

2018 CRP Annual Reporting

CGIAR Research Program on Livestock Agri-Food Systems (CRP LIVESTOCK)

Name of Lead Centre: International Livestock Research Institute (ILRI)

Flagship lead institutions (CGIAR Centres or lead partners):

- Flagship 1: Livestock Genetics - ILRI
- Flagship 2: Livestock Health - Swedish University for Agricultural Sciences (SLU)
- Flagship 3: Livestock Feeds and Forages - International Centre for Tropical Agriculture (CIAT)
- Flagship 4: Livestock and the Environment - ILRI
- Flagship 5: Livestock Livelihoods and Agri-Food Systems - ILRI

Other participating CGIAR Centres:

- International Centre for Agricultural Research in the Dry Areas (ICARDA)

CGIAR is a global partnership that unites organizations engaged in research for a food-secure future. The CGIAR Research Program on Livestock provides research-based solutions to help smallholder farmers, pastoralists and agro-pastoralists transition to sustainable, resilient livelihoods and to productive enterprises that will help feed future generations. It aims to increase the productivity of livestock agri-food systems in sustainable ways, making meat, milk and eggs more available and affordable across the developing world. The Program brings together five core partners: the International Livestock Research Institute (ILRI) with a mandate on livestock; the International Center for Tropical Agriculture (CIAT), which works on forages; the International Center for Research in the Dry Areas (ICARDA), which works on small ruminants and dryland systems; the Swedish University of Agricultural Sciences (SLU) with expertise particularly in animal health and genetics and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) which connects research into development and innovation and scaling processes.

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EXECUTIVE SUMMARY

In 2018, the CRP Livestock received W1/2 funding for all five flagships, which made significant progress towards their outcomes. Compared to 2017, the number of innovations increased more than five-fold (from 10 to 54) and the number of peer-reviewed publications almost doubled (from 94 to 174)—reporting on work carried out under the current CRP and the earlier CRP on Livestock and Fish. With reference to cross-cutting issues, the Women's Empowerment in Livestock Index (WELI) is gaining ground as a way for projects to understand gender issues, while the CRP undertook a range of capacity development activities, including developing training materials, testing new extension approaches, and creating blended online and offline learning experiences.

The **Livestock Genetics FP1** focuses on understanding and characterization of livestock production systems, new breeds and tools for improving livestock productivity, and delivery of research products to smallholder farmers. In 2018, most of the flagship's outputs related to the first element. Highlights included: a landmark multidisciplinary publication reporting that sustainable poultry development interventions for smallholder farmers should be locally tailored for flexible implementation; the opening of the poultry research platform at ILRI Addis Ababa; the development of initial business strategies for the delivery of improved poultry and dairy cows, and guidelines for certification of improved sires from small ruminant breeding programs.

Livestock Health FP2 firstly identifies animal disease risks, then develops methods to mitigate these risks through herd health management, diagnostics and vaccine innovations, and finally, tests approaches for delivering these products. Some key achievements in 2018 were: modelling disease transmission in pigs and initiating a dialogue with stakeholders about the economic impact of these diseases in Vietnam; and identification of policy constraints that constitute obstacles for efficient delivery of animal health services.

Feeds and Forages FP3 made significant advances in 2018 on the development of feed intervention prioritization tools, which now incorporate cross-cutting issues such as gender. Several cost-benefit analyses were conducted for forage technologies in Kenya and Colombia, indicating suitability of technologies is dependent on the market environment, while strong contributions were made to innovation platforms in Colombia and Tunisia, both of which aim at mid-term policy influence.

Livestock and Environment FP4 addresses the possible impacts of climate change. In 2018, the flagship identified forage intensification options to be disseminated in four countries (with FP3) and worked with government agencies in Tunisia, Tanzania and Kenya on policies and institutional arrangements to support rangeland management.

Livestock Livelihoods and Agri-Food Systems FP5 aims to ensure that the technologies and strategies developed through the CRP translate into positive impacts on the resource poor. In 2018, the team continued to generate evidence to influence policies and investments through the Livestock Master Plan (LMP) work in Ethiopia, Tanzania, Rwanda and Bihar (India), and on the role of animal source foods in healthy diets. Lessons learned on packages of technologies and institutional arrangements were further piloted and, in some cases, brought to scale with development partners in Ethiopia, Kenya, Tanzania and Uganda.

Part A: NARRATIVE SECTION

1. Key Results

1.1 Progress Towards SDGs and SLOs

Feeds and Forages FP3 scaled *Urochloa* hybrids on approximately 100,000 additional hectares in 15 countries. The total area sown with CIAT hybrids is estimated at 930,000 hectares in 30 countries, based on seed sales as of end 2018 (private sector partner will provide data on coverage by mid-2019). Through ex-ante cost-benefit analyses, the flagship was able to show the profitability of including improved forages in Colombian cattle and dairy systems at farm level, providing a pathway for the promotion of technologies. **Livestock and Environment FP4** developed community grazing plans in Kenya and Tanzania to reduce grazing pressure by designating areas for wet and dry season grazing and drought reserves. Communities can then agree on areas to be protected for rehabilitation interventions, such as a longer resting period for natural vegetation regeneration, or re-seeding. The area under improved grazing management is 1 million hectares in Kenya and 95,000 hectares in Tanzania. **Livestock Livelihoods and Agri-Food Systems FP5** influenced the design of the World Bank loan of \$170M in Ethiopia, based on the completed Livestock Master Plan. The dairy business hub approach was scaled in East Africa: over 100,000 farmers are registered in hubs, availing access to inputs and services, including markets for their milk. The whylivestockmatter.org website has been finalized, while the Women Empowerment in Livestock Index (WELI) tool and paper were published, allowing partners to better capture and monitor progress of this key indicator in livestock systems.

