



Photo: Stevie Mann (ILRI)

# Livestock-related research in CGIAR: what do we know of the impacts?<sup>1</sup>

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## Key messages

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- An estimated US\$1 billion has been invested by the CGIAR in livestock-related research since 1990, and yet it has substantially underinvested in economic, social, and environmental impact assessments (IAs) of this work.
- The critical review of livestock-related research confirms the limited range, reach and depth of the *ex-post* IAs (*eplAs*). For example, while significant IA has been conducted in the area of technology adoption and management practices of service related aspects to livestock production (e.g. feed, technology), analyses of value chains, livestock production technology, or topics related to livestock and the environment, are absent from the studies. The integration of research across CGIAR Centers and Research Programs in a system-wide framework for livestock research could provide an opportunity to develop an advanced, systematic process of implementing and conducting *eplAs*.
- Another important finding that emerges from the review is the need to incorporate methodological advances in *eplAs*, and to apply measurable benefits and effects in a returns to investment analysis framework.
- Out of 159 IA studies identified by the CGIAR Centers involved in livestock-related research, only 12 met the criteria for uptake, outcomes, and impacts of livestock research.
- Ten of the 12 IA studies found positive returns to livestock-related research and interventions. However, with the exception of one study that examined a global intervention, most of the studies are context specific and provide only modest evidence of global impact. A larger set of micro-level case studies examine the link between the adoption of livestock technologies/practices and direct farm-level impacts, and some of these may offer useful analysis.

1. This brief is based on: Jutzi, S.C. and Rich, K.M. 2016. An Evaluation of CGIAR Centers' Impact Assessment Work on Livestock Related Research (1990-2014). Rome: Standing Panel on Impact Assessment (SPIA), CGIAR Independent Science and Partnership Council (ISPC). 69 pp. The foreword on the study by the SPIA Chair is included in the full report.

## Background

Animal agriculture is a key component of global food systems. Increased demand for livestock products, the prominence of livestock as a significant household asset, particularly for women, and the contribution of livestock emissions to climate change are all critical issues. Livestock-related research is a key area of CGIAR research efforts and encompasses a broad range of activities (see Box 1). However, compared with other research areas (e.g. crop germplasm improvement), livestock-related CGIAR research has been under-evaluated in terms of impact assessment (IA). To address this issue, the CGIAR Independent Science and Partnership Council's (ISPC) Standing Panel on Impact Assessment (SPIA) commissioned a system-wide review of IAs of livestock-related research.

This brief summarizes the findings and recommendations of the critical review of livestock research IAs<sup>1</sup>. Critical reviews such as this are intended to encourage new IAs for livestock research and to provide recommendations for improving IA quality.

## Scope of the review

All CGIAR livestock-related research IAs completed since 1990 were reviewed to:

- Estimate total investment in livestock research dating back to 1990.
- Summarize impacts documented by the more reliable IA studies.
- Pinpoint areas requiring attention for future adoption and IA studies.

## Investment in livestock-related research

Considerable financial resources – around US\$1 billion – have been allocated to CGIAR livestock and livestock-related research since 1990. Most of this work – an investment of US\$869.9 million – has been funded through the International Livestock Research Institute (ILRI). Besides ILRI, nine CGIAR Centers were approached to assess the share of their budgets allocated to livestock research in the

### Box 1. Defining livestock-related research

The critical review applied the following definitions for livestock-related research:

- Animal genetic resources (farm animals): diversity, breeding, management, and use.
- Animal and veterinary public health, including food safety.
- Animal feed and nutrition (feed grain crop development, feed-food crop development, forages/pastures, food crop development [investments in maintaining/enhancing feed value of straws and other by-products], multi-purpose trees for feed, supplements, animal nutrition).
- Livestock production systems; crop-livestock production systems; range/pasture management.
- Commodities (milk, meat, eggs, hides and skins, non-food; processing/value adding, market, trade, retail); manure (crop fertilization, fuel); animal traction (transport, tillage).
- Livestock-sector policy (institutions/organizations, legislation, environment, health, markets, trade, services, credits, subsidies).
- Livestock and society/economy (GDP, poverty/equity, gender, resilience, non-food dimensions).
- Animal-source food and human nutrition and health.
- Natural resource management in livestock production; livestock and the environment.
- Livestock and climate change.

five 5-year periods since 1990. Agricultural Science and Technology Indicators (ASTI) data from the International Food Policy Research Institute (IFPRI) was used as a reference. A more thorough, but tedious, historical analysis of the budgets of other Centers might help achieve more precision in resource allocation. But US\$1 billion was considered a sufficient benchmark for the purpose of this review.



