

Modelling framework for improved Livestock Master Plans

Karl M Rich¹, Sirak Bahta¹, An Notenbaert², Alary Veronique³, Paul Birthe², Dolapo Enahoro¹,
Abdrahmane Wane³, Valls-Fox Hugo³ Isabelle Baltenweck¹ and Barry Shapiro¹

1 International Livestock Research Institute

2 International Center for Tropical Agriculture (CIAT)

3 French Agricultural Research Centre for International Development (CIRAD)

May 2020




©2020 International Livestock Research Institute (ILRI)

ILRI thanks all donors and organizations which globally support its work through their contributions to the [CGIAR Trust Fund](#)



This publication is copyrighted by the International Livestock Research Institute (ILRI). It is licensed for use under the Creative Commons Attribution 4.0 International Licence. To view this licence, visit <https://creativecommons.org/licenses/by/4.0>.

Unless otherwise noted, you are free to share (copy and redistribute the material in any medium or format), adapt (remix, transform, and build upon the material) for any purpose, even commercially, under the following conditions:

 **ATTRIBUTION.** The work must be attributed, but not in any way that suggests endorsement by ILRI or the author(s).

NOTICE:

For any reuse or distribution, the licence terms of this work must be made clear to others.

Any of the above conditions can be waived if permission is obtained from the copyright holder.

Nothing in this licence impairs or restricts the author's moral rights.

Fair dealing and other rights are in no way affected by the above.

The parts used must not misrepresent the meaning of the publication.

ILRI would appreciate being sent a copy of any materials in which text, photos etc. have been used.

Editing, design and layout—ILRI Editorial and Publishing Services, Addis Ababa, Ethiopia.

Cover photo—ILRI/Zerihun Sewunet

Citation: Rich, K.M., Bahta, S., Notenbaert, A., Veronique, A., Birthe, P., Enahoro, D., Wane, A., Hugo, Valls-Fox., Baltenweck, I. and Shapiro, B. 2020. *Modelling framework for improved Livestock Master Plans*. Nairobi, Kenya: ILRI.

Patron: Professor Peter C Doherty AC, FAA, FRS

Animal scientist, Nobel Prize Laureate for Physiology or Medicine—1996

Box 30709, Nairobi 00100 Kenya

Phone +254 20 422 3000

Fax +254 20 422 3001

Email ilri-kenya@cgiar.org

ilri.org

better lives through livestock

ILRI is a CGIAR research centre

Box 5689, Addis Ababa, Ethiopia

Phone +251 11 617 2000

Fax +251 11 667 6923

Email ilri-ethiopia@cgiar.org

ILRI has offices in East Africa • South Asia • Southeast and East Asia • Southern Africa • West Africa

Contents

1. Introduction	1
2. Overview: why conduct a Livestock Master Plan?	1
3. What do Livestock Master Plans seek to achieve?	1
4. ILRI's experience in the development of Livestock Master Plans	2
5. The process for developing Livestock Master Plans	2
6. Updates to the LMP process	4
7. Limitations of current Livestock Master Plans	5
8. Proposed future directions: the role of the POLICIES project	6
9. References	9

1. Introduction

The following document provides an overview of current progress on proposed improvements to Livestock Master Plans (LMPs). It first reviews current protocols and rationales for conducting LMPs to guide sector investment strategies, including past applications in different settings. It also provides details on the Livestock Sector Investment and Policy Toolkit (LSIPT) platform that has historically been the backbone of the LMP process and some of the limitations found in its use. The document provides details of upcoming enhancements to the next generation of LMPs, in part conceived through a consortium approach to the development of LMPs with the Food and Agriculture Organization of the United Nations (FAO) and the French Agricultural Research Centre for International Development (CIRAD), facilitated by funding for new modelling platforms through the POLICIES project.

2. Overview: why conduct a Livestock Master Plan?

The purpose of producing an investment roadmap or Livestock Master Plan is to attract more substantial and better targeted livestock sector investment from finance ministries, development partners and private sector investors. Chronic underinvestment in the livestock sector is a major constraint for the livestock sector, which often contributes more than crop agriculture to national development goals. In addition, agriculture or livestock ministers lack solid evidence such as returns on investment to obtain financial resources for livestock development from ministries of finance. There is also a need for stronger human capacity for quantitative livestock sector planning to inform decision-making. Effective livestock development requires sector analysis to understand current situations and predictive analysis to set long-term strategies and design action plans. Finally, governments need realistic action plans to meet targets in five-year national economic development plans.