1.2 CRP Progress towards Outputs and Outcomes (spheres of control and influence)

1.2.1 Overall CRP Progress

The flagships successfully completed 35 (73%) of the 2018 milestones and made progress towards another 12 that were extended to 2019. One milestone was cancelled. Improving this performance from a 41% completion rate in 2017 (12/29, with 17 extended) was a priority for the Independent Steering Committee and CRP management. **Livestock Genetics FP1** developed environmental suitability maps for sheep, goats and chickens in Ethiopia, to maximize productivity and survivability by targeting breed dissemination to appropriate habitats. **Livestock Health FP2** developed a Knowledge, Attitudes and Practices tool to understand farmers use of antimicrobials, tested a novel gender-sensitive farmer training approach, and identified a possible vaccine target for Contagious Bovine Pleuro-Pneumonia and proof-of-concept for a novel East Coast fever vaccine. **Feeds and Forages FP3** launched the genderized feed assessment (FEAST) tool, published the annotated reference genome of *Urochloa* and drought/agronomic performance protocols of *Cenchrus purpureus*, and identified spin-off technologies from 2nd generation biofuel to convert cereal straws/stover into concentrates. **Livestock and Environment FP4** published greenhouse gas baselines for Kenya (with CCAFS)—currently being used to determine Nationally Determined Contributions, identified sustainable rangeland interventions in Kenya, Tanzania and Tunisia and informed global debates through engagement at two high level events and the livestockmatters.org website. **Livestock Livelihoods and Agri-Food Systems FP5** continued work on a new modelling tool for Livestock Master Plans (with FP4) and launched a report on the role of animal source foods in the first 1,000 days (with A4NH and Chatham House) as well as the Women Empowerment in Livestock Index tool.

1.2.2 Progress by Flagships

F1 Livestock Genetics - Flagship Progress:

The flagship achieved six of its seven milestones in 2018. For data on livestock diversity (Outcome 1.1), with the opening of the poultry research platform in Addis Ababa, chicken breeds characterization may now be performed under controlled conditions. Development of environmental breeds suitability maps (chicken, small ruminant) for optimization of genotype-environment interactions is also completed. Similarly, genome diversity and adaptation information for chicken, sheep and cattle is now available, providing candidate DNA polymorphism and haplotypes for marker-assisted selection and genome editing. Major progress was made on genetic improvement strategies (1.2) with the development of a mobile recording system for upscaling of small ruminant community-based breeding programs (CBBPs) in Ethiopia and Tanzania and the identification of a SNPs panel required for developing a SNP chip. Business models to optimize the multiplication and delivery of improved chicken (1.3), dairy cow and small ruminant have been developed. A gender strategy for poultry keeping in Ethiopia, Tanzania and Nigeria and a report on strengthening women's participation in small ruminant breeding cooperatives in Ethiopia were published (1.4). Finally, substantial progress was made with the publication of institutional guidelines for distributing improved rams for small ruminant CBBPs (1.5).

F2 Livestock Health - Flagship Progress:

The flagship completed 5 of its 2018 milestones, extending the remaining 4 to 2019. On assessment tools and risk maps for animal diseases (Outcome 2.1), together with Livestock Livelihoods and Agri-Food Systems FP5, an epidemiological modeling framework and risk map were developed for endemic pig diseases in Vietnam. Progress was made on promoting herd health (2.2) in small ruminant production in Ethiopia through community-based gastro-intestinal parasite control programs, and community conversations—a novel participatory farmer training approach. A data collection tool on knowledge, attitudes and practices on farmers' use of antimicrobials (2.3) was developed and applied in three countries: initial results revealed high levels of medically irrational drug use. With CRP A4NH, a CGIAR-wide strategy for Anti-Microbial Resistance (AMR) was agreed and a major conference held in India. On diagnostics and vaccines (2.4), a challenge model was established for testing Contagious Caprine Pleuro-Pneumonia (CCPP) vaccines, a possible vaccine target for Contagious Bovine Pleuro-Pneumonia (CBPP) identified, and progress made towards proof-of-concept for an East Coast fever (ECF) vaccine. On access to animal health services (2.5), research showed that in Kenya this is constrained by inappropriate policies; practical, evidence-based recommendations were made for improving farmer participation in Mali vaccination campaigns.

F3 Feeds and Forages - Flagship Progress:

To strengthen capacity to diagnose feed constraints/opportunities and prioritize feed and forage interventions (3.1), the Flagship launched and promoted the genderized Feed Assessment (FEAST) and LegumeChoice tools, and began an updating process of the Tropical Forages tool which, by mid-2019, will provide a mobile app for end users. To promote use of enhanced forage and rangeland resources (3.3), the flagship increased commercialization of existing *Urochloa* hybrids through a private sector partner and published forage ontologies on the annotated reference genome of *Urochloa* and drought/agronomic performance protocols of *Cenchrus purpureus*. For better utilization of feeds and forage resources (3.5), a ration balancing tool was designed and spin-off technologies from 2nd generation biofuel have been identified that can convert cereal straws and stover into feed resources with an equivalent value to concentrates. Regarding pasture management strategies (3.6), an off-farm feed processing option was tested and is now being used in India. To improve uptake of feed and forage resources (3.8), cost-benefit

analyses were conducted for forage technologies in Kenya and Colombia and feed processing technologies studied in Tunisia. Lastly, extension approaches were tested and strong contributions made to innovation platforms in Colombia and Tunisia. No major course corrections were made in 2018.

F4 Livestock and the Environment - Flagship Progress:

As described in Table 5, the flagship completed 6 milestones and extended 2. To increase policy attention for environmental concerns (4.1), the first GHG baselines were published for Kenya and completed for Vietnam (with CCAFS) and are being used by Kenya to establish its Nationally Determined Contributions. Forage intensification options were identified to adapt to climate change (4.2) and will be disseminated in four countries (with FP3). Sustainable rangelands interventions (4.3) have been formulated in three countries; dissemination is ongoing in Tunisia and beginning in Kenya and Ethiopia. Developing gender responsive environmental management options (4.4) has been delayed due to personnel changes. Two milestones on improved environmental management policies (4.5) have been completed, with government agencies in Tunisia, Tanzania, and Kenya drawing upon our findings in their formulation and implementation of policies and institutional arrangements to support rangeland management. Evidence generated to influence the global agenda (4.6) was presented at two high level events and made readily available on the website livestockmatters.org.

