future, Dr. Geleti recommended an increased engagement of the private sector, while focusing on the multiple dimensions of the feed problem including physical, financial and knowledge.

Presentations



Kristen MacNaughtan Program Officer, Bill and Melinda Gates Foundation Realizing livestock's potential: Why animal feed is critical to achieving our strategic goals

In light of the recent award to the Livestock Systems Innovation Lab, Ms. MacNaughtan discussed the importance of animal feed for meeting the strategic goals of the Bill and Melinda Gates Foundation. Ms. MacNaugtan explained that the Bill and Melinda Gates Foundation works across four areas: Global Health, Global Development, U.S. Program and Global Policy and Advocacy. Agricultural Development falls under the Global Development area. Their strategic pathways for agricultural development are to increase: 1) equitable consumption of safe, affordable and nutritious food year-round; 2) agricultural productivity for smallholder farmers; 3) income for smallholder farmer households; and 4) women's empowerment in agriculture. Ms. MacNaughtan also highlighted the reasons why the Bill and Melinda Gates Foundation is working on livestock. Approximately 60% of people in extreme poverty own livestock and the livestock sector accounts for 30-40% of agricultural GDP.

It is becoming increasingly obvious that we won't realize the potential gains in our investments in health and genetics without addressing feed.

In addition, animal-source food is one of the best, accessible sources of nutrition, and livestock offer a significant opportunity to empower women. The priority livestock species for the Bill and Melinda Gates Foundation are cattle, chickens and goats. The core body of the foundation's work on livestock is focused on: 1) livestock health, 2) genetics and reproduction, and 3) production and markets. Animal feed and fodder, in addition to aquaculture and regulatory systems, are exploratory bodies of work for the foundation. Ms. MacNaughtan concluded that research on animal feed and fodder is critical, since without proper animal nutrition the gains from improved livestock health and genetics cannot be fully realized. Thus, the Bill and Melinda Gates Foundation is working to close research gaps and build the evidence base around animal feed.



Dr. Adegbola Adesogan Director, Feed the Future Innovation Lab for Livestock Systems Focus on Feed: USAID and Bill & Melinda Gates Foundation collaboration on feed research and capacity building

Dr. Adesogan described the serious impacts of stunting, both the decreases it causes in cognitive ability and in national productivity, which can cost up to 10% of GDP. Dr. Adesogan highlighted that animal-source foods are the best high-quality, nutrient-rich foods for children because they contain all essential amino acids and provide bioavailable micronutrients that are critical for growth and development, and studies have shown dramatic improvements when such foods are added to their diets. Currently, the demand for animal-source foods is increasing greatly in South Asia and sub-Saharan Africa. With this in mind, the Livestock Systems Innovation Lab is working to intensify animal-source food production in order to increase the incomes, livelihoods, nutrition and health of vulnerable people. The Livestock Systems Innovation Lab has held priority-setting meetings six countries (Ethiopia, Niger, Nepal, Rwanda, Burkina Faso and Cambodia) to identify the constraints to livestock productivity, with inadequate quality feed supply identified as the top constraint in each country.

The main constraint in all of our countries to livestock production was supply of high quality feed.

Although sometimes overlooked, Dr. Adesogan noted that feed is a critical prerequisite for livestock growth and productivity, which influences the health of an animal and the success of genetic interventions. Feed is the most expensive component of livestock production, accounting for 60% to 90% of total costs. Thus, quality feed is a research focus for the Innovation Lab, and feed projects range from testing feed processing strategies in Burkina Faso and Niger to the development of an app for ration formulation in Nepal. In addition, the Innovation Lab recently received an \$8.7 million award from the Bill and Melinda Gates Foundation for two sub-projects: one on improving quality feed supply for dairy cows in Ethiopia and small ruminants in Burkina Faso, and the other on *Campylobacter* genomics and environmental enteric dysfunction. They link with other Gates Foundation projects that address the four interdependent pillars of livestock production of feed, genetics, health and management. Dr. Adesogan concluded that together these efforts will help to contribute to the reduction of stunting and poverty through increased production and availability of animal-source foods.

Poster Session: Improving Supply, Fostering Demand:

Experiences in Quality Feeds

The poster session served an important function at this year's Symposium. It introduced the Symposium participants to a wide range of research and development experiences in the two areas covered by the working groups: (1) solutions for increasing the supply of quality feed inputs and models, and (2) tools for feed delivery. A booklet of the poster abstracts was available.

Poster Number	Title	Author(s)
1	Inter-connection between feed resources availability, livestock production and soil carbon dynamics under smallholder systems in eastern Ethiopia	Hassen M. Ahmed, Zewdu K. Tessema, and AdugnaTolera
2	The future of feed: Lepidium cake as a feedstuff to pigs	Hagos Arefaine, Lotta Rydhmer, Roger Andersson, and Emma Ivarson
3	<i>Acacia nilotica</i> - Potential fodder tree for 25% Dorper cross sheep in the low land area of Ethiopia	Wondimagegne Bekele, Getachew Kassa, Alemayehu Mengistu, and Yoseph Getye
4	Opportunities for improved forages and utilization practices to intensify the mixed farming system in the Ethiopian highlands: Experiences of Africa RISING project	M. Bezabih, K. Mekonnen, A. Adie, A.J. Duncan, P. Thorne
5	Spin-off technologies from 2 nd generation biofuel: potential game changers for upgrading cereal straws and stovers for livestock feed	Michael Blümmel and Chris Jones
6	Effects of supplementing broiler chickens with varying levels of raw or full-fat soybean and a microbial protease	Mammo M. Erdaw and Paul A. Iji
7	Evaluation of dry matter yield of highland grass and legume forage varieties: the case of highlands of Southern Zone Tigray Region, Ethiopia	Tesfay Hagos, Temesgen Tesfay, Yohannes Takia, Teshale Teklu, and Tsigab Nirayo
8	Effect of fertilizer rate and spacing level on green forage and dry matter yield of desho grass <i>(Pennisetum pedicellatum)</i> in the lowlands of Southern Ethiopia	Derrebe Kassa Hibebo, Tessema Tesfaye Atumo, and Milkias Fanta Heliso
9	Comparative study on nutritive value of Atella and Brewers' Grain for dairy rations in Ethiopia	Badasa Rata Jalata, Veerle Fievez,Alemayehu, and Tadesse Tassew
10	Animal feed technological development for feeding efficiency and market price stabilization in Japan: What lessons can be learnt for developing countries like Ethiopia?	Shigdaf Mekuriaw, Atsushi Tsunekawa, Toshiyoshi Ichinoheand, and Kobayashi Nobuyuki

11	Improved forage development innovations in Sidama highlands of Southern Ethiopia	Tesfaye Shewage, Yoseph Mekasha, Birhanu Biazen, Azage Tegegne, Dirk Hoekstra, Solomon Gizaw, and Birhanu G/Medhin
12	Genotyping-by-sequencing reveals population structure in a Napier grass (<i>Pennisetum purpureum</i>) collection and identifies marker-trait associations underpinning the selection of improved varieties	Meki Muktar, Jean Hanson, Abel Gari and Chris Jones
13	Oat-vetch mixtures as feed options under supplementary irrigation conditions in highland semi-intensive dairy systems, southern Ethiopia	D.G. Talore, A. Adie, B. Zeleke, M. Bezabih, B. Michael, A. Tesfaye
14	Effects of Feeding <i>Moringa oleifera</i> leaf meal on quality and shelf life of chicken eggs	Etalem Tesfaye, Wubalem Alebachew, and Berhan Tamir
15	Feeding value potential of mulberry (<i>Morus alba</i>) leaf meal to replace concentrate mix	Gebrekidan Tesfay, Berhan Tamir, and Gebreyohannes Berhane
16	Evaluation of feeding options for Raya cattle young bulls to attain export market weight (250-300kg): The case of Raya valley southern Tigray, Ethiopia	Temesgen Tesfay, Adehanom Baraki, Zelalem Tesfay, Tesfaye Alemu, Tesfay Atsebha, and Solomon Wayu
17	Partial replacement of dried <i>Leucaena leucocephala</i> (Lam.) de Wit leaves for noug (<i>Guizotia abyssinica</i>) (L.f.) Cass. seed cake in the diet of highland sheep fed wheat straw.	Temesgen Tesfay and Yayneshet Tesfay
18	From food aid to feed aid: Pastoral vulnerability and aid agencies' response in Borana	Waktole Tiki
19	Effect of sorghum stalk silage supplementation on milk production and composition of indigenous milking cows in the peak dry season at Shoa Robit, Ethiopia	Aschalew Tsegahun, Lemma H/Yohanes, Tefera Mekonen, Nake Ziku,Getachew Gebru, and H. Dana
20	Animal feed production, processing and marketing: a case for public-private partnership	Bruck Yemane, Yacob Aklilu, Melkamu Bezabih, Aberra Adie and Michael Blümmel
21	The relative importance of dairy products to other Animal Source Foods to family nutrition in mixed crop-livestock production systems of Ethiopia	Sintayehu Yigrem, André Markemann, Girma Abebe, Joseph O. Ogutu, Hans-Peter Piepho, and Anne Valle Zárate
22	Seed yield and quality of <i>Desmodium uncinatum</i> as affected by method and stage of harvesting	Tekalegn Yirgu, Solomon Mengistu, Fekede Feyisa, Getnet Assefaand Edao Shanku
23	Feed resources availability and livestock feeding strategies in the agro-pastoral zone of Koumbia in western Burkina Faso	Nouhoun Zampaligre, Mamadou Sangare, Tidiane Traore Cécile Sarambe and Karen Marie Greenough



Session 2: Quality Feeds: Roles, Impacts and Experiences

Improving the supply of quality feed can be a win-win strategy that results in improved human nutrition through greater availability of animal-source foods, improved environmental health due to reduced greenhouse gas emissions, and reduced expansion of pasture land due to sustainable intensification of livestock production. However, the gap between the future demand and expected supply of quality feed is growing, as livestock populations grow and pasture resources dwindle. For instance, the Ethiopia Livestock Master Plan notes that, of the main livestock systems in Ethiopia, currently only the agro-pastoral system has sufficient feed resources, and this is only when rainfall is average to higher than average." It also notes that in the business as usual scenario, by 2028, all systems will be deficient in all years. Fortunately, over the past decades, numerous research and development efforts have been conducted on improving the supply of quality feeds, offering an evidence base that can be mined for important lessons.

