

## USAID Livestock Discussion Paper FINAL VERSION 6-30-14

### Context

The U.S. Agency for International Development (USAID) Bureau for Food Security (BFS) implements the Feed the Future initiative as the United States' contribution to a collaborative global effort supporting country-owned processes and plans for improving food security. BFS has developed the Food Security Innovation Center (FSIC) to implement the Feed the Future Research Strategy through its seven programs. A key partner in the FSIC programs are the 24 Feed the Future Innovation Labs (formerly called Collaborative Research Support Programs or CRSPs). The Innovation Labs engage U.S. universities and colleges in collaboration with developing country research partners to conduct agricultural research and human and institutional capacity (HICD) in support of joint U.S.-host country food security goals.

The Feed the Future Innovation Lab for Adapting Livestock Systems to Climate Change falls under the FSIC Program for Research on Nutritious and Safe Foods. This Program links research on the production and processing of safe, nutritious agricultural products to a learning agenda on household nutrition, including the utilization of and access to fruits, vegetables, meat, fish, dairy and legumes with the goal of preventing under-nutrition, especially in women and children, improving child survival, and securing family investments in agriculture.

As the current Adapting Livestock Systems to Climate Change Innovation Lab ends in April 2015, BFS seeks to develop a new Innovation Lab that defines a livestock-focused research agenda which enhances livelihood possibilities and food security while attending to key value chains and agricultural development priorities identified by USAID Missions in the framework of Feed the Future priorities. BFS will host a web-based Livestock AgExchange July 28 – August 1 to solicit global, public input in defining key research and capacity development priorities which BFS will use to help inform the development of the new Innovation Lab.

USAID's efforts to date suggest several important lessons for future investments. Livestock research must attend to *country- and region-specific value chains* that drive local and national agricultural productivity and combat food insecurity. This supports USAID's focus on country-led programs and can be accomplished in part through close coordination with USAID Mission and local stakeholder priorities. However, understanding the *challenges and opportunities present in broad production systems* – for example, mixed crop and livestock systems or pastoralist systems – constitutes an important research agenda. Investigation of *innovative strategies* to enhance productivity and sustainability of the most widespread mixed crop and livestock systems represents a key research priority. In addition, connecting research findings to concrete and *applied development interventions* while addressing the role of policy in the livestock system remains a critical need. *Impact pathways* must be identified and pursued as a particular objective of funded projects. Experience to date also highlights the need to create and design research projects that *integrate cross-cutting themes of gender, nutrition and environment* from the design to dissemination stages. Keeping the global donor landscape in view will maximize research benefit by *filling research gaps* in existing programs and taking

advantage of synergies in research investments. Finally, *sustainability* must serve as a core objective for both development technologies and practices and capacity development initiatives.

The Feed the Future Research Strategy recognizes that international efforts to decrease poverty and improve food security for poor households and communities must include a focus on the livestock sector. The majority of the world's poor (as much as 70%) derive part or all of their income from livestock keeping, a conclusion supported by numerous studies over the past 20 years.<sup>1</sup> While many researchers hold that livestock sector growth is demand driven, a recent study demonstrates that livestock sector development can be one of the preceding conditions for increased national as well as household incomes.<sup>2</sup> Mixed crop-livestock systems provide approximately half of the world's food supply,<sup>3</sup> demanding research on smallholder livestock production to alleviate hunger and provide equitable and sustainable livelihood opportunities.<sup>4</sup> Key research areas to support global food security improvements include assessment of constraints on livestock sector development such as environmental impact, fodder and water availability, animal health services, and market access in both mixed crop-livestock and pastoralist systems.

The challenges posed by climate change to global agriculture and food supply manifest themselves in particular ways in livestock production, necessitating research on both adaptive strategies and resilience for small-holder farmers as well as mitigation of the environmental impacts of livestock production. The complex and key role of livestock keeping in pro-poor, equitable and climate-smart development requires investment in research to develop better policies, technologies and development programs. This paper outlines several key areas of research as a starting point for discussion on a targeted research investment focused on livestock and development in the Feed the Future context.