F5 Livestock Livelihoods and Agri-Food Systems - Flagship Progress:

Good progress was realized, with 11 of 15 milestones achieved. However, delays were experienced in completing three milestones, which were extended to 2019, and one was cancelled. To guide investment, Livestock Master Plans (LMPs) were finalized in Tanzania and Bihar with a gender lens incorporated. A cross-flagship activity was initiated with FP4 to incorporate environmental indicators in LMP modelling responding to national demands. The whylivestockmatter.org website informing the global livestock debate was supported with evidence (5.1). A CRP youth strategy was completed (5.3). Key to advancing gender transformative approaches, the Women's Empowerment in Livestock Index concept and tool were published and are being applied in new gender studies (5.4). To enable livestock-mediated nutritional impacts, a report on the role of animal source foods in the first 1,000 days produced with A4NH CRP and Chatham House received considerable media attention, and a behaviour change strategy was successfully implemented in 5,000 households in Kenya (5.5). Uptake of dairy innovations was supported by guiding development projects in three East African countries, reaching 140,000 households (5.6), and extending recommended dairy business models to 133,000 households (5.7). A protocol to guide the evaluation of institutional innovations was prepared, to be applied in 2019.

1.2.3 Variance from Planned Program for this Year

A) Have any promising research areas been significantly expanded?

Livestock Health FP2 began expansion of the successful tick mapping in Tunisia to Kenya and initiated plans to work on risk maps/models in Uganda together with national stakeholders. Evidence of changes in behaviour and household dynamics is emerging following community conversations on livestock related issues in Ethiopia, and the scope of the sessions was expanded to include animal welfare and anti-microbial use and resistance. The diagnostic and vaccine cluster is putting increasing emphasis on vaccine development as there have been several promising scientific achievements in this area, including identification of a potential subunit vaccine target for Contagious Bovine Pleuro-Pneumonia (CBPP). Through bilateral funds (Colombian Forages Network), Feeds and Forages FP3 expanded its ex-ante assessment work to determine potential economic impacts resulting from the adoption of a new forage variety in Colombia, and aligned barley breeding within its forage breeding programs. Livestock and

Environment FP4 expanded work on rangeland management to include more gender dimensions in response to partner interest expressed through the International Land Coalition Rangelands Initiative. Initial funds for a gender study came from PIM CRP FP5 (the lead researcher works in both flagships) and the Livestock CRP is now incorporating gender dimensions in rangeland management tools.

B) Have any research lines been dropped or significantly cut back?

The partnership for establishing a diagnostic development platform for Livestock Health FP2 was postponed to 2019, since talks were not successfully completed with the private sector on this initiative during 2018. Feeds and Forages FP3 activities in Nicaragua were severely affected by the socio-political unrest starting in April 2018 and a planned cost-benefit analysis had to be dropped; it is unclear whether this can be taken up in the near future. In Colombia, multi-locational testing of water-logging resistance of *Urochloa* could not be conducted due to extreme weather events. This activity will now be conducted in 2019. In Kenya, development of a feeds and forages upscaling approach including radio dissemination materials was postponed to 2019 as the available data in 2018 were too scarce. Of the four environmental dimensions originally envisioned to be part of the FP4 focus (GHG emissions/climate change, soil health/degradation/restoration, water use/quality and ecosystem services), the latter two had to rely on mobilizing bilateral support as W1/2 resources have not been sufficient to support major work in all areas. The work on payments for ecosystem services remained unfunded, due to a lack of opportunities for bilateral support, and will not be continued until further notice.

C) Have any Flagships or specific research areas changed direction?

The Livestock Health FP2 has identified an urgent need in lower- and middle-income countries to rapidly diagnose whether an infected animal can be cured with antibiotics, in order to reduce their unnecessary use. Therefore, the flagship initiated a proof of concept project where the aim is to judge if the concept of measuring the inflammatory response is worthwhile to continue or drop at the end of 2019. Feeds and Forages FP3 will include ICARDA's barley breeding for feed/forage as one of its key pillars from 2019, to complement the ongoing CIAT forage grass breeding programs. The addition of barley adds another critical feed and forages resource, complementing the existing breeding programs in targeting semi-arid and highland environments.

1.2.4 Altmetric and Publication highlights

The top 20 research outputs in 2018 as per the Altmetric scores represented work across all 5 CRP flagships and included 17 peer-reviewed journal articles, one working paper, one conference paper and one training workshop report. The top article was a global assessment of agricultural system redesign for sustainable intensification (FP5), published in Nature Sustainability in August 2018. With an Altmetric Attention Score of 345, this journal article is in the 99th percentile compared to other outputs of the same age. It was mentioned by 12 news outlets and an astonishing 318 twitter users and read by 167 people on Mendeley. The second article, also published in Nature Sustainability and with an Altmetric Attention Score of 75 (96th percentile), was on the role of local adaptation in sustainable production of village chickens (FP1). This paper garnered mentions by 5 news outlets and was tweeted 40 times. The third article, published in Agricultural Systems and with a score of 45 (95th percentile), described a new approach for improving emission factors for cattle in East African smallholder systems (FP4), which attracted 4 blog mentions and 21 tweets. The fourth, published in International Parasitology and with a score of 27 (92nd percentile), concerned characterization of the *Theileria* parvasporozoite proteome (FP2). The paper provided evidence for the expression of 2,007 proteins in this life-cycle stage of the parasite, helping to identify novel sporozoite proteins that induce sporozoite neutralising antibodies, and was tweeted 21 times. The highest ranked output from FP3 was the paper ranking sixth overall for the

CRP, on policy options for inclusive dairy value chain development in Nicaragua, published in Agricultural Systems and with a score of 23 (90th percentile).