Keynote Address



Dr. Harinder Makkar former Senior Animal Production Officer, Food and Agriculture Organization (FAO); and Private consultant

Improving livestock productivity, nutrition security, and the environment through the food-not feed strategy

Dr. Makkar's key note address touched on several important themes such as the need to enlarge the livestock feed resource base, the need to develop strategies for utilizing existing feed resources and the need to move from 'calorie security' to nutrition security. To illustrate the need to increase the feed resource base, Dr. Makkar presented data showing the demand for cereals and oilcakes for animal feed is projected to increase by 40% and 60% respectively by 2050. However at present, there is a shortage of quality feed in Ethiopia due to seasonal fluctuations in feed availability and distribution. In addition, the livestock sector faces competition for cereals with human consumption, and increasingly biofuel production. Thus, in order to enlarge the food resource base, Dr. Makkar discussed several potential strategies. These were the development of food-not feed resources as well as novel feed resources, smart feeding strategies, using and reducing food waste, and considering the efficiency of livestock feeding and production from multiple dimensions.

For example, a food-not feed strategy would use a part of the grain from ethanol production to produce animal feed co-products, thereby expanding the feed resource base as biofuel production increases. An example of a novel feed resource could be insects, which can provide high quality protein as well as iron, zinc, and vitamin A. Another novel feed resource is Moringa oleifera, which provides nearly 5 times the protein yield per hectare compared to soybeans. Optimizing the nutrition and feeding strategy of livestock is another way to expand the feed resource base by improving efficiency, while at the same time increasing productivity. Ration balancing has many benefits including increased milk yield, decreased water use and methane emissions, and increased fat content in milk. Another smart feeding strategy is the use of mixed ration blocks and urea-molasses block variants in order to reduce feed waste and to increase productivity. Finally, Dr. Makkar discussed how the efficiency of livestock production should take into consideration multiple dimensions such as emissions, and protein output to input ratio. In addition, he suggested that measures of efficiency should be based on the productive life of livestock (i.e. all lactations of a dairy cow), which provides a more complete picture of the productivity of an animal versus its greenhouse gas emissions in various systems.

Session 2: Presentations



Dr. Michael Blümmel

Deputy Program Leader – Feed and Forage Development International Livestock Research Institute (ILRI) Mapping Feed Supply and Demand

In his presentation, Dr. Blummel discussed why it is important to map feed supply and demand, the results of the pilot of the FEEDBASE tool for Ethiopia, and potential future uses for the tool. Dr. Blummel stressed the importance of measuring feed supply and demand because it is necessary to 1) understand current levels of livestock production and productivity; 2) understand opportunities and limitations for increasing livestock production and productivity; 3) target and prioritize feed interventions; and 4) use as an input to identify small and medium scale animal production enterprise opportunities. Dr. Blummel also described the conceptual underpinnings of the model, explaining how feed supply and demand is determined from secondary data (such as crop area, crop harvest, livestock number, herd structure etc.) using constants. For example, the FEEDBASE model uses a constant to convert maize crop area and harvest into maize crop residue available for livestock feed. Dr. Blummel also demonstrated how all of this data comes together in the FEEDBASE tool, showing results from pilot data from 6 districts in Ethiopia.

Feed is not absolute, feed is very context-specific so we need to develop context-specific tools.

Through collaboration with the Agricultural Transformation Agency (ATA) data from 20 more districts in Ethiopia will be added to the tool, at which point analyses will be conducted for plausibility and sensitivity. If the tool works, as evidenced by the results of the plausibility and sensitivity tests, further refinements will be made to capture seasonality in feed supply and demand as well as feed import and export. In addition, Dr. Blummel described how environmental data could be added to the tool to estimate the environmental impacts (water or greenhouse gases) due to changes in feed sources or animal species. If the tools works, it requires relatively little time and resources to generate generic models for new contexts.



Dr. Adunga Tolera Professor Hawassa University Improving the Supply of Quality Feeds in Ethiopia: Successes and Lessons Learned

In Dr. Tolera's presentation on the successes and lessons learned on feed supply and quality in Ethiopia, Dr. Tolera discussed the potential for livestock production in Ethiopia, current productivity levels and feed-related challenges, successes in feed research and development, as well as lessons learned and ways forward. Dr. Tolera noted that Ethiopia has great potential for livestock production given the large numbers of livestock and the amount of genetic and agro-ecological diversity present in Ethiopia. In addition, demand is increasing for livestock products and there is greater interested from the government and private sector in market-oriented livestock development. However, the current productivity of livestock in Ethiopia is very low and there is low per capita consumption of animal products. Challenges related to feed supply and quality constrain livestock development, as seen in the case of peri-urban dairy farmers who must purchase feeds of varying price and quality since there is not a consistent supply.

There is a huge gap between the actual productivity level and the potential productivity that can be achieved from both local and crossbred animals.

Although many years of research and development efforts have focused on feed, the adoption rate of feed technologies has been low and the technologies are not widely available. One factor influencing adoption is the lack of on-farm feeding and animal response trials to demonstrate the impact of forage on productivity and income. Other challenges include poor market linkages that are a disincentive to investment in improved feed, difficulty accessing seeds for forage production, and competition with food and cash crops for land and labor resources. However, there have also been successes in Ethiopia such as the large number of forage crops that have been identified and characterized, the integration of forage production in sustainable land management practices, increased private sector interest in forage production and marketing, and increased use and storage of crop residuals by farmers for animal feed. Some of the lessons learned through research and development efforts on feed in Ethiopia include the need to have more compelling evidence linking forage to productivity and income outcomes, further understanding the context of beneficiaries and the reality of on-farm conditions, and the need for stronger inter-institutional collaboration. Looking ahead there are opportunities to expand agro-industrial production of feed ingredients and to strengthen the roles of customary institutions in natural resource management in pastoral areas.



Dr. Oumou Sanon Deputy Director Institute for Environmental and Agricultural Research (INERA) Improving the Supply of Quality Feeds in Burkina Faso: Successes and Lessons Learned

Dr. Sanon talked about improving the feed supply of quality feed in Burkina Faso, with emphasis on constraints, opportunities, and lessons learned. She also indicated that livestock production systems in Burkina Faso is divided into pastor al system in the drier northern drier Sahlian zone and an increasingly intensified system in the wetter southern Sudanian zone. Despite the large number and diversity of livestock, Dr. Sanon indicated that the productivity is below optimal, because of complex set of constraints the most important of which is limited access to quality feed. She also indicated that there are emerging opportunities that, if utilized, may foster increase in productivity in the livestock sector. Such opportunities include; steady shift towards commercialization, large and diversified livestock population and diversified agro-ecology, a dynamic and growing technological inputs, traditional knowhow in livestock production, and increase in availability of agro-industrial by products.

Focusing on the most important problem, the feed problem, Dr. Sanon identified four main types feed sources in Burkina Faso including natural pasture (85%), crop residues (11%), and fodder crop and agro-industrial by-products. She indicated that quality and availability of natural pasture is better in the Sudanian zone than the Sahelina zone. Crop-residues is an important feed resource in both zones, but mainly in the Sahelian zone, contributing 40-60% dry matter intake by cattle in the Sahel zone.

With increased orientation of production towards market, farmers are more and more aware of the need to use improved technologies.

Fodder crops, though appreciated by farmers and experts as better quality than crop residues and natural pasture, their adoption below optimum, with exceptional success in Sorghum and cowpea in some areas. Reasons for limited success with fodder crops is related to limitations in technical knowledge and availability of resources. Dr. Sanon also provided details on the type of fodder crops available, and other technologies that have been adopted such as multi-nutrient block prepared from locally available resources, varies training and capacity building interventions by various GO's and NGO's. Finally, Dr. Sannon concluded by indicating that despite various integrated interventions, adoption of technologies is still limited, but she also indicated that the progressive shift towards commercialization in the livestock sector will force more and more farmers to adopt technologies for improving productivity.



Session 3: Working Groups – Solutions for Increasing the Supply of Quality Feed

There is no single all-encompassing solution to improving the supply of quality feed and, even on a single farm, a combination of solutions may be required. The working groups in this session will explore the potential to improve the supply of quality feed with proven and novel strategies for different livestock systems and environments. Presenters, responders, and participants will present and constructively critique specific experiences, viewpoints, and alternative approaches. The goal is to identify up to three research themes and three development solutions that should be tackled to improve quality livestock feed supply. The "what," "where," and "how" of each solution should be specified.