The LMP process enables livestock ministries to accomplish this by identifying needed investments and policies to develop the livestock sector and carrying out foresight or ex ante investment analysis to document and demonstrate the potential returns on investment (ROI) of combined livestock technologies and policies that increase the livestock sector's contribution to reduction of greenhouse gas emissions, mitigation of climate change and poverty eradication.

3. What do Livestock Master Plans seek to achieve?

Livestock Master Plans (LMP) seek to provide policymakers, private investors and development partners with packaged evidence on:

1. current contributions and constraints of the livestock sector;
2. potential of the sector to contribute to national development objectives;
3. priority livestock commodities and value chains and proposed investment options (combining both technologies and policies); and
4. impact of targeted investments in livestock on the economic performance and livelihoods in the sector.

4. ILRI's experience in the development of Livestock Master Plans

At the request of the national governments of Ethiopia, Tanzania, Rwanda, Uzbekistan and the state of Bihar in India, the LMP team at ILRI helped carry out fact-based, realistic financial planning together with livestock ministries in the respective countries to produce an LMP. These comprise of a Livestock Sector Analysis (LSAs) of current situations and trends, a long-term (15-year) forecast on the impact of proposed livestock sector strategies (LSS), and a medium-term (5-year) investment plan or roadmap (Michael et al. 2018; Shapiro et al. 2015; Shapiro et al. 2018).

Previous LMPs have proved successful in helping generate greater investments in livestock research and development. In Ethiopia, the government, donors and development partners (e.g. the Bill and Melinda Gates Foundation (BMGF), the European Union (EU), the Netherlands, New Zealand, USAID and the World Bank) are investing in the implementation of the LMP and preparing programs or projects to help fund future investment in the sector. For instance, the Ethiopian government is investing its own budget and other resources to improve primary livestock production through improved animal genetics and vaccination programs to lower ruminant morbidity and mortality. It is also supporting efforts to add value to processed livestock products by setting up four agroindustrial parks with the support of the EU and FAO. Furthermore, private investment of more than USD250 million in the processing sector has taken place, including an investment of USD145 million in two abattoirs by two meat export companies with large feedlots. The Government of Ethiopia and the World Bank have also just launched a USD170 million livestock sector program based on the LMP.

In Tanzania, planning for the implementation of the LMP as part of the national Agricultural Sector Development Plan II (ASDP II) is still ongoing by a newly created Ministry of Livestock and Fisheries (MLF). In both Tanzania and Ethiopia, BMGF is currently funding more than USD50 million in genetics research and development programs for the poultry and dairy subsectors, with ILRI implementing the research program.

In Rwanda, the government is now planning its next national economic development plan using insights from its LMP, while in Uzbekistan, the government and the World Bank have developed a USD150 million sector investment plan informed by the Livestock Sector Analysis conducted for the country.

5. The process for developing Livestock Master Plans

Developing an LMP includes the following sets of activities.

1. Initial assessment and identification of coalition for change at country level.
2. Analysis of livestock systems and household level analysis (including typology; modelling for technical, economic and financial analysis of livestock systems; identification, typology and socioeconomic analysis at household levels (gender, labour distribution, resilience to shocks, etc.) and analysis of identified specific livestock sector themes at production/household levels.
3. Assessment of livestock value chains (typically qualitative) and national level impacts (economic, poverty, food safety and nutrition).
4. Consolidation of the analyses and assessments done into a Livestock Sector Analysis (LSA) addressing the current situation, past and present trends and identification of key factors that affect the evolution of the sector.
5. Development of a livestock sector strategy with ways forward; scenarios; policy options; and analysis of impacts, benefits, costs and tradeoffs associated with jointly defined objectives in order to identify future orientations for livestock development.
6. Development of a 5-year Livestock Master Plan with commodity value chain "roadmaps".

7. Promotion and advocacy of the LSA and LMP, as well as fundraising and helping to organize the implementation of the LMP.