1.3 Cross-cutting dimensions (at CRP level)

1.3.1 Gender

A) List any important CRP research findings

- The CRP gender coordinator, who also leads the cluster in FP5 on gender and social equity, participated in the UN CSW 62 (committee on the status of women) in New York in March 2018, providing an opportunity to convey the message that livestock can play an important role for women in economic empowerment, nutrition and food security.
- The Women's Empowerment in Livestock Index (WELI) was published, has been tested in two countries, and is gaining ground as a way for projects to understand how livestock is empowering women.
- To reach greater scale on gender, the CRP worked closely with the Livestock Master Plan (LMP) of Bihar, which aims to guide investment in the livestock sector, to integrate the needs of women in the plan.
- The continued work with the Ethiopian Agricultural Research Institute on gender has meant that the institute has increased the gender balance of its researchers, and also has become more aware of how women fit within the agricultural sector.
- A first step in gender getting its own research portfolio has been in the awarding of two proposals which had gender as a starting point. One is looking at how women can become entrepreneurs in the poultry value chain by selling day old chicks, and the other is focusing on using gender transformative approaches in vaccine uptake and use.
- Training was done with FAO for ministry of agriculture and livestock staff and FAO staff in East Africa on how to better integrate gender in their work.
- Gender transformative work was done in Ethiopia using community conversations to understand how men and women deal with animal diseases. This allowed them to understand each other's contributions and has resulted in a more equitable sharing of roles.
- The CRP Livestock hosted the 2018 CGIAR gender platform scientific conference at ILRI in Addis Ababa, Ethiopia.

B) What have you learned? What are you doing differently?

- To influence investment for women it has been important to also target policy level decision making, such as influencing the Livestock Master Plans at country level.
- Gaining more funding for strategic research will be important, as noticed with the successful funding of two gender specific projects starting 2019 (on women-centred chicken businesses, and small ruminants and chicken vaccination systems).

C) Have any problems arisen in relation to gender issues or integrating gender into the CRP's research?

- Funding is still a challenge. Though some flagships are providing funding to mainstream gender in their work, it is often very piecemeal (i.e. providing below 10% of a person's time), resulting in possible mediocre work.
- Ensuring that the CGIAR is considered an attractive career opportunity for young gender researchers.

1.3.2 Youth and other aspects of Social inclusion / “Leaving No-one Behind”

The CRP held an e-consultation on youth to validate its emerging youth strategy. As most constraints faced by youth are the same as for other smallholders, it was decided not to devote an entire research program to youth issues. Rather, a ‘youth lens’ will be added to current and future research projects while the CRP will integrate youth perspectives on the livestock sector and its livelihood potential by interviewing youth in the field. Additionally, a select few challenges and opportunities do require a more specific youth focus, including access to land and finances, and migration. Linked to gender, one project has started looking at how younger women can become entrepreneurs in poultry. On leaving no one behind, there were deliberate attempts to move towards gender and social equity, to include issues around social inclusion within different livestock value chains and sectors.

A) List any important CRP research findings

Research in this area is just starting.

B) What have you learned? What are you doing differently?

Recognizing the high value of livestock products, youth is finding a natural home in work on entrepreneurship, hub approaches, incubators and within value chains. It is also of interest for the impact at scale work at ILRI.

C) Have any problems arisen in relation to youth issues or integrating youth into the CRP’s research?

Since the departure of the joint appointee with KIT in the first half of 2018, the youth cross-cutting area has not had a champion within the CRP Livestock. A youth specialist/researcher? will need to be identified, to help coordinate the work of either leveraging the appropriate expertise through partnership or investing internally once sufficient bilateral funding can secure a staff position.

1.3.3 Capacity Development

In 2018, in addition to the training figures in Table 7, the CRP undertook a range of Capacity Development activities, including:

- Development of training materials and facilitation of training events.
- Testing of new extension approaches, including digital extension, ICT4Ag (mobile, radio, video, offline), mobile apps and decision support tools.
- Design and delivery of blended learning experiences, with online and offline training data combined in one learning record database.

Flagship-specific activities of note included:

- Piloting community conversation in Ethiopia as a gender transformative approach on topics like zoonotic diseases (FP2).
- Participatory trainings to deliver knowledge on biosecurity to pig farmers in Uganda (FP2).
- Testing and application of new extension approaches in Colombia and Tunisia involving different groups of livestock producers (FP3).
- Launching new tools (e.g. G-FEAST), maintaining or enriching others (e.g. SoFT, LegumeChoice, TGFT), and beginning development of others (e.g. AFAWA), all designed to help next users with feed intervention prioritization (FP3).
- Training national partners in Kenya and Burkina Faso on the Comprehensive Livestock Environmental Assessment for Improved Nutrition, a Secured Environment and Sustainable Development along Livestock and Fish Value Chains (CLEANED) R and CLEANED X tools (FP4).

- Multiple trainings with, and outreach to, research and development organization partners on the Rural Household Multi-Indicator Survey (RHoMIS) tool (FP4).
- Capacity building of decision makers at national level continued as part of the Livestock Master Plans in Ethiopia, India and Tanzania (FP5).
- Gender capacity building within the Ethiopian Institute of Agricultural Research (EIAR), which subsequently decided to extend the training to staff in their regional centres (FP5).

1.3.4 Climate Change

The contribution of the CRP Livestock to climate change issues is predominantly in FP4 Livestock and Environment, although FP3 Feeds and Forages also has some climate-related activities. The tools and platforms developed under FP3 are designed to prioritize feed interventions that contribute to climate change mitigation and adaptation. The commercialized *Urochloa* hybrids have superior performance in environments with prolonged droughts or water-logging. The economic analyses of forage technologies in Colombia incorporate the necessity to adapt to a changing climate. Climate change is also a key discussion point in the Colombian Roundtable for Sustainable Cattle and a central element within the formulation of a public sector policy on Sustainable Cattle Production. In FP4, climate change is embedded throughout the flagship. The environmental assessment framework developed by the flagship, together with the greenhouse gas (GHG) emission baselines, allows for the estimation of changes in GHG emissions due to technological interventions in, or transitions of, livestock production systems. This helps countries to set and monitor their climate change commitments to the UNFCCC. The flagship also provides information on the possible impacts of climate change on livestock technologies; notable examples include increasing heat stress on pigs in Uganda and shifts in the potential growing areas for forages in east Africa and southeast Asia. The flagship identified a number of potential interventions for reducing GHG emissions from livestock production systems e.g. better feeding regimes and improved grassland/rangeland management. For adaptation to climate change, interventions include: providing policy support to participatory rangeland management in Ethiopia, Kenya and Tanzania, incorporating dimensions of drought preparedness; and continued scaling and improvement of index-based livestock insurance as a tool to help pastoralists manage climate-related risks, especially recurrent droughts. Under FP5 Livestock Livelihoods and Agri-Food Systems, discussions started on how to include environmental considerations in the Livestock Master Plans modelling work.