Working Groups

- 1. Achieving a "forage revolution" through improved varieties and seed systems
- Presenters: Dr. Chris Jones and Dr. Jean Hanson, ILRI
- Responder: Dr. Solomon Mengistu, EIAR

In this working group, Dr. Jones asked, "Are we having a forage revolution?" and the group participants answered both yes and no citing examples for each side. In favor of "yes," participants named examples of on-farm demonstrations and uptake by farmers, specifically in case of the increasing demand for desho grass in Ethiopia. Awareness and support were considered important by the group members, along with ongoing support and a community of practice to reinforce innovations. Testing on farms works better than demonstrations off-site, and the marketplace must be attractive to catalyze the change instead of forcing it. Favoring "no," group members discussed the lack of capacity to take advantage of new technologies, with many aspect of influence, including costs, which need to decline to an affordable level. Knowledge of innovation may exist, but farmers may need guidance to consider newer options. The adoption process involves a learning curve for all stakeholders, and simply improving forages does not result in changed practices. In conclusion, although Dr. Jones felt that were more arguments in favor of a forage revolution than against, he also said that there was still a long way to go beyond giving new forages to farmers by also working with them within the context of their farms and households.

2. Increasing synergies and impact through dual-purpose crops

- Presenter: Dr. Tim Dalton, Kansas State University (KSU)
- Responder: Dr. Fekede Feyissa, EIAR

In this working group, Dr. Dalton discussed when dual-purpose crops make sense and under which conditions by presenting some data from pearl millet trials in the Sahelian region in West Africa. In these trials there was no clear relationship between grain and fodder yield, except in certain specific conditions. From this introduction, the working group developed some key questions for research in this area. First, do we have strong working definitions for dual-, multi-, and full-purpose varieties? In general, the group felt that these terms were not rigorously define necessitating further contextual information upfront when discussing these types of crops. For example, outputs for sorghum farmers in Ethiopia include grain and fodder, but also other outputs are used in construction, feed byproducts and more. Second, what do we value? Grain values are better understood than forages, and data on construction and fuel values are very weak. Seasonality also has strong affect in Africa and needs better data. For example, group members discussed how forage prices can double or triple during the year in certain West African contexts. A third question in the group was: What are the sources of variation in outputs? Is it mainly influenced by environmental or managerial factors? Finally, the group questioned if livestock producers understand the value of improved forage crops? In Central America the benefits of using improved forage were evident in the resulting milk yield increases, which then triggered greater adoption. For aspects like weight gain that take longer to accrue as a benefit of improved animal nutrition, the group questioned if there was a knowledge gap faced by the farmers potentially pointing to the role for education to better inform producers about the value of improved forages.

Based on the first two questions, the working group discussed some themes for future research in this area. These research themes included a better understanding of farmer demand for crop attributes as well as forces driving variation in demand, such as market locations and livestock densities. With this information researchers and development practitioners can do a better job of identifying crop varieties with the most desirable attributes for farmers. In terms of development solutions, the group discussed working with plant breeders to inform them about attributes most important to farmers in order to create varieties with the most economic potential. Researchers could also create portfolio of improved varieties for various attributes depending on the output of interest (grain, fodder, construction etc.) for farmers since their demands may vary by size or location.

3. Forage quality improvement

- Presenter: Dr. Michael Blümmel, ILRI
- Responder: Dr. Salissou Issa, National Institute of Agricultral Research (INRAN)

For this working group, the group members discussed the research to development process of forage quality improvement. To begin Dr. Issa discussed how forage production and processing may be input intensive and require some capacity from the private sector. In addition when examining forage processing it is also to understand the type of forage and the context in which it is produced. For example, it is important to distinguish between forage from natural pastures, new varieties in development or crop residuals. In the West African context, there is high usage of crop residue. Thus, in order to improve forage quality, researchers should look at how to improve crop residue as a forage. For this issue, the group discussed five research strategies. The first strategy was to select dual-purpose crops and to increase yield and digestibility. The second strategy involved creating business plans for processing, especially for small and medium operations. The third strategy was to develop technologies for harvest and post-harvest, such as techniques for addressing rainy season effects in West Africa. The fourth is to develop NIRS usage and the necessary certification for assessing the quality and safety of forages, such as for mycotoxin contamination. Finally, the fifth strategy was to scale-up and spin-off technologies, such as for second generation biofuels.

4. Balancing rations for productivity and profitability

- Presenter: Dr. Barry Bradford, KSU
- Responder: Dr. Bhola Shrestha, Heifer International Nepal

From the discussions of this working group Dr. Bradford shared discussion themes and strategies related to balancing rations. For the first discussion theme of applicable tools the importance of tools adapted to the local context was emphasized. For example, tools developed for the US or European contexts are pre-loaded with nutrient information or maintenance requirements for the species of those contexts. However, rather than building the databases for these tools from scratch through expensive and intensive research, in the short run information from related breeds such as metabolizable protein can be used as a first step to develop these tools for less researched contexts. Some of these tools have been developed for India and Nepal and could potentially be adapted to other contexts. In addition, Dr. Bradford clarified that by tools the group considered everything from an informational sheets to localized phone apps. The second theme discussed in the working group was establishing economics on supplementation. On this topic, the group had a lengthy discussion touching on both the mindsets of producers that may prevent them from investing in supplements and the economic benefits of supplementation. For producers with limited cash there may be both psychological and economic barriers to investing in an expensive supplement, even if they have the information that it improve the productivity of their livestock and thus increase their income. On way that this barrier could be overcome is through better documentation in research of the return on investment for supplements. Finally, the third theme from the working group was thinking of a framework to evaluate the value or economic impact of various tools and technologies, such as feed additives or phone apps. In the working group discussion, the consensus was that these tools and technologies needed to be adapted to the local contexts of smallholders. Tools or technologies can better help smallholders make better decisions, but those tools and technologies need to reflect local conditions.

5. Exploiting and preserving the quality of concentrates and by products

- Presenter: Dr. Asamoah Larbi, International Institute of Tropical Agriculture (IITA)
- Responder: Dr. Dirk Maier, Iowa State University

In the last working group, Dr. Maier reported on six points relating to concentrates and byproducts. Dr. Maier started by discussing the importance of considering the animal's nutritional needs based on its life stages, location, scale of productivity and other factors, which influence the concentrates and byproducts that might be needed. The second point discussed by the working group was the importance of defining and quantifying byproducts and concentrates. The quantification of ingredients in concentrates and byproducts is critical as it relates to issues of composition, quality, feed safety, ration formulation, labeling, and measurement technology. The third point from the working group was on standards, regulations and best practices. One of the challenges of standards discussed was how they often looked good on paper, but were rarely put into practice. Sometimes standards are adopted from US or European agencies, but do not fit the local context, other times there is a shortage of human resources to implement standards through auditing and enforcement. The fourth point was on availability, affordability and quality of concentrates and byproducts. The group discussed the alternative feed sources that may be available in different regions, which also need to be considered both in terms of their economic benefit, processing needs, storage and preservation. For example, for oilseed cakes the group discussed the various oil levels that can be present in the cakes and the storage implications, as well as blocking technologies to extend their preservation. Finally, the group discussed capacity building and training methods for feed processing, feed formulation, and ingredient preservation. The group not only discussed capacity building through extension, but also capacity building within universities and industries.



Session 4: Working Groups - Models and Tools for Feed Delivery

The need for quality feed is increasing due to the rapid increase in demand for animal-source foods and the reduced availability of natural pastures. Models for market-driven feed delivery vary substantially in size, scope, and the types of feeds in question. Feed processing businesses range from microenterprises consisting of a chopper and mixer to much larger plants with sophisticated technology. Cooperative models are unique due to various factors, including perhaps having an easier supply of backward credit. Small-scale urban feed vendors fill a void particularly in the supply of fresh forages. Finally, pastoral lands present their unique challenges given their remoteness, strong reliance on natural pastures, dependence on semi-arid to arid areas, and difficult pathways to intensification. In this session, experiences with these delivery methods as well as tools for mapping feed resources and technologies will be reviewed, along with their strengths and challenges. Focus will be on fostering innovation in feed delivery and recommending research and development actions. The goal is to identify up to three research themes and three development solutions that should be addressed to improve the supply of quality livestock feed. The "what," "where," and "how" of each solution should be specified.

Working Groups

1a. Mapping resources and targeting technologies: Making the most of FEAST and TechFit

- Presenter: Dr. Alan Duncan, ILRI
- Responder: Dr. Nouhoun Zampaligre, INERA

Dr. Zampaligre shared five discussion points about implementation and other issues relating to the ILRI-developed FEAST and TechFit tools. First, he discussed the importance of cost-benefit analyses for feed and the need to better integrate price and market considerations into the intervention process. The second point discussed was the need for an evaluation of the success of the FEAST and TechFit tools in order to generate recommendations for intervention activities to improve the adoption of feed technologies. The third topic discussed was the suggested sample size of the FEAST tool, which is nine, but it is also possible in the tool to have a larger sample size. The fourth point was about categorizing farmers in order to target specific feed interventions. In the FEAST tool there are wealth categories of farmers that are created based on land and livestock holding sizes. Prior to implementing a feed intervention, stakeholder activities can be conducted with farmers to determine which category they fall into as well their specific feed needs and feed constraints. The final point discussed was to be careful about raising farmer's expectations when conducting research on the FEAST tool. Dr. Zampaligre that through researching for FEAST many different feed needs and potential interventions are identified, however not all may be implemented. The work for scientists most often stops at the identification of these feed needs and suggesting potential activities, however it is important to link farmers with extension services so that they can receive support during the implementation process.