Traditionally, the Livestock Sector Investment and Policy Toolkit (LSIPT) has been used to develop the LMP comprising the Livestock Sector Analysis, a long-term livestock sector strategy and a five-year investment roadmap or LMP. LSIPT was developed under the direction of ALive, the partnership for Africa Livestock Development, Poverty Alleviation and Sustainable Growth in Africa (www.ALive-online.org). ALive, housed in the African Union-Interafrican Bureau for Animal Resources (AU-IBAR), spearheaded the development of LSIPT with technical support from CIRAD, the World Bank and FAO.

LSIPT is a suite of tools for quantitative methods that can be used to build livestock herd dynamics models and a bioeconomic livestock sector model (LSM), which in turn enables in-depth and systematic quantitative analysis of major constraints facing the livestock sector. The result of this analysis can then be used for carrying out scenario analysis of the ex ante impacts of proposed interventions (technologies and policies) on economic growth, poverty alleviation and other development objectives (employment, equity, etc.). LSIPT can also be used to test technology interventions for improving primary productivity on farm, to carry out quantitative diagnostic value chain assessments to identify the most economically and socially attractive post-harvest investment options to add value to livestock sector products, or to test the ex ante impacts of changes in policies and institutions.

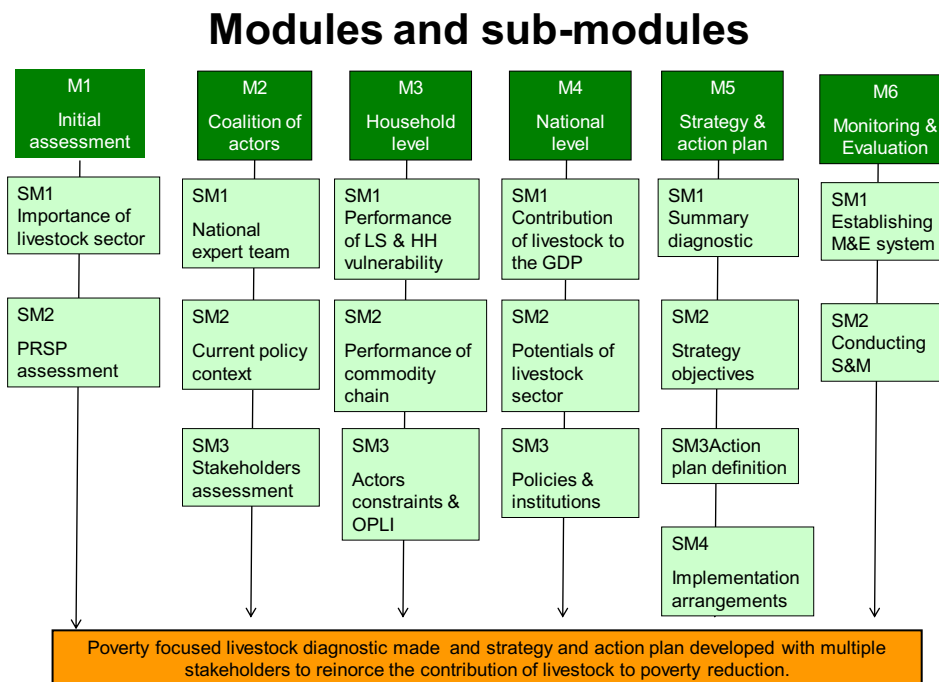
While the direct economic functions of livestock are generally understood, accounting for the contribution of livestock production to households and the national economy is not an easy undertaking. The ALive toolkit helps circumvent these difficulties through a rigorous characterization of production systems and livestock-based phenomena. It starts with a situation analysis of the livestock sector and links households, livestock production systems and regional and/or national livestock activities. It further offers the possibility to analyze a baseline scenario at each of these levels and conduct scenario analysis or evaluate the impact of an intervention, disease shocks, technological uptakes, etc. (Dutilly et al. 2011; Alary et al. 2014).

LSIPT integrates micro, meso and macro analysis for quantitative and qualitative assessment of household vulnerability; the role of livestock in forming poverty reduction strategies; and the contribution of livestock to the overall economy. It accounts for the multiple functions of livestock, including their cultural importance, contribution to food security and nutrition and supply of draught power and manure for soil fertility.