2. Effectiveness and Efficiency

2.1 Management and Governance

The CRP management and governance function was only partially funded in 2017. With full funding restored in 2018, the CRP completed recruitment of the management team for a total of six full-time positions. These additions have increased management capacity to support the flagships with administrative, communications and monitoring and evaluation functions. The management team also relies on part-time contributions of researchers who coordinate the cross-cutting themes across the flagships and the priority country programs. The restored funding also allowed recruitment of a fifth member to complete the Independent Steering Committee, who as a group decided to maintain a single face-to-face meeting annually with one or two virtual meetings as required, for example to review the annual report and plan of work and budget.

The CRP Management Committee strengthened the coherence of research activities within the CRP by improving the clarity and transparency of the role of W3 and bilateral projects aligned to the CRP. This

was achieved by establishing an agreement between each W3/bilateral project Principal Investigator and the relevant Flagship Leader explaining the added value to both the W3/bilateral project investment and the CRP to be achieved through the alignment, and clarifying the associated roles and responsibilities. The Management Committee also implemented the decision to reduce the number of CRP priority countries to improve the focus and support dedicated to the work on the selected value chains and livestock systems by undertaking a re-selection process. The four selected priority countries are Ethiopia, Tanzania, Uganda and Vietnam.

Annual flagship meetings are critical for team building, and importantly, the restored W1/2 funding to two flagships enabled their management to convene joint planning exercises for the first time. The Livestock Health FP2 increased investment in flagship management (staff time), leading to a significant improvement in the flagship's planning and reporting capacity.

2.2 Partnerships

2.2.1. Highlights of External Partnerships

(i) Based on the recommendation from the Independent Steering Committee, CRP management engaged with the [Global Agenda for Sustainable Livestock](#) at its annual meeting in Mongolia to better understand the global landscape in which the CRP operates and to identify potential partners, including from the private sector. (ii) Established an innovative partnership with Cosmopolitan Chicken BVBA, led by conceptual artist [Koen Vanmechelen](#) of the [MOUTH Foundation](#), to design the book of genomes display (whole genomes of one exotic and one indigenous Ethiopian chicken) and artwork for the new poultry facility in Addis Ababa with the aim of conveying the importance of diversity for sustainable livestock productivity improvement and conservation to the general public. (iii) The partnership with the Centre for Tropical Livestock Genetics and Health (CTLGH) has evolved from providing strategic basic research support to increasing involvement in delivery of research outputs. (iv) With the Ministry of Agriculture in Ethiopia, community-based small ruminant breeding programs are being scaled up and out throughout the country. (v) Work with the private sector partner Papalotla has allowed the commercialization and dissemination of forage hybrids. (vi) Joint research and development activities with Heifer International have provided complementary expertise in dairy value chains and discussions are underway to expand this collaboration to poultry.

2.2.2. Cross-CGIAR Partnerships

(i) The CRP Livestock hosted the annual CGIAR gender platform research conference at the ILRI Campus in Addis Ababa Ethiopia in September 2018, bringing together CRP and Centre gender researchers from across the entire CGIAR system. (ii) The three CGIAR partners – ILRI, CIAT and ICARDA – involved in FP4 have developed a very close working relationship. They have developed joint projects (Climate Smart Dairy for IFAD) and hold regular interactions to emphasize complementarities and synergies (for example they are now using both RHoMIS and CLEANED for ex-ante impact assessments and evaluation of the impact of sustainable intensification options). In addition, one of the three clusters of the flagship is explicitly designed to serve the technology flagships and by design fosters cross-CGIAR collaboration (e.g. heat stress mapping). FP4 also co-delivers outputs with CCAFS FP3 and PIM FP5.

2.3. Intellectual Assets

Have any intellectual assets been strategically managed by the CRP (together with the relevant Centre) this year?

Under the cluster of activities on vaccine and diagnostic development, FP2 Livestock Health began investigating the possibility of filing a patent between the three institutes involved in the African swine fever program (ILRI, the Friedrich-Loeffler-Institut Federal Research Institute for Animal Health in Germany, and the J. Craig Venter Institute in USA).

Indicate any published patents and/or plant variety right applications (or equivalent)

N/A

List any critical issues or challenges encountered in the management of intellectual assets in the context of the CRP

N/A

2.4 Monitoring, Evaluation, Impact Assessment and Learning (MELIA)

With increased awareness throughout the CRP for the requirements and demands for evaluation studies, a wider range of technologies and innovations have been identified for assessments. In 2018, these included studies on adoption (forage seed), technologies (the Infection and Treatment Method [ITM] vaccine against East Coast fever [ECF]), institutional innovations (Index-Based Livestock Insurance [IBLI]) and a review of policies and regulations (Kenyan private sector animal health services). These studies are in various stages of completion. Adoption assessments of forages and multi-purpose crops are ongoing with challenges in establishing basic information to formulate efficient designs. The initial results of the ITM assessments indicate that per capita income was significantly higher among the “long-term” ITM adopters compared to those “just starting”, indicating that the reductions in cattle losses from vaccinating against ECF and the resulting increase in livestock sales would be large enough to be detected despite many other influences on household income. The study also indicated that livestock productivity, defined as the value of livestock products per tropical livestock unit, is also significantly higher amongst “long-term” adopters. These results confirm the hypothesis that despite its considerable cost, the ITM vaccination can provide an important contribution towards increasing livestock productivity and reducing poverty amongst small-holder livestock keepers. The existing panel data from long term research on Index Based Livestock Insurance (IBLI) and an experimental research design have allowed for various studies to determine short-term causal impacts of the IBLI payouts. Those findings conclude that IBLI coverage reduces the use of detrimental coping strategies (e.g., distress sales of livestock and skipping meals) during drought. IBLI coverage also relaxes risk constraints, allowing households to increase investments in livestock inputs, such as veterinary services, which are shown to lead to increased income in insured households.