### **Global investments in livestock sector for pro-poor development (FAO, World Bank, EU, IFAD, and other donors such as Gates Foundation)**

USAID investments must also be made with an awareness of the global investment landscape in the field of livestock and development. A constellation of bilateral and multi-sectoral donors support initiatives focused on pro-poor development in the livestock sector, including the World Bank, EU, IFAD, Gates Foundation, and others. For instance, the CGIAR Research Program on Livestock and Fish, led by ILRI, has focused on several key themes: biotechnology research; markets, gender and livelihoods; and people, livestock and the environment.

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<sup>1</sup> Delgado, C. et al. 1999. *Livestock to 2020: The Next Food Revolution*. International Food Policy Research Institute Food, Agriculture and the Environment Discussion Paper 28 (May).

<sup>2</sup> Pica, G., Pica-Ciamarra, U. and Otte, J. 2008. *The Livestock Sector in the World Development Report 2008: Re-assessing the Policy Priorities*. Pro-Poor Livestock Policy Initiative Research Report RR Nr 08-07 (August).

<sup>3</sup> Herrero, M.; Thornton, P.K.; Notenbaert, A.M.; Wood, S.; Msangi, S.; Freeman, H.A.; Bossio, D.; Dixon, J.; Peters, M.; Steeg, J. van de; Lynam, J.; Rao, P.P.; Macmillan, S.; Gerard, B.; McDermott, J.; Seré, C.; Rosegrant, M. 2010. Smart investments in sustainable food production: revisiting mixed crop-livestock systems. *Science*. v. 327(5967). p. 822–825.

<sup>4</sup> Smith, J., Tarawali, S., Grace, D. and Sones, K. 2013. Feeding the world in 2050: Trade-offs, synergies and tough choices for the livestock sector. *Tropical Grasslands - Forrajes Tropicales* 1(2): 125-136.

A mapping initiative undertaken by ILRI, FAO and other partners offers a visual and dynamic representation of the ‘livestock revolution’:

In developing countries, by 2050 demand for meat and dairy products is expected to rise by 73% and 58%, respectively, from their 2010 levels. This growth is driven not only by population increase — the world population will grow from 7.2 billion today to 9.6 billion in 2050 — but also by changing consumption patterns linked to increasing wealth and urbanization.<sup>5</sup>

The increased availability of this type of data on a global scale – together with numerous local and regional studies and data on consumption and production trends - offers new opportunities to analyze linkages between livestock systems, environmental change, human and animal health, and migration patterns. This example illustrates how understanding the global context can shape USAID’s investments and help to define a niche for this research portfolio.

## Key Issues for Discussion

### Climate Change

Climate change with its associated weather variability and changes in temperature and water availability impacts on livestock production systems (e.g., pre- and post-harvest mycotoxin contamination, altered crop nutrients, crop/fodder production levels, altered disease vectors, precipitation patterns). Research in specific production systems can link the production and processing of safe, nutritious agricultural products to these climate-related developments. The vulnerability of households to climate change-related food insecurity depends upon the susceptibility of different types of livestock to acute and chronic climate-related stress. Susceptibility depends, in turn, on innate characteristics of the animals but equally on the feasibility of mediating climate stress, for example via shade trees. Research can illuminate the multiple pathways whereby climate induced stresses link to crop and livestock production, as well as interventions that can occur at the farm, landscape, and country scale. Key questions:

- ***What adaptation strategies assist small holders in maintaining livestock-based livelihoods in the face of increasing climate variability?***
- ***What are effective mitigation strategies for the impact of livestock production systems on climate (e.g., cattle supply chain)?***

### Gender

Gender operates as a critical factor in all aspects of livestock keeping as a form of social, cultural and economic differentiation. Understanding women’s roles and responsibilities with respect to livestock and identifying systems and practices conducive to gender equality remain

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<sup>5</sup> <http://news.ilri.org/2014/05/30/new-maps-for-navigating-a-sea-of-changes-in-livestock-production/>

central challenges for development research. Gender roles influence access to and control over livestock resources as well as the forms of work undertaken by women and men. Questions of land ownership and access, livestock ownership, gendered mobility patterns (e.g., can women travel independently to care for animals, access markets, etc.), household divisions of labor and children's work in agricultural systems require gender analysis.