LSIPT provides a systematic framework for organizing accessible quantitative data (mostly from secondary sources) and includes tools to carry out analyses which help to understand the production potential of the sector and its contribution to agricultural and overall economic growth (GDP), as well as reduction in rural poverty and food insecurity. Furthermore, LSIPT enables the visualization of alternative technology and policy scenarios to gauge the supply response of potential government investments in research and extension (such as technologies that impact on feed availability, animal health, etc.), as well as private sector investments of over 5 to 15-year projection periods. The scenario analysis is transparent and easy to understand, and thus useful policymakers and development investors. Moreover, analysis of potential impact from changes in key aspects of policy, such as the enactment of food quality standards and regulations required to compete in formal markets (including export markets), can also be evaluated with the ALive toolkit.

The core elements of LSIPT are modules 3, 4 and 5 as shown in figure 1. Module 3 assesses the productivity at household, value chain and production system levels. These micro and mesa data figures are then consolidated and extrapolated to the national level in module 4. Once this database is established, the participatory tools of module 5 can be used to identify—together with all stakeholders—the priority sectors, target groups and the most effective technology and policy interventions to ensure optimal use of scarce human and financial resources. Once the interventions are identified, financial, economic and social impacts can be rapidly assessed using the database established in modules 3 and 4. Finally, using the tools, mutually agreed implementation arrangements can be established.

Figure 1: Modules and sub-modules of LSIPT



Key data needed for module 3 and 4 include:

1. a typology of the main production systems in the country with respective number of livestock keeping households
2. livestock performance data for each production system, with a breakdown by age group and sex, reproductive performance, mortality by age group and sex, average milk production, and live weight and carcass weight
3. a breakdown of costs and margins in the value chains for the different commodities
4. household survey data on consumption patterns of livestock source foods, livestock ownership and income from other activities (crops, off farms activities, etc.). (Income data from livestock related activities are not essential because they are generated by LSIPT, but they are useful for validation of findings)
5. dry matter yields of grass and crop lands (for crop residues) of the main agroecological zones

Available data and parameters required for the herd models would be collected from secondary sources—published papers, consultancy reports, as well as other “grey” literature. Any remaining gaps would be filled through consultations with national experts. Available survey data collected by the Central Statistics Bureaus and research organizations in the respective countries will be used as input for the household survey data. However, this data needs to be assessed to determine how representative it is, and any gaps needing to be filled in.

6. Updates to the LMP process

Since September 2018, the preparation and delivery of new LMPs has been conducted through the engagement of a consortium of institutions comprising ILRI, FAO and CIRAD. This consortium plays upon the collective strengths and experiences of each institution in the use of LSIPT, as well as expertise in areas of economic modelling, sector analysis, capacity building and advocacy. ILRI, FAO and CIRAD have partnered within a consortium to continue the promotion and development of LSIPT and are working together to further enhance their application in different settings.

So far, this consortium model has been applied in the development of LMP concept notes for Nepal and Kenya, with the former likely to begin in early 2020. The consortium approach to the LMP process expands the remit of previous LMPs to include the following activities:

1. assessment of livestock value chains using quantitative value chain tools developed by ILRI;
2. assessment of climate change at household, value chain and national levels using FAO's GLEAM model;
3. analysis of identified specific sector themes seeking to (a) provide specific details about the current status quo; (b) identify constraints and areas of technical and/or policy intervention in consultation with stakeholders; (c) develop a set of potential best practices on these thematic areas. Each thematic area will be presented in a technical note of three to five pages describing the current situation and trends and proposing policy options and recommendations for the future; and
4. use of multisector modelling that pay particular attention to issues of gender and household distributional issues in the context of developing the LSA.

The enhancements proposed in consortium LMPs address some of the shortcomings associated with the LSIPT toolkit that are detailed in the next section. They also provide additional information that is missing from past LMPs, particularly in the context of climate change and gender.