2.5 Efficiency

Feeds and Forages FP3 sought strong interaction and collaboration with the CCAFS CRP, for example on the development of forage materials for regions strongly affected by climate change and research on the Biological Nitrification Inhibition phenomenon in grasses and soil-grass interactions. This has created research synergies. The Breeding Program Assessment Tool (BPAT) developed by the University of Queensland in Australia was applied at CIAT in 2018 identifying areas for improvement in the Centre's forage breeding programs. This will result in a restructuring and improvement process from 2019 onwards and lead to significant efficiency gains. In Livestock Livelihoods and Agri-Food Systems FP5, time and effort

efficiency gains were achieved by using common sampling procedures for some research projects (sample size calculations and sample selection). Expanded processing modules for Rural Household Multi-Indicator Survey (RHoMIS) data, especially for transforming data sets between database formats, have improved data cleaning and extracting steps. Quantitative impact assessments (of smart marketing and value chain interventions) in Ethiopia were carried out through direct data recording (CS pro and ODK), which required more time in survey preparation in 2018 but greatly improved speed and quality control during survey implementation.

2.6 Management of Risks to Your CRP

Programmatic: The early termination of the CRPs in 2021 creates new risks: insufficient time and resources to achieve outcomes/targets, and disruption of W1/2 funded research, particularly cross-partner and cross-CRP activities. To address the first risk, pending SMO guidance, the CRP will undertake a full program review of flagship plans to 2021 by October 2019, adjusting outcomes and targets. Flagships will identify which W1/2 funded activities are a priority to continue (assuming they remain a funding priority within the post-CRP configuration), which should be a focus for mobilizing bilateral resources, and which can be wound down. With respect to the second risk, the implementing partners agreed that their institutions will protect the CRP investment in priority countries.

Institutional: A related risk is erosion of the synergies achieved in capacities across the CRP partners contributing to the livestock research agenda. The management committee therefore recommended holding a CRP-wide meeting to reinforce researcher identification with the CRP agenda, highlighting the benefits of collaboration.

Contextual: Implementation of the Nagoya protocol (2010) on access and benefit sharing, subjecting cross-boundary movement of biological materials to import/export permits, affected Livestock Genetics FP1. The solution adopted is to engage more closely with national partners. Insecurity in Nicaragua affected Feeds and Forages FP3: some activities were shifted to Colombia. One ICARDA bilateral project in Sudan stopped due to foreign currency difficulties. In Tanzania, we will continue to monitor the implications of new laws regarding publishing research data that are inconsistent with national statistics.

2.7 Use of W1-2 Funding

Livestock Genetics FP1 shifted 5-10% of its W1/2 funding from generating new data on livestock systems, to developing strategies, tools and business plans. W1/2 was also used for recruiting graduate fellows, paying publication open access fees, finalizing construction of the poultry research facility in Ethiopia, and developing business plans for two donor-funded projects.

Following strategic discussions, Livestock Health FP2 used W1/2 funding to identify areas for further exploration, drawing on collective team competences, e.g. mapping African tick distribution and diagnostics to guide antibiotics use, and to support expansion of promising activities such as capacity development activities within the Ethiopia herd health work.

Feeds and Forages FP3 used W1/2 funds to launch a gendered version of the Feed Assessment Tool (G-FAEST), develop an innovative non-destructive digital vegetation charting technique for rangeland monitoring, evaluate abiotic stress-tolerance of different species of *Urochloa* and *Megathyrus* as an input for forage breeding, and commission a short film on the flagship work.

W1/2 funds were used in Livestock and Environment FP4 for environmental impact assessments (CLEANED X tool and heat stress mapping for FP1), to complement bilateral research on grassland/rangeland productivity and soil health, and to support global advocacy activities.

Livestock Livelihoods and Agri-Food Systems FP5 used W1/2 funding to harmonize foresight studies across CRPs (Livestock, PIM and GLDC), and initiate improvement of the Livestock Sector Investment Policy Toolkit. About 15% of the allocation was used to leverage bilateral project funding, ensuring that strategic opportunities were not lost.

3. Financial Summary

The budget figures included in Table 13 are as per the submitted POWB 2018. W1/2 expenditure was higher than budgeted for all flagships, reflecting significant carry-over of funds from 2017. An unanticipated commitment of W1/2 funds was made too late in the year to be allocated effectively, so these funds will be carried over into 2019. Centre Own Funds from ILRI were expected to be over US\$ 1 million but the actual expenditure was less than US\$ 100,000 due to significant carry-over of CRP funds from 2017 and additional W3/bilateral funds secured during the year. Management support costs were lower than expected due both to delays in recruiting management unit staff and the decision to reduce the number of priority countries, leading to postponement of country support activities

Part B. TABLES

Table 1: Evidence on Progress towards SRF targets (Sphere of interest)

SLO Target (2022)	Brief summary of new evidence of CGIAR contribution	Expected additional contribution before end of 2022
100 million more farm households have adopted improved varieties, breeds, trees, and/or improved management practices.	<i>Urochloa</i> hybrids developed by Feeds and Forages FP3 were scaled up on approximately 100,000 additional hectares in 15 countries in 2018. Livestock Livelihoods and Agri-Food Systems FP5 partner organization, Heifer International, reported (in an email) the number of farmers who are using dairy hubs as 8,717 in Tanzania, 17,824 in Uganda and 60,081 in Kenya. Dairy hubs are collective farmer-owned milk bulking and/or chilling plants through which farmers get access to output markets and inputs as well as other services necessary for their dairy enterprises. The hubs act as a linkage between milk buyers and smallholder dairy farmers. Another partner organization, Technoserve, reported that over 10,000 smallholder dairy farmers from 29 businesses achieved enhanced access to finance, inputs and services in Kenya.	We expect further adoption of the hybrids on at least 100,000 hectares annually.
30 million people, of which 50% are women, assisted to exit poverty	No new evidence in 2018.	
2.5 million ha of forest saved from deforestation	N/A	
Improve the rate of yield increase for major food staples from current < 1% to 1.2-1.5% per year	No new evidence in 2018.	
30 million more people, of which 50% are women, meeting minimum dietary energy requirements	No new evidence in 2018.	
150 million more people, of which 50% are women, without deficiencies of one or more of the following essential micronutrients: iron, zinc, iodine, vitamin A, folate, and vitamin B12	No new evidence in 2018.	