2a. Feed microbusinesses and processing plants

- Presenter: Mr. Seyoum Bediye, EIAR and Ethiopian Animal Feed Industry Association
- Responder: Mr. Beruk Yemane, Ethio Feed PLC

Mr. Yemane shared the major issues from the working group on microbusinesses, processing plants and quality feed. Mr. Yemane discussed the two main issues that came out of discussion in the working group which were 1) are microbusinesses recognized as contributing to the feed issue, and 2) how can microbusinesses become more vibrant. Out of these issues the first point Mr. Yemane discussed is the lack of baseline data on feed ingredients and byproducts. The animal feed industry within Ethiopia may be able to begin to address this gap. Next, Mr. Yemane referenced earlier discussions about feed affordability noting that at the moment certain kinds of

feed may not be affordable for farmers. One way to reduce the cost of feed would be by producing feed in closer proximity to farmers using more local materials. Another way to address the issue of affordability would be to examine the comparative costs and benefits of commercial versus local feed for smallholders so that they can make more informed decisions. The third point discussed by Mr. Yemane was the benefit of commercial feed for indigenous animals. He suggested that commercial feed should be targeted for cross-bred animals in order to see significant improvements in productivity, or in other words quality feed should be matched with improved genetics. In addition, Mr. Yemane discussed how private companies and associations should create a more focused market promotion and extension strategy rather than relying exclusively on the general government extension service system. Also, Mr. Yemane discussed the need to look at alternative feed resources in addition to compound feeds. This is especially important during the times of the year when price of some feed ingredients is very high or not available at all. Rather than stopping commercial feed production, companies should look for alternative feed ingredients that can be substituted. Finally, the Ethiopian Animal Feed Industry Assocation (EAFIA) needs to be strengthened so that it can be proactive and self-sustaining within the feed industry. In addition, the Ethiopian animal feed industry should work closely with government offices in charge of ensuring safe and quality animal feed is produced.

3a. Feed supply through cooperatives

- Presenter: Dr. Carl Birkelo, ACDI/VOCA
- Responder: Mr. Matthew Karugarama, Zamura Feeds Rwanda

For the feed supply through cooperatives working group, Dr. Birkelo summarized the key points discussed. The first key point was capacity building and training to manage feed and livestock enterprises efficiently and effectively. Dr. Birkelo also noted how this training does not have to specifically relate to feed, but could also cover areas such as accounting or human resources management or procurement. Training in these areas is important since these are all aspects which contribute to functioning of the feed business. For example, in the case of procurement processes there may be issues with the approvals required to make a purchase that are not compatible with the business environment (i.e. an urgent need to order noug cake but approval required from the board of directors who meet on a biweekly basis). Streamlining these types of processes helps feed businesses be competitive. Another way to develop the management capacity of cooperatives is through identifying best practices, such as through exchange visits with successful cooperatives in other countries to learn what their management practices are. Finally, the working group discussed the commercialization or commercial-orientation of cooperatives. Unions within Ethiopia were not designed to be profit-seeking so building on that platform to promote commercial-orientation can be a challenge. For exmaple, incentivized compensation plans were not a part of cooperatives originally, but are important for turning cooperatives towards a more commercial-oriented perspective. Also commercial linkages need to be developed between unions as well as the private sector in order to promote sustainability as well as infuse commercialorientation. For example, with poultry feed some cooperatives purchase the difficult to produce component of finished feed (about 25% of the total) and then purchase the other feed ingredients locally in bulk and then mix the feed themselves. This strategy has been effective by taking advantage of the private sector's expertise while also producing at a competitive price by using local commodities and minimizing transporation costs. Even after the project is over, the linkages with the private sector may make this activity sustainable as it increases the reach of the private feed companies and is financially viable for the unions.

4a. Urban forage vendors

- Presenter: Dr. Marjatta Eilitta, Deputy Director, Feed the Future Innovation Lab for Livestock Systems
- Responder: Dr. Getnet Assefa, EIAR

Dr. Jones summarized the main discussion points for the urban forage vendors working group, which discussed examples from both West and East Africa. The first point was that urban forage vendors were mostly operated informally. However, the group also recognized that the opportunities for urban forage were expanding and that there were a number of ways to support the development of urban forage vendors. One way that opportunities for urban forage is expanding is through the price premium paid based on color, which can signal quality. To support the further development of quality based payments analytical platforms could be formed to provide guidance to customers on what to look for in high quality forage. Another aspect discussed was the transportation of forage to the market. Examples from West Africa suggest that fodder is sometimes carried over very long distances, however there may also be opportunities to produce forages closer to the market and thus reduce transportation costs. Much of the fodder harvested came from natural pastures, in West Africa traders often harvested the fodder while in East Africa the producers most often the ones harvesting. Planting forages rather than harvesting natural pastures could improve the quality of forage and are an opportunity. Another point discussed was the emergence of a fodder business in Kenya, with the introduction of Bracharia. Dr. Jones discussed how the increase in productivity due to the improved fodder was driving demand and expanding the adoption of this feed resource. Future opportunities for fodder development include potential regional feed exports. At the moment the market for forages is perceived as opportunistic and unstructured and the working group discussed how this could potentially be an entry point for youth since the barrier to entry is low in terms of knowledge and capital. Finally, cooperatives, associations and seed businesses could also be potential entry points for increasing forage productivity and expanding urban forage opportunities.

5a. Feed reserves and transport to areas of need

- Presenter: Dr. Lemma Gizachew, FAO
- Responder: Dr. Michael Jacobs, Mercy Corps

In the working on feed reserves and transport, Dr. Gizachew noted the importance of this topic in Ethiopia due to its potential to redistribute feed resources both seasonally and between Ethiopia's varied agro-ecologies. Dr. Gizachew also noted the importance of feed reserves and transportation as a way to reduce the impact of droughts, which some parts of Ethiopia are prone to, and which may increase with climate change. Through discussion, the working group identified three action points for development agencies as well as three action points for research. The first action point for development agencies investment was the need for capacity building, especially in the lowland areas of Ethiopia. Currently the lowland areas of Ethiopia do not have a surplus of feed that could be transported, so first investments are needed to increase production. In addition, capacity building is needed to improve feed conservation and storage, which contribute to feed quality and safety issues in Ethiopia. The second point for development agencies was to engage with the private sector. Dr. Gizachew stated that Ethiopia has relatively few private feed companies relative to the size of its livestock population. The third point for development agencies was investment in feed densification technologies. Dr. Gizachew mentioned that the feed technology in Ethiopia is in its early stages, and that investments are needed in order to intensify livestock feed production. Another solution would be to develop a more distributed system in order to reduce the transport costs of feed, by only shipping the feed concentrate over long distances. For the first research theme, Dr. Gizachew discussed the quality and safety issues in livestock feed. For example, research could look at how quality and safety degrades over time with current storage practices for industrial byproducts. The second research are was on technologies for feed, specifically for TMR systems to address transport and price issues. The third research theme was the efficiency and effectiveness of feed densification technologies. These technologies could also be targeted to different types of farmers or farmers of various scales.



Session V: Ways Forward

Whereas budgetary resources and policy attention for increasing the supply of quality feeds have been limited in the past decades, this trend is now being reversed in some countries. For instance, the 2015 Ethiopian Livestock Master Plan analyzed current and future trends in demand for livestock products, described feed and other inputs needed to meet the growing demand, and developed roadmaps for key value chains. Such detailed knowledge forms a valuable basis for the development of enabling policies for improving the supply of quality feed. In this final session, factors contributing to such enabling policy frameworks will be analyzed and discussed.

Ways Forward Presentations



Mr. Seyoum Bediye, Director, EIAR and Ethiopian Animal Feed Industry Association

Developing an enabling policy framework for ensuring the supply of quality feeds

Dr. Syeum Bediye's presentation focused on five aspects of policy framework namely, the justification for the need to a feed sub-sector policy framework, the

key challenges demanding policy solutions, the generic policy interventions in the feed sub-sector, and the policy instruments or interventions for the major categories of feed. While there is agreement that feed is a major limiting factor to livestock sector development, Dr. Bediye indicated that many scientists and practitioners focus on the technical side of the problem, while giving negligible consideration to policy issues.

The feed sub-sector can be considered important from the biological, environmental and economic perspective. From the biological perspective, feed is critical to consider since more than 50% of livestock productivity is attributable to feed. Environmentally feed is important since 84% of the greenhouse gas emission from the livestock sector are due to the feed sub-sector. The feed sub-sector is also important to consider from an economic perspective since 60-70% of cost of livestock production is related is to feed and the feed sub-sector generates revenue job opportunities for millions of people. Other issues of important policy considerations in the feed sub-sector also include responding to key demographic and economic drivers of change in the livestock/ feed sector, assuring affordability of animal source food, and creating an enabling environment for the domestic production of feed ingredients.