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## How were IA cases for the review identified?

All CGIAR Centers and CGIAR Research Programs (CRPs) were asked to submit a list of relevant IAs. In total, 159 studies were submitted, of which only 12 met the review criteria for *ex-post* IAs (*ePIAs*), with nine originating from ILRI and three from the International Center for Agricultural Research in the Dry Areas (ICARDA) relating to drylands and small ruminants (see Table 1).

The studies were considered eligible when they satisfied at least four out of five IA criteria identified by donors as high priority in a 2014 SPIA survey:

1. Reliable and representative data on yields, incomes, other outcomes and benefit-cost analyses.
2. Reliable and representative data on adoption.
3. Adequate justification and reasonableness of impact pathway.
4. Sound attribution of benefits to research and, if relevant, attribution to specific institutions.
5. Transparent and reasonable assumptions.

In addition, only studies that included information on returns to investment were considered eligible, including those using the 'gold standard' methodology often applied in the context of *ePIAs* – the use of economic surplus models. Such models estimate sector-level benefits through the calculation of producer surplus, and allow direct and indirect impacts to be more rigorously teased out. These sector-level benefits are subsequently weighed against intervention costs (as a means of providing guidelines on the returns), and summarized through investment metrics such as net present value (NPV), internal rate of return (IRR), and/or benefit-cost ratios (BCRs).

Thus, the review did not qualify as *ePIAs* a few otherwise acceptable CGIAR IA studies<sup>2</sup> that failed to weigh the outcomes/impacts measured (e.g. adoption rates, learning rates) in a framework that allows donors to assess the costs associated with the benefits achieved. Nonetheless, some of these excluded studies contribute important elements of impact, which may have to be incorporated in future IA work (see *Promising innovations and programs for IAs*, p.8).

2. See Appendix 5 of the review for a list of these studies.

**Table 1. Overview of livestock research IA studies**

ILRI projects and countries	Research and/or intervention and investment (US\$)	Timeframe
1. Operational research program for more effective <b>control of Highly Pathogenic Avian Influenza (HPAI)</b> in Indonesia, focusing on the returns and cost-effectiveness of HPAI mass vaccination campaigns delivered in 2008-2009	2,891,823	2008-2009
2. Impact of the Smallholder Dairy Programme in Kenya, which focused on <b>liberalizing informal milk marketing</b> and documenting the policy processes associated with the intervention	5,000,000	1997-2005
3. Impact of genetically improved, dual-purpose <b>cowpea</b> adoption in West Africa	20,000,000	2000-2009
4. Ex-post impact of the World Bank's intervention on <b>HPAI</b> in Nigeria	41,000,000	2006-2010
5. Impact of establishing <b>fodder banks</b> , supplementing dry season feed resources, by agro-pastoralists in West Africa	41,758,000 (of which 7,226,000 devoted to fodder banks)	1975-1997
6. Ex-post impact of <b>rinderpest eradication</b> , focusing on two case studies in Chad and India	Global costs >610 million	Incurred through eradication in 2011
7. Impact of <b>broad bed maker (BBM)</b> technology innovations in Ethiopia	63,600,000	1986-2008
8. Ex-post impact of the role of the <b>BBM plow</b> in Ethiopia for surface draining of readily water-logged Vertisols in the highlands	Included in above cost (7)	As above
9. Impact of various projects on the <b>improved management of goat production</b> in the Philippines	A\$7,490,000	1999-2007
ICARDA projects and countries	Research and/or intervention and investment (US\$)	Timeframe
1. Impact of <b>spineless cactus in alley cropping</b> in Tunisia	Not reported	1999-2004
2. <b>Natural resource management technologies</b> in crop-livestock systems in Tunisia and Morocco	Not reported	1991-1995 (introduction costs) 1999-2015 (dissemination costs)
3. Impact of Mashreq/Maghreb project: use of <b>spineless cactus in alley cropping</b> in Tunisia	Not reported	1994-2004



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As indicated by studies that use propensity score matching (PSM) or randomized control trials (RCTs), there is an important shift in CGIAR livestock research in trying to more rigorously examine household-level impacts associated with interventions. These types of studies are noteworthy in their application, by both economists and non-economists alike, to examine a diversity of livestock research domains, though there are significant differences in the quality of PSM/RCT studies.