Several important research questions:

- ***What constraints operate to limit women's livelihoods and income generation in the livestock sector? How does gender structure production and marketing practices in the livestock sector?*** Understanding specific gendered constraints on women as livestock keepers remains critical to livestock sector development. Among the important considerations, research can illuminate gender-disaggregated use of technology and services and gendered ownership and control of resources. Specific concerns include animal and land ownership and access, decision making roles (animal products, sale and earnings), gendered production practices (who does which forms of work and cares for which animals, who pays for expenses such as vaccination and feed), access to inputs and to markets, time use (e.g., cattle keeping is time intensive – balance with other time demands), mobility.

- ***How do family systems and structures interact with livestock production?*** Beyond roles associated with men and women, kinship structures and conceptions of childhood influence how families and communities undertake livestock management. Research designed to illuminate community-specific expectations for the forms and location of girls' and boys' labor can play a key role in formulating gender-sensitive development technologies and practices.

- ***What approaches maximize capacity building for women as livestock keepers?*** Gender norms impact the ability to build women's capacity in the livestock sector. Research can shape effective capacity building initiatives through analysis of how women's mobility affects their ability to get livestock-related care, education and income as well as investigating any gendered and specialized knowledge concerning livestock keeping. In addition, research on widely used development strategies such as cooperatives and veterinary services and training must be evaluated with a gender lens in order to engage women in education activities, input access, and income generation.

## **Nutrition**

Nutrition as a core dimension of food security demands attention to the utilization, consumption and safety of animal-source foods as well as the nutritional value of livestock products in the context of environmental stress and change. The roles played by human and livestock microbiomes, and their relationships to health and disease, feed efficiency, productivity, sanitation and hygiene represents a related and crucial research area. Future nutrition research efforts should link to the USAID *Multi-Sectoral Nutrition Strategy, 2014-2025* and its focus on alleviating chronic under-nutrition (as measured by stunting) as well as supporting nutrition in the 'first 1000 days' of children's lives. An 'enabling environment'

including central components related to gender equality, women's empowerment and girls' education represents another emphasis of the newly released strategic framework.<sup>6</sup>

Among the key questions researchers might address:

- ***What is the relationship of consumption of animal source foods (ASF), especially livestock products, to child nutritional status and cognitive development?*** Research efforts can illuminate links between livestock production and dietary quality, particularly increased ASF consumption and its effects on child nutritional status, growth, and cognitive development. Recent studies in Ethiopia,<sup>7</sup> Nepal,<sup>8</sup> and Kenya<sup>9</sup> demonstrate increased children's ASF consumption connects to gains in cognitive development and nutritional status.
- ***What effects do enteric pathogens have on livestock and human health?*** Growing interest in the role of livestock health in human nutrition suggests a focus on how livestock management practices affect the number of pathogens shared between livestock and children in livestock-holder households as well as implications for children's health and nutritional status. Specifically, how can links between diet, human and livestock microbiomes, and livestock production be exploited to improve the value of ASFs?
- ***How can utilization of ASFs, specifically livestock products, improve nutrition outcomes?*** Knowledge, attitudes, and cultural practices (KAPs) may constrain consumption of livestock products (e.g., milk and meat). For example, intra-household food allocation patterns may limit milk intake among the most vulnerable groups such as women and children. A better understanding of population and culture-specific KAPs will facilitate development of effective social and behavioral change strategies (e.g., using mass media and other methods to increase consumption of livestock products for improved nutrition outcomes).
- ***What linkages exist between agro-technologies and improved nutrition outcomes?***

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<sup>6</sup> USAID. 2014. *Multi-Sectoral Nutrition Strategy, 2014-2025*.