7. Limitations of current Livestock Master Plans

A weakness of the LSIPT framework used in current LMPs is its limitations in modelling changes in and evolution of markets, trade and value chains as a result of proposed investment options, particularly in the design of livestock sector strategies that compute returns to a range of scenarios over a projected 15-year period. Gender and climate change are also not given sufficient emphasis due to the limited flexibility inherent in the LSIPT platform, nor are considerations of digital readiness and financial inclusion that can mediate uptake. The addition of new and complementary models to the suite of LMP tools would add more robust, fit for purpose modelling platforms that generate a wider range of scenarios and analyses to guide investments and improve uptake. Moreover, given the implementation of LMPs is often made at national rather than regional levels, models that are sensitive to regional phenomena and variations are of critical importance.

At the value chain level also, there is a need to assess more rigorously targeted investment options within LMPs. The current suite of value chain tools within LSIPT operate at a fairly high level of aggregation considering only national level value chains, when in fact there may be multiple value chains operating at different temporal or spatial levels. Within past LMPs, value chain analyses have typically been qualitative in orientation, which reduces the ability to quantify short- and long-term returns from specific interventions.

ILRI has pioneered the use of system dynamics models in a variety of livestock settings in Asia, Africa and Latin America to build scenarios that assess the dynamic ex ante returns associated with various technological, policy and market-led interventions in the livestock sector. These models are built at a finer level of resolution (regional or local) than sector-based models and can integrate value chain processes alongside their contextual drivers (e.g. markets, environment, animal health, institutions and gender). As they are dynamic, they further consider feedback between the value chain and its contextual drivers, revealing important insights that might differ in the short run vs long run, which might influence uptake of specific interventions for different value chain actors. As ex ante decision support tools, they can guide the choice of interventions to be implemented and monitor their effectiveness over time. ILRI has also pioneered the use of participatory platforms to create models with value chain stakeholders to identify and co-design locally grounded intervention options, bringing science closer to client groups. ILRI's work in the pig value chain in Myanmar, where such models are informing the choice of intervention strategies to be facilitated through producer organizations and value chain finance, is an exciting application of this approach. Nonetheless, there is a critical need for the development of rapidly deployable and standardized templates that can be utilized across a number of different value chain contexts.

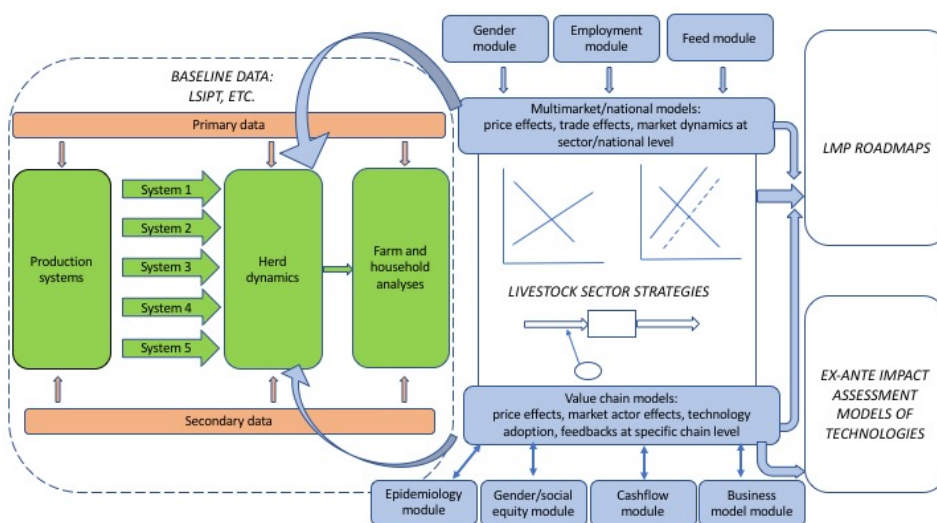
8. Proposed future directions: the role of the POLICIES project

With the support of BMGF, ILRI recently received funding to enhance its suite of economic impact assessment and investment modelling tools for LMPs in support of generating more robust analyses of livestock investment scenarios that take into account both economic impacts (GDP growth, return on investment, sectoral income and employment) and noneconomic ones (specifically, gender and social equity). The development of this proposal was supported in part through supplemental funds allocated from the CGIAR Research Program on Livestock.