10% reduction in women of reproductive age who are consuming less than the adequate number of food groups	No new evidence in 2018.	
5% increase in water and nutrient (inorganic, biological) use efficiency in agro-ecosystems, including through recycling and reuse	N/A	
Reduce agriculturally-related greenhouse gas emissions by 0.2 Gt CO ₂ -e yr ⁻¹ (5%) compared with business-as-usual scenario in 2022	No new evidence in 2018.	
55 million hectares (ha) degraded land area restored	No new evidence in 2018.	

Table 2: Condensed list of policy contributions in this reporting year (Sphere of Influence)

Name and description of policy, legal instrument, investment or curriculum to which CGIAR contributed	Level of Maturity	Link to sub-IDOs (max. 2)	CGIAR cross-cutting marker score				Link to OICR (obligatory if Level of Maturity is 2 or 3) or link to evidence (e.g. PDF generated from MIS)
			Gender	Youth	CapDev	Climate Change	
170 - Sustainable livestock policy of Colombia's national livestock producer organization (FEDEGAN) included information on improved pasture nutrition and methane emissions, which is informing livestock options in the development of the Government of Colombia's Nationally Appropriate Mitigation Action policy	Level 1	<ul style="list-style-type: none"> Conducive agricultural policy environment Appropriate regulatory environment for food safety 	1 - Significant objective	1 - Significant objective	1 - Significant objective	1 - Significant objective	In 2018, through the Colombian Roundtable of Sustainable Cattle Production, we started working on the technical basis for elaborating a national public policy on Sustainable Cattle Production for Colombia. Apart from CIAT, several public (e.g. Ministry of Agriculture, Ministry of Environment) and private entities were involved in creating the baseline document. This document is still confidential and not open for sharing. In 2019, we will further advance on the document which will then be presented to the relevant authorities.
195 - Rwanda Livestock Master Plan	Level 2	<ul style="list-style-type: none"> Conducive agricultural policy environment 	0 - Not Targeted	0 - Not Targeted	0 - Not Targeted	0 - Not Targeted	OICR2822
198 - Commitment by Ethiopian Institute of Agricultural Research to invest in gender training	Level 1	<ul style="list-style-type: none"> Gender-equitable control of productive assets and resources 	2 - Principal objective	0 - Not Targeted	2 - Principal objective	0 - Not Targeted	Scientists from EIAR, CIMMYT, ICARDA and ILRI conducted a gender training at EIAR headquarters. Following this training, EIAR conducted on their own a similar training, using a ToT approach. While a monetary value cannot be attached to EIAR investment to increase gender awareness and understanding in their centres, a total of 244 researchers (185 men and 59 women), as well as 185 administrative staff (117 men and 68 women) were trained for 2 days. Topics included: importance of gender; gender analysis and mainstreaming; gender diversity and Inclusion; gender analysis before research proposal writing; gender in plant breeding; gender responsive research; gender transformative research; gender in agriculture research.

							<p>Currently EIAR has invested in sending people to training organised by the CGIAR. Their commitment to invest their own resources for future training is not yet confirmed (hence level 1).</p> <p>Letter requesting support: https://cgiar.sharepoint.com/sites/livestock/Shared%20Documents/Forms/AllItems.aspx?viewpath=%2Fsites%2Flivestock%2FShared%20Documents%2FForms%2FAllItems%2Easpx&id=%2Fsites%2Flivestock%2FShared%20Documents%2FAnnual%20Reports%2F2018%20Annual%20Report%2FEvidence%20%28Deliverables%2C%20Innovations%2C%20Policies%202018%29</p>
237 - Progress towards development of policies that enhance private sector investment in animal health service delivery in Kenya	Level 1	<ul style="list-style-type: none"> • Closed yield gaps through improved agronomic and animal husbandry practices • Reduced market barriers 	2 - Principal objective	0 - Not Targeted	2 - Principal objective	0 - Not Targeted	<p>The first step was a review of the animal health laws to find out if they constrain private sector investment: https://hdl.handle.net/10568/100491. They did not prohibit private sector but they were also not supportive. Arising from that review, we are currently discussing with the Director of Veterinary Services a review and consolidation of various veterinary laws to ensure private sector interests are included.</p>
238 - World Organisation for Animal Health (OIE) policy analysis to develop typology of public private partnership models for veterinary service delivery, as input to development of practical guidelines	Level 2	<ul style="list-style-type: none"> • Increased safe use of inputs • Reduced livestock and fish disease risks associated with intensification and climate change 	1 - Significant objective	0 - Not Targeted	0 - Not Targeted	0 - Not Targeted	OICR2821
239 - CGIAR Antimicrobial Research (AMR) strategy developed	Level 1	<ul style="list-style-type: none"> • Increased safe use of inputs • Reduced livestock 	1 - Significant objective	0 - Not Targeted	0 - Not Targeted	0 - Not Targeted	<p>Researchers from Flagship 2 provided technical inputs into the special initiative on AMR described in the new CGIAR Business Plan (2019-2021) and played a major role in the</p>

		and fish disease risks associated with intensification and climate change					development of the CGIAR AMR Strategy (https://www.dropbox.com/s/c0fop87k6iz27bc/CGIAR%20AMR%20strategy.docx?dl=0) along with Centers (ILRI, IFPRI, IWMI and WorldFish) and at least two other CRPs (A4NH and WLE).
240 - World Organisation for Animal Health (OIE) guidelines on prioritization of animal diseases for which the use of vaccines could reduce antimicrobial use	Level 2	<ul style="list-style-type: none"> • Reduced livestock and fish disease risks associated with intensification and climate change • Increased safe use of inputs 	0 - Not Targeted	0 - Not Targeted	0 - Not Targeted	0 - Not Targeted	OICR2823

Table 3: List of Outcome/ Impact Case Reports from this reporting year (Sphere of Influence)