[http://www.usaid.gov/sites/default/files/documents/1867/USAID\\_Nutrition\\_Strategy\\_5-09\\_508.pdf](http://www.usaid.gov/sites/default/files/documents/1867/USAID_Nutrition_Strategy_5-09_508.pdf)

<sup>7</sup> The *Milk Matters* report revealed that, in Ethiopian pastoral zones where small-scale livestock interventions were introduced, child consumption of animal milk increased and child nutritional status stabilized compared to children in control sites. A related key economic finding was that the direct costs of small-scale livestock interventions was approximately 45-75% less than the estimated costs for therapeutic feeding programs to manage child acute malnutrition.

<sup>8</sup> Neumann et al (2007) found that primary school children in Nepal fed a local plant-based dish supplemented with meat showed the steepest rate of increase on cognitive tests while among school age children fed the same dish but with a milk, rather than meat, supplement, only younger and stunted children showed a greater rate of gain in height. These findings suggest a relationship between type of protein source and linear growth patterns. Furthermore, ASFs are a highly bioavailable form of protein and micronutrients which can affect linear growth and cognitive development.

<sup>9</sup> A study in Kenya (Whaley et al, 2002) found that increased ASF consumption, specifically meat more so than milk, is positively associated with child cognitive development.

Little is known about the nutritional effects of technology adoption in smallholder livestock systems compared with smallholder crop systems. More robust understandings of the effects of interventions to improve livestock systems (e.g., introduction of improved dairy cow breeds, complementary feeding of dairy animals, and good animal-health practices) on nutrition outcomes are needed. Understanding whether and how improved livestock systems improve household nutrition is essential for informed policymaking.

- **How can market-based solutions around ASFs improve nutrition outcomes?** Research in collaboration with the Global Alliance for Improved Nutrition (GAIN) and other groups on market-based solutions (e.g., as effective packaging and marketing of ASFs) can respond to the increasing demand generated by communication campaigns around nutrition.

## Policy

Feed the Future's policy guide identifies several key policy areas: institutional architecture for improved policy formulation, enabling environment of private sector investment, and policy related to agricultural trade, land and natural resources, resilience and risk management, and nutrition, along with the cross-cutting area of gender. The livestock value chain spans the spectrum from agricultural inputs to market access and trade. One promising research approach would follow policy for a specific livestock system from start to finish to assess policy impacts regarding land, water, the private sector, agricultural inputs, resilience, nutrition, trade and gender. Research on livestock policy could address priority areas including:

- **How can livestock policy serve in a supportive role to other critical policy areas such as nutrition, thereby enhancing the policy environment for food security and poverty reduction?** Research investments in livestock policy can directly (e.g., nutritional value of livestock as a consumed food source is well supported<sup>10</sup>) and indirectly (e.g., policy supporting livestock value chain improvement) add value to nutrition policy. Enforcement of stronger policies regarding animal disease prevention also offers increased food safety and reduces potential negative impacts on nutrition through disease transmission. Policy in the areas of land, agricultural inputs, gender and trade will also impact the livestock value chain.

- **How can livestock policy enhance resilience and reduce risk for vulnerable populations?**

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<sup>10</sup> Animal source foods (ASF) are an irreplaceable supply of vitamins and micronutrients during Feed the Future's identified critical development period of the first 1000 days from conception through two years of age. ASF may be vital to Feed the Future's indicator addressing reduction in the prevalence of anemia among women of reproductive age through the provision of iron, thereby improving maternal and child health and nutrition. Micronutrients found in ASF such as milk, meat, and eggs are more bioavailable than from crops. ASF provide 15% of total food energy and 25% of total dietary protein. The biological value of animal source protein is 1.4 times that of plant foods. Natural unsupplemented B12 is found only in ASF. The combination of these micronutrients in ASF provides synergistic effects unable to be replicated with supplementation Smith, J., Sones, K., Grace, D., MacMillan, S., Tarawali, S., & Herrero, M. (2013, January). Beyond mlk, meat and eggs; Role of livestock in food an nutrition security. *Animal Frontiers* , pp. 6-13. There are strong statistical associations between the intake of ASF and improved growth, cognitive function and development, activity, pregnancy outcome, and morbidity Neumnn, G. G., Bwibo, N. O., Murphy, S. P., Marian, S., Whaley, S., Allen, L. H., et al. (2003). Animal Source Foods to lprove Micronutrient Nutrition and Human Function in Developing Countries. *The Journal of Nutrition* , 3941S-3949S..