Specifically, Dr. Bediye emphasized the need to focus on specific feed types while formulating policy framework. Accordingly, he identified issues and challenges that require policy solutions for each of the feed types namely natural pasture and range, cultivated forages, crop residues and agricultural by-products and concentrate or compound feed. While policy issues are different for each feed type, the issues that cut across the feed sector include scarcity and unavailability due to limited local production, limited adoption of promising or even working technologies, technical constraints caused by limited or inadequate technical support, limited private sector involvement, and an underdeveloped value chain for most of the feed types. Dr. Bediye therefore, emphasized that there is a need to formulate policy solutions that would help solve the aforementioned challenges and constraints, but also indicated that such policy interventions need to be specific for the specific type of feed.

In terms of key actors in the policy framework, Dr. Bediye emphasized the need to take into we need to take into account four categories of actors namely government with its key actors, the community, the private sector and the public private partnership. Involving the local community should be based on specific policy prescriptions that are relevant to various specific production systems, such as for example, taking Ethiopian case, the crop-livestock mixed farming, the pastoral and agro-pastoral, urban and peri-urban and commercial livestock, each of which demand specific approaches and policy support, pertaining to their distinct characteristics. Policy support in terms of involving local communities are needed to focus on management of local or communal feed resources, while specific economic incentives such as loan, tax and duty free, technical capacity building, research, extension are needed to attract private sector. Public private partnership should

also include piloting innovative production of quality feed, transfer of proven technology, scaling up research recommendations, technical capacity building for feed processors, and feed micro-business. Concluding Dr. Bediye indicated that policy framework is critical to for ensuring supply of quality feed and attainment of macro level goals of the livestock sector in general and the feed sub-sector in particular. Good understanding of macro- level and sector- wide policies is a key step in designing feed sub- sector policy framework. Policy framework for insuring supply of quality feed requires attention for three areas 1) focused or differentiated feed sub-sector development, 2) major categories of feed, and 3) identification of policy interventions for consideration.

Summary



Dr. Asamoah Larbi, Country Representative (Ghana), IITA; and External Advisory Board, Feed the Future Innovation Lab for Livestock Systems

Dr. Larbi appreciated the interesting deliberations that have been done in the last one and half days. Session 2 of the Global Nutrition Symposium focused on the roles, impact and experiences, mapping of feed demand and supply, sharing of

experiences from Ethiopia and Burkina Faso. In the third session participants looked at solutions and strategies for increasing supply of quality feed or igniting a forage revolution. The different strategies discussed included introducing improved varieties and effective seed systems, dualpurpose crops, improving quality of crop residues, balancing rations for increased productivity and profitability and exploiting the quality of concentrates and agro-industrial by-products. In the fifth session, participants discussed on models and tools that would facilitate the delivery of quality feed. Discussions and presentations focused on mapping of feed resources, feed micro-business and processing plants, feed supply through cooperatives, urban forage vendors, transport of feed from or to areas of need and the pertinent issue of policy frameworks.

Looking at the lessons learned and issues entertained and comparing to his more than thirty years of experiences in the issue of livestock feed across continents and CGIAR institutions, Dr. Larbi indicated that this was one of the most interesting and forward looking workshops that promises action and improvement in the livestock feed sector. According to the challenges that have been pointed out and suggestions made, Dr. Larbi emphasized that a persistent theme that occurred across all presentations has been the missing of effective multi-stake holder partnership along the quality feed value chain. He therefore, emphasized the strengthening of such effective multi-stake holder partnership. He believes that such partnerships will bring together all the actors, so that technical researchers will no more have to work alone, but together with actors from the public, private and NGO, who will be brought aboard through effective partnerships, will able to identify targets and deliver innovations that could bring impact. Finally, Dr. Larbi thanked all participants and reiterated the need for strengthening the partnerships, to serve the purpose of the workshop that is to deliver on increasing the availability of animal source foods through greater production and marketing of quality feeds.

Appendix 1 - Agenda

Day 1: Wednesday January 24, 2018

Session I. Opening

Chair: Dr. David Sammons, External Advisory Board Feed the Future Innovation Lab for Livestock Systems

Lack of high quality feed was identified as the greatest constraint to livestock production and animal-source food consumption during inception meetings in the six core target countries of the Feed the Future Innovation Lab for Livestock Systems. Consequently, with funding from both USAID and the Bill & Melinda Gates Foundation, the Livestock Systems Innovation Lab manages and implements research for development projects aimed at concerted improvements in the supply of quality feed in Ethiopia and Burkina Faso; USAID funds additional feed-enhancing research projects in Rwanda, Niger, Cambodia, and Nepal. This second, 2018 Global Nutrition Symposium marks the beginning of the joint funding of the Livestock Systems Innovation Lab by both donors. It brings together researchers, development practitioners, and policy makers to critically assess knowledge, tools, practices, and products that are needed to develop a roadmap for increasing the supply of quality feed.

8.00 am Registration

8.30 am Opening of the Symposium

•	Representative of the U.S. Agency for International Development
	(USAID) – Dr. Faith Bartz Tarr, AAAS Science and Technology Policy Fellow &
	Agriculture Officer

- Representative of the Bill & Melinda Gates Foundation Ms. Kristen MacNaughtan, Program Officer
- Representative of the Ethiopian Institute of Agricultural Research (EIAR) – Dr. Diriba Geleti, Deputy Director
- Representative of Institute for the Environment and Agricultural Research (INERA) Dr. Oumou Sanon, Deputy Director
- Representative of International Livestock Research Institute (ILRI) *Dr. Alan Duncan, Director General's representative in Ethiopia*
- Representative of the External Advisory Board, Feed the Future Innovation Lab for Livestock Systems *Dr. David Sammons*
- 9.00 am The U.S. Global Food Security Strategy, USAID Multi-Sectoral Nutrition Strategy, and the importance of nutrition sensitive agriculture for the development of Ethiopia Dr. Faith Bartz Tarr, AAAS Science and Technology Policy Fellow & Agriculture Officer, USAID
- 9.20 am Realizing livestock's potential: Why animal feed is critical to achieving our strategic goals

	Ms. Kristen MacNaughtan, Program Officer, Bill & Melinda Gates Foundation
9.40 am	Focus on Feed: USAID and Bill & Melinda Gates Foundation collaboration on feed research and capacity building Dr. Adegbola Adesogan, Director, Feed the Future Innovation Lab for Livestock Systems
9.55 am	Opening of the poster session – Improving supply, fostering demand: Experiences in quality feeds

Session II. Quality Feeds: Roles, Impacts, and Experiences

Chair: Joyce Turk, External Advisory Board Feed the Future Innovation Lab for Livestock Systems

Improving the supply of quality feed can be a win-win strategy that results in improved human nutrition through greater availability of animal-source foods, improved environmental health due to reduced greenhouse gas emissions, and reduced expansion of pasture land due to sustainable intensification of livestock production. However, the gap between the future demand and expected supply of quality feed is growing, as livestock populations grow and pasture resources dwindle. For instance, the Ethiopia Livestock Master Plan notes that, of the main livestock systems in Ethiopia, currently only the agro-pastoral system has sufficient feed resources, and this is only when rainfall is average to higher than average." It also notes that in the business as usual scenario, by 2028, all systems will be deficient in all years. Fortunately, over the past decades, numerous research and development efforts have been conducted on improving the supply of quality feeds, offering an evidence base that can be mined for important lessons.

10.30 am	Keynote address – Improving livestock productivity, nutrition security, and the environment through the food-not feed strategy
	Dr. Harinder Makkar, former Senior Animal Production Officer, Food and Agriculture Organization (FAO); and Private consultant
11.15 am	Mapping feed demand and supply
	Dr. Michael Blümmel, Deputy Program Leader – Feed and Forage Development, ILRI
11.45 am	Improving the supply of quality feeds in Ethiopia: Successes and lessons learned Dr. Adugna Tolera, Professor, Hawassa University and
12.15 pm	Improving the supply of quality feeds in Burkina Faso: Successes and lessons learned Dr. Oumou Sanon, Deputy Director, INERA
12.45 pm	Lunch and poster session continued

Session III. Working Group 1 – Solutions for Increasing the Supply of Quality Feed

Chair: Dr. Harinder Makkar, External Advisory Board Feed the Future Innovation Lab for Livestock Systems

There is no single all-encompassing solution to improving the supply of quality feed and, even on a single farm, a combination of solutions may be required. The working groups in this session will explore the potential to improve the supply of quality feed with proven and novel strategies for different livestock systems and environments. Presenters, responders, and participants will present and constructively critique specific experiences, viewpoints, and alternative approaches. The goal is to identify up to three research themes and three development solutions that should be tackled to improve quality livestock feed supply. The "what," "where," and "how" of each solution should be specified.