The proposal states that the goal of the activity entitled Policy Options for Livestock Investment, Capacity Improvement and Equitable Solutions (POLICIES) is to identify and support sustainable investment that drive equitable livestock growth and development in target countries. Through the development of a suite of readily deployable models which are web-hosted, focus on sector and value chain levels, have indicators and monitoring tools, and incorporate strategies for their institutionalization at country and regional levels, POLICIES will provide the necessary infrastructure to support local, national and regional livestock decision-making in policy spheres, particularly for LMPs. Parallely, it will contribute to the design of suitable technological and policy packages across commodity platform research at ILRI.

In the first phase of the project (November 2019–April 2021), POLICIES will develop two sets of generic ex ante impact assessment models at sector and value chain levels. Figure 2 below highlights how these two types of models work together in the context of LMPs and ex ante impact assessment models of technologies. LMPs have traditionally followed the collection of baseline data using the LS IPT toolkit to parameterize models of herd dynamics and farm and household models. At present, this data is used in an ad hoc manner to develop livestock sector strategies, projecting over different scenarios based on strong assumptions (fixed prices, lack of market adjustments, etc.). The approach proposed here considers two sets of models—a multimarket model that generates sector-level evidence (i.e. at the level of a national production system) on how prices, trade and livestock/feed markets adjust to different investment options¹ and a value chain model that looks at specific value chains of interest to consider how different technological interventions influence marketing and behavior of different value chain actors, and the path of success (as well as constraints) to their adoption. The combination of both types of information will generate more comprehensive LMP roadmaps to guide sector strategy and specific value chain investments. An important innovation in POLICIES will be to add modules of gender, social equity, finance, employment and business models to each of these sets of modules to consider both economic and noneconomic factors associated with impact.

Figure 2: Conceptual framework for POLICIES



¹ More detail can be found in a companion document, “Progress report on Livestock Master Plan modelling innovations”.

The sector-level model will comprise a spatial multimarket model of the national livestock sector that is disaggregated across different regions that would integrate gender (in production, consumption and labor), use of feed and employment as additional modules to the analysis. The initial template for such a model would be the livestock sector model developed by Rich and Winter-Nelson (2007) to analyze the dynamic effects of foot and mouth disease across different regions in South America. As a linkage to LMPs, the sector-level model would use baseline LSIPT data as input while tailoring livestock sector strategies (LSS) to use these new tools to run scenarios of alternative investment options. In this way, the new sector-level model would replace the current ad hoc approach to LSS development with a more rigorous platform that encompasses economic and noneconomic dimensions of impact. A further innovation within this modelling is to couple herd dynamics with economic behavior, allowing herd growth to be influenced by sector investment rather than deterministically assumed. The 2020 activities of the CGIAR research program on Policies, Institutions, and Markets (PIM) will go parallelly with POLICIES linking herd models (as found, for instance in LSIPT) to other analytical approaches, including partial equilibrium and economywide models.

The second set of models to be developed is a set of standardized value chain models which can be used in LMPs to augment the qualitative approach to value chains in LSIPT at both national and regional levels. Templates for such a model include Dizyee et al. (2019) of the dairy sector in Tanzania, the model of Dizyee et al. (2017) of the beef sector in Botswana and Ouma et al. (2018) of the pig sector in Uganda. In this exercise, standardized modules of herd growth, value chain marketing and stakeholder profitability will be developed based on a review of previous modelling exercises which can be applied across different livestock sector contexts. In addition, specific modules that can be added as needed and which are associated with disease spread, institutional models (e.g. the use of different business models such as producer groups and cooperatives), gender (particularly in terms of control of assets and allocation of labor), and finance will be created and linked to core value chain modules. Participatory processes will be used to support module development and help parameterize data for pilot testing.

The two sets of models provide complementary information at different levels of resolution, with the multimarket model highlighting inter-sectoral effects across production systems and regions and the value chain models showing specific details at a stakeholder level in a given commodity chain. Both models are derived from the herd model used in LSIPT, allowing for common data collection for information in the supply side. From the standpoint of delivering advice on investment strategies, the two models provide alternative and complementary perspectives, with the multimarket model at macro level focused on national/regional level investment across the livestock sector as a whole and the value chain models going in greater detail focused on more targeted investment on a particular species.