Resilience policy efforts are complex and multi-faceted, with livestock policy integral to addressing risk and vulnerability. In Africa, both in the Horn and the Sahel, where considerable effort is devoted to strengthening resilience to shocks, a considerable proportion of the population maintains livestock interests through pastoralist or conventional livestock practices. Including pastoralists in policy development requires creating inclusive dialogue to generate relevant policy solutions. Research on policies for livestock value chain development can help livestock keepers maintain the value their animals represent. Livestock policies can also augment resilience through improving livestock animal health (e.g., optimizing prices for healthier animals) and addressing the impact of conflict on livestock keepers (e.g., transhumance patterns and routes in conflict zones).

• ***How can livestock policy support agricultural input, trade and land and resource use policies?*** Agricultural input policy addresses needs for inputs, such as seed and fertilizer, to increase outputs and productivity for farmers. In livestock systems, such inputs help to increase agricultural productivity and in turn feed and forage quantity and nutritional quality for livestock. Policies supportive of livestock will also help agricultural inputs (e.g., livestock manure serves as readily available and no-added-cost fertilizer). Addressing livestock policy issues such as pharmaceuticals, vaccinations, feed and supplementation should be considered a component of agricultural inputs. Research that engages with government livestock authorities can help protect input pathways and integrity. Identifying policy environments inclusive of private sector groups providing livestock inputs will encourage their involvement.

Similarly, trade in livestock and animal products represents a key area for policy-focused research and collaboration. Transboundary animal diseases and animal product quality and food safety issues highlight the need for cooperation on Sanitary and Phytosanitary Standards (SPS) projects. Research and capacity development initiatives in this area can complement work by African organizations such as the African Union's InterAfrican Bureau for Animal Resources (AU-IBAR) focusing on both animal health and production systems. Policy interventions have the potential to create space for dialogue on humane livestock practices. Land and natural resources policy also offers great potential benefit to the livestock sector through understanding how land use and ownership policies and shared water and other community resources impact livestock keepers.

• ***What is the economic impact of improved livestock policy?*** To support implementation of policies supportive of livestock sector development, research can demonstrate the economic impact of policy changes. For example, policies promoting control of transboundary animal diseases can result in decreased costs for animal health services and loss of livestock. Research into policies that have led to unintended negative consequences in the livestock value chain and those that have conversely eliminated barriers to development of smallholder livestock systems supports the Feed the Future mission.

## Value chains and markets

Feed the Future programs have focused on key value chains defined in national contexts. Research will improve understanding of these value chains and how productivity and income can be improved at various points ranging from inputs to markets.

- ***What barriers exist to market access in a region or production system?*** Research can enhance access to livestock and ASF markets by exploring gendered mobility constraints, conflict situations, and land ownership patterns. Key issues include food safety and storage, transportation, water and fodder availability and quality, and processing of livestock products.

- ***How can intensive production for commercial markets/upgraded markets be encouraged to improve income generation? Which production models promise small holders access to upgraded markets?*** Investigation of inputs and services needed to support production for upgraded markets can provide poverty reduction solutions. The context of increasing global demand and climate change provides opportunities for research on models for private sector engagement with local extension systems to promote smallholder-friendly approaches. Strategies to intensify mixed crop/livestock systems so that farmers can sell to maturing markets while maintaining benefits of a diverse system will improve access and income.

- ***How can value chains be enhanced to maximize income for livestock producers?*** Research focused on priority value chain analysis – identified in collaboration with local stakeholders – can identify opportunities to provide improved income streams for farmers.