2.15 pm

Working Groups

1. Achieving "forage revolution" through improved varieties and seed systems

- Presenters: Dr. Chris Jones and Dr. Jean Hanson, ILRI
- Responder: Dr. Solomon Mengistu, ELAR
- 2. Increasing synergies and impact through dual-purpose crops
 - Presenter: Dr. Tim Dalton, Kansas State University (KSU)
 - Responder: Dr. Fekede Feyissa, ELAR
- 3. Forage quality improvement
 - Presenter: Dr. Michael Blümmel, ILRI
 - Responder: Dr. Salisson Issa, National Institute of Agricultral Research (INRAN)
- 4. Balancing rations for productivity and profitability
 - Presenter: Dr. Barry Bradford, KSU
 - Responder: Dr. Bhola Shrestha, Heifer International Nepal
- 5. Exploiting and preserving the quality of concentrates and by products
 - Presenter: Dr. Asamoah Larbi, International Institute of Tropical Agriculture (IITA)
 - Responder: Dr. Dirk Maier, Iowa State University
- 4.00 pm Working group presentations and discussion
- 5.30 pm Reception hosted by ILRI

Day 2: Thursday January 25, 2018

Session IV. Working Group 2 - Models and Tools for Feed Delivery

Chair: Dr. David Sammons, External Advisory Board Feed the Future Innovation Lab for Livestock Systems

The need for quality feed is increasing due to the rapid increase in demand for animal-source foods and the reduced availability of natural pastures. Models for market-driven feed delivery vary substantially in size, scope, and the types of feeds in question. Feed processing businesses range from microenterprises consisting of a chopper and mixer to much larger plants with sophisticated technology. Cooperative models are unique due to various factors, including perhaps having an easier supply of backward credit. Small-scale urban feed vendors fill a void particularly in the supply of fresh forages. Finally, pastoral lands present their unique challenges given their remoteness, strong reliance on natural pastures, dependence on semi-arid to arid areas, and difficult pathways to intensification. In this session, experiences with these delivery methods as well as tools for mapping feed resources and technologies will be reviewed, along with their strengths and challenges. Focus will be on fostering innovation in feed delivery and recommending research and development actions. The goal is to identify up to three research themes and three development solutions that should be addressed to improve the supply of quality livestock feed. The "what," "where," and "how" of each solution should be specified.

8.30 am Working Groups

1. Mapping resources and targeting technologies: Making the most of FEAST and TechFit

- Presenter: Dr. Alan Duncan, ILRI
- Responder: Dr. Nouhoun Zampaligre, INERA
- 2. Feed microbusinesses and processing plants
 - Presenter: Mr. Seyoum Bediye, ELAR and Ethiopian Animal Feed Industry Association
 - Responder: Mr. Beruk Yemane, Ethio Feed PLC
- 3. Feed supply through cooperatives
 - Presenter: Dr. Carl Birkelo, ACDI/VOCA
 - Responder: Mr. Matthew Karugarama, Zamura Feeds Rwanda
- 4. Urban forage vendors
 - Presenter: Dr. Marjatta Eilitta, Deputy Director, Feed the Future Innovation Lab for Livestock Systems
 - Responder: Dr. Getnet Assefa, ELAR

- 5. Feed reserves and transport to areas of need
 - Presenter: Dr. Lemma Gizachew, FAO
 - Responder: Dr. Michael Jacobs, Mercy Corps

Session V. Ways Forward

Chair: Dr. Michael Jacobs, External Advisory Board Feed the Future Innovation Lab for Livestock Systems

Whereas budgetary resources and policy attention for increasing the supply of quality feeds have been limited in the past decades, this trend is now being reversed in some countries. For instance, the 2015 Ethiopian Livestock Master Plan analyzed current and future trends in demand for livestock products, described feed and other inputs needed to meet the growing demand, and developed roadmaps for key value chains. Such detailed knowledge forms a valuable basis for the development of enabling policies for improving the supply of quality feed. In this final session, factors contributing to such enabling policy frameworks will be analyzed and discussed.

10.15 am	Working group presentations and discussion
11.30 am	Developing an enabling policy framework for ensuring the supply of quality feeds Mr. Seyoum Bediye, Director, ELAR and Ethiopian Animal Feed Industry Association
12.15 pm	Summary Dr. Asamoah Larbi, Country Representative (Ghana), IITA; and External Advisory Board, Feed the Future Innovation Lab for Livestock Systems
12.30 pm	Adjourn

12.30 pm Lunch followed by field trip

Appendix 2 – Speaker Profiles

Adegbola Adesogan

Feed the Future Innovation Lab for Livestock Systems Gainesville, Florida, USA

Dr. Adgebola ("Gbola") Adesogan is the Director of the Livestock Systems Innovation Lab and a Professor of Ruminant Nutrition at the University of Florida. His research interests include sustainable improvement of livestock production, using animal-source foods to improve human health and nutrition, improving forage and feed quality, preservation and safety and using feed additives to enhance rumen digestion and the performance, health and welfare of livestock. Prior to his tenure at the University of Florida, he was an Assistant Professor of Animal Nutrition at the University of Wales, UK. He has served on the editorial boards of various Animal Science journals, mentored several PhD and MS students, and authored or coauthored over 200 scientific publications. He has received various awards for graduate student mentorship and his research as well as the 2017 Nilson Award for leadership.

Getnet Assefa

Ethiopian Institute of Agricultural Research (EIAR) Addis Ababa, Ethiopia

Dr. Getnet Assefa is the Feed Resources and Animal Nutrition expert at EIAR. His research has focused on characterizing animal feed resources in Ethiopia and he has published numerous journal articles on livestock feeds. He is the lead author of the 2016 study titled "Animal feed resources Research in Ethiopia: achievements, challenges and future directions." Dr. Assefa received his MSc from the Swedish University of Agricultural Science and his PhD from Humboldt University of Berlin, Germany. His research has focused on the evaluation of browse trees including quality and nutrition aspects as well as feeding performance.

Seyoum Bediye

Ethiopian Institute of Agricultural Research (EIAR) and the Ethiopian Animal Feed Industry Association Addis Ababa, Ethiopia

Dr. Seyoum Bediye is a senior researcher at the Ethiopian Institute of Agricultural Research. Previously he was the Director of the Livestock Research Directorate under the Ethiopian Institute of Agricultural Research. Dr. Bediye was also formerly the Center Manager of the Holeta Research Center. He is a member of the Ethiopian Feed Industry Development Association and has published extensively on livestock production.

Carl P. Birkelo ACDI/VOCA Addis Ababa, Ethiopia

Dr. Carl P. Birkelo is Chief of Party and lead technical specialist of the USDA Food for Progress supported Feed Enhancement for Ethiopian Development – Phase II (FEED II) project implemented by the U.S. based international development organization ACDI/VOCA. Feed II works to improve the lives and resilience of smallholder and agro-pastoralist households and expand livestock based opportunities through development of feed resources and improved animal nutrition. Dr. Birkelo received his BS degree at California State University – Chico and his MS and PhD degrees at Colorado State University. Previously, he was Associate Professor of Ruminant Nutrition at South Dakota State University and has worked for more than 30 years in commercial livestock production. Dr. Birkelo has worked in Ethiopia for over 8 years through the first and second phases of FEED and is currently managing the startup of Phase III.

Michael Blummel

International Livestock Research Institute (ILRI) Addis Ababa, Ethiopia

Dr. Michael Blümmel is the Deputy Program Leader of Feed and Forage Development at ILRI in Ethiopia. He has a Dr. of Science and a Habilitation degree from the University of Hohenheim and more than 25 years of experience in teaching, development, research ,and research management in Europe, US, Africa and Asia. Dr. Blümmel's major research interests are feeding and feed resourcing at the interface of positive and negative effects from livestock, multi-dimensional crop improvement, crop-livestock interactions, and establishment of equitable feed and fodder value chains.

Barry Bradford

Kansas State University (KSU) Manhattan, Kansas, USA

Barry Bradford is a Professor in the department of Animal Sciences and Industry at Kansas State University. He received his bachelor's degree at Iowa State University, and then went on to obtain his doctorate in animal nutrition at Michigan State University, where his research focused on metabolic regulation of feed intake in dairy cattle. In 2006, Bradford began his current position at Kansas State University with a 60% research, 40% teaching appointment. Bradford oversees an active research program focused on uses of alternative feedstuffs in dairy nutrition, transition cow health, and physiological regulation of carbohydrate and lipid metabolism. He also teaches over 185 students per year as an instructor in Fundamentals of Nutrition, Physiology of Lactation, and Dairy Cattle Nutrition.

Tim Dalton

Kansas State University (KSU) Manhattan, Kansas, USA

Dr. Tim Dalton is a Professor in the Department of Agricultural Economics at Kansas State University and the Director of the Feed the Future Innovation Lab for Collaborative Research on Sorghum and Millet. Dr. Dalton's research and teaching focuses on international agricultural development in less developed countries around the world. He studies how new varieties of sorghum, rice, and maize affect food productivity, production risk management, and nutrition, as well as the impact of natural resource degradation—primarily soils and agricultural biodiversity—on agriculture and human well-being. Dalton has worked in Africa and southeast Asia. Dr. Dalton received his MS in Agricultural Economics from the University of Illinois at Urbana-Champaign and his PhD in Agricultural Economics from Purdue University.

Alan Duncan

International Livestock Research Institute (ILRI) Edinburgh, UK and Addis Ababa, Ethiopia

Professor Alan Duncan is a Principal Livestock Scientist at ILRI and an associate of the University of Edinburgh's Global Academy for Agriculture and Food Security. Dr. Duncan has a technical background in livestock nutrition, but in recent years has become interested in institutional barriers to livestock feed development among smallholder farmers. This has involved him in experimentation with the use of local innovation platforms to catalyze innovation to overcome system level blockages to improved livestock feed issues. Within many of these he has developed and applied the use of simple participatory tools such as FEAST and Techfit to aid identification of appropriate feed development strategies in smallholder systems.