The assessment of what constituted an ePIA does not necessarily preclude the use of other measures to compute benefits. For example, for some livestock domains (e.g. food safety, animal health, value chains), the strict computation of producer welfare measures may not fully reflect the benefits associated with an intervention.

## Impacts of CGIAR livestock-related research and investments in IAs

A number of important points emerge from the 12 studies identified as eligible ePIA studies:

- **Focus of IAs:** A significant number of IAs have been conducted in the areas of technology adoption, management practices of service-related aspects of livestock production (e.g. feed, technology), and crop/livestock systems. Eight of the 12 studies focused on these themes, with three examining the impact of animal disease interventions (e.g. rinderpest and avian flu), and one examining commodity marketing (milk).
- **IA methodologies:** Economic surplus methods<sup>3</sup> for conducting ePIA were used in six studies. Two of the animal health studies on avian flu (HPIA) used rudimentary cost-benefit techniques, while the rinderpest study and three ICARDA studies utilized a mix of bio-economic and standard economic models to calculate impacts.

3. Suggested reading: SPIA foreword of the review.

4. Strong returns to investment in terms of IRR and NPV were reported in the Kenya dairy study (US\$230 million, projected over 1997-2039), dual-purpose cowpea (US\$606 million projected over

- **Rates of return to research investment:** Other than the two studies on adoption of the broad bed maker (BBM) – a type of plow for clay surface soil drainage – all IAs revealed positive returns to livestock research/interventions, with an estimated IRR of 6-71 percent<sup>4</sup>. Considering the application of economic surplus methods in many of the IA studies, these reported benefits are likely to be a significant underestimate of the impacts of investment downstream, and do not factor in externalities associated with the uptake of livestock technologies. This confirms the complexity and difficulty in systematically and effectively disentangling various economic, social, and environmental impacts (direct and indirect) once a technology is adopted at a significant scale.



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a 20-year period), parasite control (A\$65 million, or approximately US\$50 million, projected over 1999-2030), and rinderpest in Chad (CFA 32 billion, or approximately US\$50 million at farm-level over 1963-2002).

- **Research domains in IAs:** The selected IA studies did not include analyses of the critical areas in livestock research such as: value chains, livestock and environment, livestock and society, and livestock production technology. It is worth noting that metrics for many of these domains are multi-faceted, difficult to quantify, and have impacts that traditional analytical methods may miss. More research is needed to enhance IA in these missing domains.
- **Nature of IAs, in terms of international public goods (IPGs) and national/regional public goods:** With the exception of the rinderpest study, which examined a global intervention with wide-ranging implications on disease control efforts in general (albeit in the context of selected country case studies), the other studies are context specific and achieved rather modest global impact. The narrow application of these studies makes it challenging to provide generalized lessons for scaling out.
- **IPGs from a methodological perspective:** The fodder bank, cowpea, and dairy marketing studies demonstrate particular innovation in the use of economic surplus techniques for IAs. The first two utilized geographic information systems and bio-economic platforms to guide computation of benefits, while the latter (dairy marketing) attempts to quantify policy processes not previously developed in the literature. The rinderpest study also provides an innovative approach to conducting ePIA at different impact levels that could aid the modeling of intervention benefits in a number of livestock domains; while the three ICARDA studies highlight the integration of bio-economic modeling perspectives. However, the two HPIA studies are far more modest in their methodological contributions, and both BBM plow adoption studies are particularly weak in their application of economic surplus techniques (see Table 1 for a list of all studies).
- **Peer review:** Only four studies (dairy marketing, HPIA in Nigeria, rinderpest, and

spineless cactus in Tunisia) were published in (peer-reviewed) external journals. The rest were published in Center-based research reports or in reports to donors.

- **Citation count and publication year:** Using *Google Scholar* citation count measures, three of the 12 studies had 25 or more citations. Seven of the IA studies received less than ten citations. Only two studies were published after 2007.

## Recommendations for addressing IA challenges

The substantial gaps identified in the IA (of livestock related research) literature highlights the intrinsic difficulties in assessing high-level impacts (poverty, food security) of agricultural research.

This review also underlines the need for building a stronger and more rigorous evidence base in examining the impact of livestock and associated research.