The sectoral model will be initially parameterized to previous LMP/LSIPT data to test its robustness. We further anticipate that additional LMPs will be requested, including in Nepal, Kenya, Guinea and Gambia. As such, we will use the opportunities presented by these LMPs to apply these models (in part or in whole) readily available to deploy at the time of LMP implementation to those LMPs to inform the development of LSS and policy roadmaps. As the LMP requests for Guinea and Gambia will likely provide less resources than standard LMPs, we will also explore the possibilities of using the new tools in a type of “LMP-lite” that links more targeted data collection to our multimarket and value chain models independent of the data intensive LSIPT framework given the team’s past experience in constructing robust multimarket/value chain models in more data constrained environments.

POLICIES will also outline a prioritization process in identifying countries for LMP-type investments and a post-LMP engagement and implementation process which aims at mentoring and enabling countries prioritized for LMP investment to develop and implement plans to successfully achieve LMP goals. This activity will thus define objective modalities that highlight which donors can best invest in LMPs; establish a comprehensive and fit for purpose post-LMP engagement process to support implementation plans of LMP investments based on government needs and priorities, including brokering relationships with relevant national and international organizations to provide support, advocacy, and training based on comparative advantage; develop capacity in policy modelling and foresight analysis; design programs and policy and institutional reform; assist with resource mobilization; and link relevant research and development activities of ILRI conducted under other components as relevant.

A critical part of this activity will be cultivating potential partnerships across research and technical institutions that can provide post-LMP support and finding mechanisms to enhance the strength of the consortium between ILRI, FAO and CIRAD.

9. References

- Alary, V., Dutilly, C., Bonnet, P., Lesnoff, M. and Juanes, X. 2014. *The Livestock Sector Investment and Policy Toolkit (LSIPT) diagnostic phase*, manual 2. CIRAD.
- Dizyee, K., Baker, D. and Omoro, A. 2019. Upgrading the smallholder dairy value chain: a system dynamics ex-ante impact assessment in Tanzania's Kilosa district. *Journal of Dairy Research* 1–10.
- Dizyee, K., Baker, A.D. and Rich, K.M. 2017. A quantitative value chain analysis of policy options for the beef sector in Botswana. *Agricultural Systems* 156: 13–24.
- Dutilly, C., Alary, V. and Bonnet, P. 2011. *Pro-poor policies and the livestock sector: the experience of the ALIVE livestock sector policy and investment toolkit (LSIPT)*. CIRAD.
- Michael, S., Mbwambo, N., Mruttu, H., Dotto, M., Ndomba, C. et al. 2018. *Tanzania livestock master plan*. Nairobi, Kenya: International Livestock Research Institute (ILRI).
- Ouma, E., Dione, M., Birungi, R., Lule, P., Mayega, L. and Dizyee, K. 2018. African swine fever control and market integration in Ugandan peri-urban smallholder pig value chains: an ex-ante impact assessment of interventions and their interaction. *Preventive Veterinary Medicine* 151: 29–39.
- Rich, K.M. and Winter-Nelson, A. 2007. An Integrated Epidemiological-Economic Analysis of Foot and Mouth Disease: Applications to the Southern Cone of South America. *American Journal of Agricultural Economics* 89(3): 682–697.
- Shapiro, B.I., Gebru, G., Desta, S., Negassa, A., Nigussie, K. et al. 2015. *Ethiopia livestock master plan*. ILRI Project Report. Nairobi, Kenya: International Livestock Research Institute (ILRI).
- Shapiro, B.I., Singh, J.P., Mandal, L.N., Sinha, S.K., Mishra, S.N. et al. 2018. *Bihar Livestock Master Plan 2018–19 to 2022–23*. Bihar, India: Government of Bihar.



The International Livestock Research Institute (ILRI) works to improve food and nutritional security and reduce poverty in developing countries through research for efficient, safe and sustainable use of livestock. Co-hosted by Kenya and Ethiopia, it has regional or country offices and projects in East, South and Southeast Asia as well as Central, East, Southern and West Africa. ilri.org



CGIAR is a global agricultural research partnership for a food-secure future. Its research is carried out by 15 research centres in collaboration with hundreds of partner organizations. cgiar.org