Fekede Feyissa

Ethiopian Institute of Agricultural Research (EIAR) Addis Ababa, Ethiopia

Dr. Fekede Feyissa is the Livestock Research Director at the Ethiopian Institute of Agricultural Research (EIAR). He has a PhD in livestock production and management from the National Dairy Institute, India. Prior to his current role at EIAR he was a Senior Researcher at the Holetta Agricultural Research Center. Dr. Feyissa's research interests are animal feeds and he has published or co-published over 50 scientific papers.

Teshay Gashaw

International Livestock Research Institute (ILRI) Addis Ababa, Ethiopia

Tsehay Gashaw is a knowledge sharing and web communications officer at the International Livestock Research Institute (ILRI). She has more than 15 years of extensive experience in knowledge management, group facilitation, strategic communication, change management, and monitoring and evaluation for agriculture and agricultural research in developing countries. Her comprehensive understanding of communications includes designing, implementation, and adaptation of knowledge management communication strategies and activities; promoting and supporting knowledge sharing and learning approaches; organizing, designing and facilitating co-creation processes both online and offline; designing and facilitating multi-stakeholder workshops and events; and managing and developing social media tools to support innovation processes and platforms. Tsehay holds a Master of Science in information systems management and development from American university of London and Bachelor of computer science from Addis Ababa University.

Gebregziabher Gebreyohannes

Ministry of Livestock and Fisheries Addis Ababa, Ethiopia

Gebregziabher was appointed State Minister for Livestock and Fishery in 2013. He has a profound experience in Ethiopia's livestock sector. He has BSc and MSc degrees from Haramaya University. During his MSc studies, he was a graduate fellow in animal production at ILRI. After gaining research experience in animal production, he completed a PhD in dairy animal breeding at Kasetsart University. He has more than 25 years research experience, and he served in the Oromia and Tigray agricultural research institutes in different research and administrative positions. His most recent position was Director General of the Tigray Agricultural Research Institute. He joined the Board representing the Government of Ethiopia in November 2015.

Diriba Geleti

Ethiopian Institute of Agricultural Research (EIAR) Addis Ababa, Ethiopia

Dr. Diriba Geleti is the Deputy Director General of EIAR. He received his BSc degree from the then Alemaya University, now Haramaya University, in Animal Science in 1986 EC, and has been serving in research management, forage and nutrition research coordination and research activities for the last 23 years. He completed his MSc study in Forage and Nutrition Science at Haramaya University in 1992 EC, and received his PhD in the same discipline from Addis Ababa University in 2006 EC. He has also attended several other training programs at various institutions during his career. During his tenure, Dr. Diriba has made an unreserved effort to share his knowledge and experience with his counterparts, and has authored/co-authored 4 books, 14 book chapters, 18 journal articles and some 50 other articles.

Lemma Gizachew

Food and Agriculture Organization (FAO) Addis Ababa, Ethiopia

Dr. Lemma Gizachew is a Livestock Production Officer at the FAO where he is engaged in crises time livestock emergency feeding, feed development and livestock production interventions geared to benefit farmers, agro-pastoralists, pastoralists, and the private entrepreneurs. In addition, he represents the FAO the country office in national networks and taskforces that focus on livestock feed and feeding systems. Prior to his current role, Dr. Gizachew was the Director of Livestock, Fishery and Apiculture Research Directorate of the Oromia Agricultural Research Institute (OARI) in Ethiopia. Dr. Gizachew has a BSc in Animal Sciences, a MSc in Tropical Agriculture, and a PhD in Grassland Sciences. For over 20 years, he has extensively researched on tropical pasture and forage crops and livestock feeding, and disseminated the research findings via on-farm works, workshops and widely read publications.

Jean Hanson

International Livestock Research Institute (ILRI) Addis Ababa, Ethiopia

Dr. Jean Hanson is a Genetic Resources Specialist at ILRI. She has a PhD from the University of Birmingham (1975) and more than 35 years of experience in seed conservation and genebank management, mostly in developing countries. She has broad experience with conserving, studying, and using forage diversity and is currently project leader for forage diversity at ILRI. She has experience in development of training and knowledge tools and was involved in the development teams for the selection of forages for the tropics and crop genebank knowledge base tools. Dr. Hanson's current research interests at ILRI include management of forage genetic resources, morphological and nutritional characterization, seed production, forage adoption, and knowledge sharing.

Salissou Issa

National Institute of Agronomic Research of Niger (INRAN) Niamey, Niger

Dr. Salissou Issa is an animal nutritionist and the Research Director of the National Institute of Agronomic Research of Niger (INRAN) where he has been working since 1992. He is also the Nutrition Team Leader of the Niger National Center of Specialization in Livestock (CNS-EL) for West Africa. He receiebed his Master in Animal Biology from Cheikh Anta Diop University and his PhD in Animal Nutrition and Industry at Kansas State University. His research focus mainly on monogastric and ruminant nutrition, including cereals grains and forage processing, crops and livestock integration, fodder and animal product value chains, pasture restoration, invasive pasture weeds control and animal breed. In addition, Dr. Issa supervises graduate students and has published over 20 papers.

Michael Jones

Mercy Corps Addis Ababa, Ethiopia

Dr. Michael Jacobs is Chief of Party for the five-year Pastoralist Areas Resilience Improvement through Market Expansion (PRIME) project. By profession, he is a range ecologist with over 27 years of experience working with communities and institutions to identify and help resolve complex socioenvironmental conflicts. He has published on plight of pastoralists in rangelands of Africa and the Middle East, is coauthor on the impacts of conflicts on biodiversity and protected areas and a management plan for Awash National Park, Ethiopia. His most recent positions involved resolving issues related to the extensive livestock production and rangelands for herders and farmers in Afghanistan as Chief of Party for the Pastoral Engagement, Adaption and Capacity Enhancement (PEACE) Project, and curriculum development for the John Garang Memorial University of Science and Technology (JG-MUST) Project in South Sudan.

Chris Jones

International Livestock Research Institute (ILRI) Nairobi, Kenya

Dr. Chris Jones is the Program Leader for Feed and Forage Development, which is a multidisciplinary research program involving a team of plant molecular biologists, physiologists and geneticists, and animal nutrition scientists. His work is directed towards accelerating the genetic improvement of feed and forage species in support of livestock production in developing countries. He has a PhD from the University of Dundee and has researched all aspects of plant biotechnology from academic to highly commercially driven projects. He Joined ILRI in July 2015 from the New Zealand Crown Research Institute, AgResearch.

Matthew Karugarama

Zamura Feeds Musanze, Rwanda

Mr. Matthew Karugarama currently serves as the General Manager of Zamura Feeds-Rwanda's leading processor of animal feeds. As a young entrepreneur, Matthew leverages his vast experience gained at Tyson Foods as well as the skills gained from his studies in Economics at the University of Arkansas to ignite his passion for

agri-business by attracting and managing large portfolios of ag investment in Africa. Matthew is passionate about agri-business because of the sector's capacity to provide sustainable solutions to poverty while improving the food security situation in Africa. In his current role as General Manager at Zamura Feeds in Rwanda, Matthew implements the company's vision of providing farmers with high quality, affordable livestock feed in order to increase their egg, meat and milk yields. As General Manager, Mr. Karugarama also approaches ag investment as an opportunity to build capacity in the protein value chain, support "farmer-preneurs" and create value by raising meat, egg and dairy productivity.

Asamoah Larbi

International Institute of Tropical Agriculture (IITA) Accra, Ghana

Dr. Asamoah Larbi is IITA's Country Representative in Ghana and a Chief Scientist for the USAIDfunded project on Africa Research in Sustainable Intensification for the Next Generation (Africa RISING), West Africa project, based in Tamale, northern Ghana. He holds a PhD from the University of Florida, Gainesville (1989) with a major in Forage Agronomy and a minor in Ruminant Nutrition, MSc in Animal Production and Forage Science (1982), and a BSc in Agriculture, Animal Production (1979). He has worked as a research scientist at the International Center for Agricultural Research in the Dry Areas (ICARDA), 2003 to 2012 based in Aleppo, Syria; and the International Livestock Research Institute (ILRI), then known as the International Livestock Centre for Africa (ILCA), 1989 to 2003 based in Addis Ababa, Ethiopia and Ibadan, Nigeria. Earlier in his professional career, he was a Lecturer at the Animal Science Department, University of Ghana (1982-1986), and an Animal Husbandry Officer (1979-1980) with the Ghana Ministry of Agriculture.

Kristen MacNaguhtan

Bill & Melinda Gates Foundation Seattle, Washington, USA

Kristen MacNaughtan is a Program Officer at the Bill & Melinda Gates Foundation. She leads the Nutritious Food Systems initiative for the Agricultural Development team, which is jointly owned with the Nutrition team. She joined the foundation in 2008 and has worked across a variety of topics on AgDev including ag-nutrition, livestock, ag-finance, extension and advisory services, roots-tubersbananas (RTBs), post-harvest loss, and emergency relief. Prior to the foundation, Kristen worked in both the private and non-profit sectors. She holds an MS in International Development with a concentration in Nutrition & Complex Emergencies from Tulane University.