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Specific recommendations include:

- 1. Expanding domain areas examined in ePIAs:** Eligible studies (that passed the review criteria) covered only four of the ten domain areas identified (see Box 1 for a list of livestock research domains). However, these gaps across the portfolio can be addressed. For instance, there has been research conducted in areas related to animal feed systems, food safety, pastoral systems, and animal disease control that, while not meeting the strict definition of ePIAs in the review, could be harnessed and applied in current or future research. Notably absent from the current suite of studies are those that examine impacts at the value chain level (see Box 2). The Livestock Agri-food Systems (AFS) CRP represents an excellent opportunity to conduct IAs at a value chain level.
- 2. Incorporating methodological advances in ePIAs:** An important research component that emerges from the review is the need to couch the advances, that have been identified, in issues of measuring the benefits and effects of livestock-related interventions into an IA framework. This is particularly crucial when donors increasingly want (and need) to quantify the returns to investment, and for priority setting for future investments.  
  
This does not necessarily require that all IAs use economic surplus models, as many types of livestock research domains are more nuanced in their impacts and benefits. What it does require, however, is a process of documentation in medium- and large-sized investments that allows the measurement of a range of benefits at farm, sector, value chain, and/or national levels to be justified rigorously and weighed against the costs of donor investment. This process of documentation is often lacking.
- 3. Integrating livestock-related research across Centers and CRPs in a CGIAR system-wide framework:** Research integration across Centers could also provide an opportunity to develop a

process of implementing ePIAs, but this needs to be mainstreamed into a diversity of livestock domains and emphasized at the highest CGIAR levels. This represents a challenge and an opportunity. Centers and donors have to recognize the need to prioritize investments in personnel and world-class research skills to achieve the significant upgrading of the profile and process of IA for livestock-related interventions that is required. However, the benefits of such investments are potentially large; and the establishment of a consortium-wide impact documentation process will facilitate the justification of targeted research themes.

#### **Box 2. Studies assessing some elements of value chain impacts**

In the study on food safety in the dairy value chain (Lapar et al., 2014), a number of metrics were used to assess whether training resulted in higher margins and traded volumes. Although the inconsistent results on margins and prices did not clearly demonstrate benefits, the paper shows potential in at least trying to conceive the chain-level effects of a rather nuanced intervention in food safety.

A number of other studies that were not selected for ePIAs also give guidance on ways to address value chain issues. For example, Rich and Hamza (2013) highlight the role that systems dynamics models could play in *ex-ante* and ePIAs at the value chain level, given their ability to model interactions and feedback between animal health, herd dynamics, marketing behavior, and adoption. Thornton (2006) makes a similar observation on the use of such models for assessing climate-related impacts. Similarly, recent papers by Notenbaert et al. (2014) and Ran et al. (2015) provide additional tools for engaging with IAs of value chain interventions. More rigorous methods that capture multi-sectoral impacts (e.g. following the rinderpest ePIAs), could also be used in this setting.

## Promising innovations and programs for IAs

As stated, several areas of livestock research remain under-assessed and should be considered for future work:

**Animal diseases and food safety** – An important element of ILRI's research has been examining the epidemiology of various animal diseases and food pathogens. These studies provide opportunities for measuring and documenting impacts associated with food safety and animal health interventions. Developing ways to quantify impacts, particularly qualitative ones such as behavioral change, will be essential to demonstrate the strong value of this research.

**Value chains** – The new Phase 2 Livestock AFS CRP should serve as a rich laboratory for conducting IAs at a value chain level. There are also opportunities for advancing new measurement methods that could build on the ePIAs for the smallholder dairy program.

**Innovation platforms** – As much of the positive impacts associated with innovation platforms are behavioral and organizational, metrics that quantify these are needed at the intervention level and beyond.

### Types of impact

**Impacts beyond farm/household level** – While many of the studies generate results on household level impacts in terms of income gained from the intervention, what is not known is i) the costs required to obtain the reporting benefits, and ii) how household-level benefits can be aggregated up to sector or economy-wide impacts.

**Health impacts** – Given that public health benefits are an important, understudied impact of food safety and animal health interventions, developing ways that

imbed Disability Adjusted Life Years (DALYs) as a metric of impact will be critical to improve future analyses.

**Financial metrics of impact** – An important shift in CGIAR livestock research has been in trying to more rigorously examine household-level impacts associated with interventions. Translating the gains from adoption into financial metrics of impacts will be critical to enhance their contributions in addressing the positive impacts of livestock research.

## Concluding remarks

This review reiterates that livestock-related research is under-evaluated in terms of reliable and meaningful ePIAs. However, the integration of research across Centers in multi-year CRPs provides an opportunity to develop a systematic process for undertaking credible, rigorous ePIAs. In conducting such impact assessments, it will be important to translate findings (benefits and effects of livestock-related interventions) into measurable impacts that address returns to donor investments.



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