## Animal health and disease

While promoting health and mitigating disease in livestock is an obvious research focus for this portfolio, the One Health concept suggests a broader array of concerns incorporating human and animal health issues as well as the interactions among environmental factors (especially climate change), health and disease. Key focus areas include:

- ***What are effective strategies for livestock disease identification and prevention (nutrition and health management practices, vaccination, animal genomics for disease resistance, worming)?*** Vaccination is the most effective tool for disease prevention. For many livestock diseases in low- to middle-income countries, there are no available and affordable vaccines. Disease surveillance and diagnosis also present significant challenges in regions with vast pastoralist livestock systems and little access to veterinary services and laboratories. Additionally, constraints such as lack of an existing cold chain affect vaccine distribution. Projects focused on developing thermostable vaccines, field-friendly diagnostic tests, and animal health management practices can provide new tools to combat livestock disease.

Breeding livestock for genetic resistance to disease and environmental factors like heat stress offers a complementary approach to vaccination in minimizing disease. Research focused on developing genomic tools to aid in breeding/selecting animals for disease resistance is needed. Research can also identify practices and structures in animal health services delivery (availability, affordability, capacity) that demonstrate positive impact on livestock sector development and livestock keeper food security and income.

- **How does climate change impact livestock production systems in specific ways (altered disease vectors, mycotoxins, altered nutrient uptake, heat stress)?** Climate change can negatively affect livestock productivity by inducing heat stress in animals, reducing the availability and nutrient content of fodder, and expanding the habitat of disease vectors. Research on the scope of the effects of climate change on livestock systems as well as ways to mitigate the effects of climate change on livestock production are needed.

- **What is the role of animal health and zoonoses in livestock production systems (One Health)?** Research can show how the interconnectivity of the environment, animal health, and human health affects smallholder livestock production. A focus on disease highlights zoonotic diseases and their impact on humans from a health and livelihood perspective, as well as environmental dimensions. The incidence of zoonoses fluctuates with changes in ecosystems, animal management practices, and intensification of livestock production systems.

## Future Directions: Research Dimensions

In designing the next generation of BFS-supported livestock research, several overarching issues demand consideration.

### Breadth vs. depth

**Problem-focused or broadly thematic?** Purpose-driven research, often focused on a specific development problem, is a very beneficial aspect of Feed the Future Innovation Labs. Research investments must balance problem-focused projects with more broadly thematic initiatives that evaluate issues impacting multiple scales or regions.

**Systems perspective vs. particular value chains?** What does it mean to take a systems perspective on livestock research? What are the payoffs of each form of research?

**Geographic focus (Feed the Future countries, others)?** Does a focus on Feed the Future countries alone represent the best investment by concentrating resources in a way that can have a significant impact on poverty and food insecurity?

**Whole-of-government context (NSF, other USG investments)?** This new program must build upon other investments, especially in basic research but also other applied contexts, undertaken by the U.S. Government (e.g., NSF and USDA).

**Niche in global donor context?** Feed the Future livestock sector research and capacity development must strive to complement, not duplicate, existing investments by other global donors.

### Adaptation and mitigation (time horizon)

Climate change represents a key challenge facing poor livestock keepers, particularly in arid and semi-arid regions. Short-term strategies for adaptation by livestock keeping communities must be one research focus. However, a longer time horizon, with research questions emphasizing mitigation of livestock sector and related impacts on climate change, should be balanced with

more immediate results to ensure sustainable solutions. Considering the balance between these potentially competing priorities will be an important aspect of program design.

### **Agro-ecological systems (production practices)**

Approaches to improving food security vary dramatically in different types of livestock production systems. Understanding production practices and challenges in broad system types constitutes a fundamental research agenda. Future efforts must identify focus and balance to effectively address livestock sector development across three major system types.

- ***Dryland livestock systems***
- ***Mixed crop/livestock systems***
- ***Intensive production for upgraded markets***

### **Future Directions: Implementation Dimensions**

#### **Knowledge dissemination and technology scaling for development impact (Feed the Future Food Security Innovation Center)**

High quality research identifying solutions (practices and technologies) must reach the poor farmers who are its intended beneficiaries. BFS seeks input to develop effective strategies to disseminate and scale research outputs for maximum uptake and development impact.