Dirk Maier

Iowa State University Ames, Iowa, USA

Dr. Dirk Maier's research program focuses on post-harvest engineering applied to grain and feed operations and processing. Projects involve post-harvest loss reduction and prevention, food security, grain operations management, feed technology, post-harvest engineering (crop handling, drying, storage, processing, and loss prevention), value-added processing of agricultural crops and food/feed products, ecosystem modeling, stored products protection (IPM, fumigation), alternative crop storage systems (grain chilling, hermetic storage), dehydration of biological products, bulk material (grain, feed) handling and segregation (IP), quality assurance of agricultural crops and biological products, and facilities planning and design. Dr. Maier's outreach program focuses on crop post-harvest handling, drying, storage, processing and loss prevention, global food and nutrition security, and continuing education and credentialing of industry professionals in the global grain and feed industry. He provides leadership to and teaches a number of distance courses in the GEAPS Continuing Education and Credentials Program.

Harinder Makkar

Independent Consultant Addis Ababa, Ethiopia

Dr. Harinder P.S. Makkar is a private consultant and was formerly a Senior Animal Production Officer with the FAO. Before joining FAO in 2010, Dr. Makkar was Mercator Professor and International Project Coordinator of a Sino-German Project on 'Fuel and Feed for Tomorrow' at the University of Hohenheim, Stuttgart, Germany. He has published over 250 research papers and 8 books in the areas of bioactive compounds and their interactions with livestock, soil, plant and environment; biotechnologies in animal agriculture; use of unconventional feed resources as livestock feed; strategies for enhancing nutrient use efficiency in animal food chains; and generation of value-added products from coproducts of the biofuel industry. He obtained his MSc degree from the National Dairy Research Institute, India and his PhD from the University of Nottingham, UK. He has also worked for the International Atomic Energy Agency in Vienna for 7 years and for the Indian Veterinary Research Institute for 10 years.

Solomon Mengistu

Ethiopian Institute of Agricultural Research (EIAR) Addis Ababa, Ethiopia

Dr. Solomon Mengistu is a senior researcher at the Ethiopian Institute of Agricultural Research (EIAR). Prior to his current role, Dr. Solomon was a forage genetic resources collector at ILRI (then ILCA) and travelled in eastern, central and western Africa for forage germplasm collection expeditions. Dr. Solomon has a PhD in Agricultural Resources and Environment from the University of Jordan and he has authored and co-authored articles and book chapters. His research interests include research project development and leadership in livestock and feed resources, crop/livestock integration, development of forage crop varieties and practices, technology adoption surveys including designing data collection tools and data analysis, and climate change impact assessment, mitigation and adaptation strategies. Prior to his current role, Dr. Solomon was a forage genetic resources collector at ILRI and travelled throughout Africa for forage germplasm collection expeditions.

David Sammons

University of Florida Gainesville, Florida, USA

David Sammons, the retired Dean of the University of Florida (UF) International Center, holds a PhD (1978) in Agronomy from the University of Illinois and an AM in Biology from Harvard University. During his career he served as Director of International Programs in the UF Institute of Food and Agricultural Sciences, held an appointment as Senior Advisor for University Relations in the Office of Agriculture at USAID/Washington, served as Associate Dean and Director of International Programs in Agriculture at Purdue University, and was Professor of Agronomy at the University of Maryland. He spent a sabbatical as a Fulbright Senior Fellow at Egerton University in Kenya and has served on the Boards of both ICARDA and the World Vegetable Center. Dr. Sammons is currently Chair of the External Advisory Board of the Feed the Future Innovation Lab for Livestock Systems. A fellow of the American Society of Agronomy, he has authored over 170 scientific articles and seven books/book chapters.

Hadja Oumou Sanon

Institute of Environment and Agricultural Research (INERA) Ouagadougou, Burkina Faso

Dr. Hadja Oumou Sanon is the Deputy Director of INERA. She has a PhD from the Swedish University of agricultural Sciences and her research interests are fodder resources characterization, the improvement of fodder production, the promotion of fodder crops, and the valorisation of local resources in animal feeding including the use of fruit residues. She is also interested in the analysis of the production systems and the meat value chains. Dr. Sanon has several publications: about 20 scientific articles in peer-reviewed journals, 15 communications or posters presented at international conferences and a dozen of fact sheets. In addition to her research activities, Dr. Sanon contributes to the training of the students from the Universities and professional Schools in Burkina Faso, through courses and thesis supervision.

Bhola Shankar Shrestha

Heifer International Nepal Kathmandu, Nepal

Bhola S. Shreshta, is a Senior Program Manager at Heifer International Nepal. He has an MS degree in Tropical Animal Production and Health from the University of Edinburgh, Scotland and his research interests are in Livestock Production Management and Animal Breeding. Prior to his current role, Mr. Shrestha was Senior Scientist and Division Chief of Animal Breeding Division, Nepal Agricultural Research Council. He has contributed mostly in genetic improvement of dairy animals in the country and currently working for productivity improvement through better nutrition management of dairy animals. He has coauthored books on Goat Production and published more than 30 papers in journal, national and international workshop proceedings and technical working papers. He has been awarded as "Most Outstanding Principal Investigator" in a Korean funded AFACI (Asian Food and Agriculture Cooperation Initiatives) project dealing with Animal Genetic Resources.

Faith Bartz Tarr

United States Agency for International Development (USAID) Addis Ababa, Ethiopia

Faith Tarr joined USAID in 2014 as an AAAS Science and Technology Policy Fellow, International Agricultural Advisor, and Technology Scaling Advisor. She is currently based in Addis Ababa, Ethiopia, and previously served in Washington D.C. at the USAID Bureau for Food Security. Faith has a PhD in Plant Pathology from North Carolina State University, and managed food safety research and graduate student training during a post-doctoral position at the Emory University Rollins School of Public Health before joining USAID. Prior to her graduate studies, Faith gained private sector research and development experience in human and animal health and nutrition at Chr. Hansen, Inc. Faith's loves of food, the natural world, and learning led her to the fields of agriculture and food safety. Her passion for sharing knowledge drives her to advance science to serve society, fostering evidence-based policy and practice for positive impacts on agricultural productivity, human, and environmental health.

Adunga Tolera

Ethiopian Institute of Agricultural Research (EIAR) Addis Ababa, Ethiopia

Dr. Adugna Tolera is a professor of animal feeds and nutrition at Hawassa University. He has a PhD degree in Animal Nutrition from Agricultural University of Norway. Adugna had short term research experiences at Rowett Research Institute, UK, Langston University, USA and Norwegian University of Life Sciences, Norway. From December 2007 to September 2011, he worked for Texas A&M University as a Livestock Production Specialist for the Ethiopia Sanitary & Phytosanitary Standards and Livestock & Meat Marketing Program (SPS-LMM). From November 1, 2016 up to April 30, 2017 he worked as a senior researcher at Ethiopian Institute of Agricultural Research (EIAR) with key responsibilities of leading preparation of Animal Feeds and Nutrition Research Strategy. His research and development work experience focuses on animal feeds and nutrition, livestock production systems, feedlot design and management, feeding and management of meat and dairy animals, rangeland management and climate change.

Joyce Turk

Independent Consultant Washington D.C., USA

Ms. Turk's career spanned thirty-six years as Foreign Service Officer and Civil Service employee for USAID with focused experience in agricultural and livestock program management after serving as a livestock advisor in the U.S. Peace Corps-Philippine Islands. She has managed a multi-million dollar portfolio of livestock projects and the implementation of research activities and teams, analyzes the feasibility of technical proposals and negotiates terms of reference, evaluates international research programs, coordinates strategic portfolio planning, and has organized and chaired international and domestic symposia on global livestock production and trade. Ms. Turk is an invited speaker at annual meetings of the American Association of Bovine Practitioners, American Veterinary Medical Association, and the American Society for Animal Science as well as to university classes. She has published numerous papers for USAID reporting as well as for public access through Elsevier, CAB International, UN-FAO and in proceedings of meetings. International consultancies have included the FAO, IFAD, OIE/World Organization for Animal Health, European Union, the International Atomic Energy Agency, and among others. USAID livestock programs in over 33 countries worldwide. She is a multi-year recipient of USAID's Meritorious Performance Awards and is listed in Who's Who of American Women.

Beruk Yemane

Ethio Feed PLC Addis Ababa, Ethiopia

Beruk Yemane did his post graduate study in Range Management, majoring in Range Nutrition from New Mexico University, New Mexico, USA. He has served in government with the former Relief and Rehabilitation Commission and Ministry of Agriculture in different positions. In addition, he has worked for Oxfam Great Britain, an international non-governmental organization, as senior pastoral program manager, coordinating national and cross border projects for ten years. In the last ten years, he has been managing a private commercial animal feed manufacturing company, specializing in innovate feed solutions.

Nouhoun Zampaligre

Institut de l'Environnement et de Recherche Agricoles (INERA) Bobo Dialsso, Burkina Faso

Dr. Zampaligré is a rangeland management and livestock production systems INERA researcher hosted by CIRDES in Bobo Dioulasso. He holds an MSc in livestock nutrition from the Polytechnic University of Bobo Dioulasso and a PhD in agricultural sciences from the University of Kassel, Germany. He boasts solid grounding of the impacts of climate change on natural resource management and local adaptation to climate change in West Africa. Dr Zampaligré has published ten peer review articles in academic journals, including Environment Development and Sustainability, Journal of Agricultural Studies, Regional Environmental Change and the Journal of Animal Science. In 2013, he was awarded a junior postdoctoral grant by the Volkswagen foundation to pursue his research in Burkina Faso. He is currently involved in the Local Governance and Adapting to Climate Change in Sub-Saharan Africa project in Kenya and Burkina Faso funded by USAID.