#### **Capacity development needs**

Feed the Future Innovation Labs include core capacity development components to reduce and ultimately eliminate donor dependence. Capacity development issues include local farmer/community needs (attending to women and hard-to-reach communities), host country scientists (emphasizing recruitment, training, retention of women), national research and policy institutions, and vocation-technical schools and universities. Local capabilities must be identified and strengthened.

#### **Effective partnerships (Missions, private sector/investors, donor community, NGOs, small holder farmers)**

The Feed the Future Research Strategy calls for partnership and collaboration with U.S. and local university communities, the global donor community, international, regional and national NGOs and IGOs, USAID Missions, civil society organizations, implementing partners including extension agents, health service providers, and private sector partners as well as national agricultural research institutes, farmers and community members. Research efforts must identify key partnership opportunities as a means to leverage investments.

#### **Building communities of practice**

Researchers and practitioners in related areas (related geographies, production systems, or research fields) benefit greatly from sharing findings and lessons learned. Effective Feed the Future research initiatives should include elements of support for building communities of practice and integrating host country participants in sustainable ways.

## Resources

Barrett, M. and Osofsky, S. 2013. One Health: The Interdependence of People, Other Species and the Planet. In Jekel, J., Katz, D., Elmore, J. and Wild, D., editors, *Jekel's Epidemiology, Biostatistics, Public Health and Preventive Medicine*. Philadelphia, PA: Elsevier Inc.

Colverson, K, S McMillan, D Odongo. 2014.

Delgado, C. et al. 1999. *Livestock to 2020: The Next Food Revolution*. International Food Policy Research Institute Food, Agriculture and the Environment Discussion Paper 28 (May).

FAO, 2013. Understanding and integrating gender issues into livestock projects: a checklist for practitioners: <http://www.fao.org/docrep/018/i3216e/i3216e.pdf>

Gender & Agricultural Assets Project: <http://gaap.ifpri.info/findings/> (BRAC, HKI, Land O' Lakes have livestock elements)

Herrero, M. et al. 2010. Smart investments in sustainable food production: revisiting mixed crop-livestock systems. *Science*. v. 327(5967). p. 822–825.

ILRI. 2014. "Celebrating International Women's Day: Gendered Challenges and Opportunities in Livestock Value Chains." <http://livelihoods-gender.ilri.org/2014/03/07/celebrating-international-womens-day-gendered-challenges-and-opportunities-in-livestock-value-chains/>

Neumann, G. G., Bwibo, N. O., Murphy, S. P., Marian, S., Whaley, S., Allen, L. H., et al. (2003). Animal Source Foods to Improve Micronutrient Nutrition and Human Function in Developing Countries. *The Journal of Nutrition*, 3941S-3949S.

Pica, G., Pica-Ciamarra, U. and Otte, J. 2008. The Livestock Sector in the World Development Report 2008: Re-assessing the Policy Priorities. *Pro-Poor Livestock Policy Initiative Research Report RR Nr 08-07* (August).

Smith, J., Tarawali, S., Grace, D. and Sones, K. 2013. Feeding the world in 2050: Trade-offs, synergies and tough choices for the livestock sector. *Tropical Grasslands - Forrajes Tropicales* 1(2): 125-136.

Smith, J., Sones, K., Grace, D., MacMillan, S., Tarawali, S. & Herrero, M. 2013. Beyond milk, meat, and eggs: Role of livestock in food and nutrition security. *Animal Frontiers* (January) 3:1 (6-13). doi: 10.2527/af.2013-0002

World Bank. 2009. *Gender in Agriculture Sourcebook*. <http://www.genderinag.org/content/gender-agriculture-sourcebook>

USAID. 2014. *Multi-sectoral Nutrition Strategy, 2014-2025*.  
[http://www.usaid.gov/sites/default/files/documents/1867/USAID Nutrition Strategy 5-09 508.pdf](http://www.usaid.gov/sites/default/files/documents/1867/USAID_Nutrition_Strategy_5-09_508.pdf)

USAID. 2011. *Feed the Future: Global Food Security Research Strategy*. May.