Title of Outcome/ Impact Case Report (OICR)	Maturity level	Status
OICR2729 - RHoMIS (a rapid, standardized, cost-effective agricultural performance tracking tool) adopted by 13 organisations to guide investments and generate information on 24,000 households in 31 countries	Level 1	New Outcome/Impact Case
OICR2767 - Improved cattle feeding practices in nine Kenyan counties, resulting in increased milk productivity for close to 80,000 farmers, with likely improved income and livelihoods	Level 2	New Outcome/Impact Case
OICR2821 - New World Organisation for Animal Health (OIE) typology of public-private partnerships in support of national veterinary services	Level 2	New Outcome/Impact Case
OICR2822 - Livestock Master Plan in Rwanda influences the government in shaping investments in the livestock sector as well as the Plan for Agriculture Transformation	Level 2	New Outcome/Impact Case
OICR2823 - Incorporation of developing country perspective in World Organisation for Animal Health (OIE) guidelines on prioritization of animal diseases for which vaccines could reduce antimicrobial use	Level 2	New Outcome/Impact Case

Table 4: Condensed list of innovations by stage for this reporting year

Title of innovation with link	Innovation Type	Stage of innovation	Geographic scope (with location)
241 - CLEANED-R (Comprehensive Livestock Environmental Assessment for Improved Nutrition, a Secured Environment and Sustainable Development along Livestock and Fish Value Chains) tool	Production systems and Management practices	Stage 3: available/ ready for uptake (AV);	Multi-national, Ethiopia, Burkina Faso, United Republic of Tanzania
277 - Joint village land use planning in Tanzania	Social Science	Stage 3: available/ ready for uptake (AV);	National, United Republic of Tanzania
279 - Woreda Participatory Land Use Planning for Pastoral Areas in Ethiopia	Social Science	Stage 3: available/ ready for uptake (AV);	National, Ethiopia
324 - Environmental suitability maps for Ethiopian sheep and goat	Research and Communication Methodologies and Tools	Stage 1: discovery/proof of concept (PC - end of research phase)	National, Ethiopia
331 - Protocol for characterizing community-based rangeland management cases	Social Science	Stage 2: successful piloting (PIL - end of piloting phase)	Global
342 - Innovative use of sheep and goats by women in climate smart villages in Kenya	Genetic (varieties and breeds)	Stage 3: available/ ready for uptake (AV);	National, Kenya
427 - Artistic decoration for the general public illustrating the importance of genetic diversity	Research and Communication Methodologies and Tools	Stage 3: available/ ready for uptake (AV);	National, Ethiopia
444 - Updated Tropical Forages Tool (formerly known as SoFT)	Research and Communication Methodologies and Tools	Stage 2: successful piloting (PIL - end of piloting phase)	Global
445 - New Brachiaria hybrid "Camello"	Genetic (varieties and breeds)	Stage 3: available/ ready for uptake (AV);	Global
446 - Commercialization of CIAT's Urochloa hybrids (e.g. Mulato II, Cayman, Cobra) through private sector partner	Genetic (varieties and breeds)	Stage 3: available/ ready for uptake (AV);	Global
447 - Gendered Feed Assessment Tool (G-FEAST)	Research and Communication Methodologies and Tools	Stage 1: discovery/proof of concept (PC - end of research phase)	Global
450 - Mobile Near Infrared Spectroscopy (NIRS) using improved algorithms	Research and Communication Methodologies and Tools	Stage 1: discovery/proof of concept (PC - end of research phase)	Global
451 - Low-infrastructure artificial insemination laboratory "mobile kit" (part of reproductive platform to support and scale goat breeding programs in Ethiopia and Tanzania)	Genetic (varieties and breeds)	Stage 3: available/ ready for uptake (AV);	Multi-national, Ethiopia, United Republic of Tanzania
454 - New Urochloa interspecific hybrids	Genetic (varieties and breeds)	Stage 1: discovery/proof of concept (PC - end of research phase)	Global

455 - New Urochloa humidicola hybrids	Genetic (varieties and breeds)	Stage 1: discovery/proof of concept (PC - end of research phase)	Global
456 - New Megathyrus hybrids	Genetic (varieties and breeds)	Stage 1: discovery/proof of concept (PC - end of research phase)	Global
457 - New groundnut dual purpose cultivars for India	Genetic (varieties and breeds)	Stage 1: discovery/proof of concept (PC - end of research phase)	National, India
458 - New maize dual purpose cultivars	Genetic (varieties and breeds)	Stage 2: successful piloting (PIL - end of piloting phase)	National, India
459 - Definition of cost-effective total mixed rations for dairy cattle in India	Production systems and Management practices	Stage 1: discovery/proof of concept (PC - end of research phase)	Sub-national, India
476 - New rice dual purpose cultivars	Genetic (varieties and breeds)	Stage 1: discovery/proof of concept (PC - end of research phase)	National, Philippines
502 - Methodology for using GIS in chicken breeds suitability map in Ethiopia	Research and Communication Methodologies and Tools	Stage 1: discovery/proof of concept (PC - end of research phase)	National, Ethiopia
503 - A panel of single nucleotide polymorphisms (SNPs) for genomic imputation and admixture proportion analysis in East African dairy crossbreed breeds	Research and Communication Methodologies and Tools	Stage 1: discovery/proof of concept (PC - end of research phase)	Regional, Eastern Africa
525 - Dissemination of improved Bonga ram	Genetic (varieties and breeds)	Stage 3: available/ ready for uptake (AV);	National, Ethiopia
572 - Tool combining different methods to identify priority diseases in livestock systems	Research and Communication Methodologies and Tools	Stage 3: available/ ready for uptake (AV);	Global
573 - Community conversation as a gender transformative approach in livestock health management	Social Science	Stage 2: successful piloting (PIL - end of piloting phase)	National, Ethiopia
576 - RHoMIS – a rural household multiple indicator survey tool	Research and Communication Methodologies and Tools	Stage 4: uptake by next user (USE)	Global
584 - Business models for three selected best-bet interventions for small ruminant value chains in Ethiopia	Social Science	Stage 3: available/ ready for uptake (AV);	National, Ethiopia
587 - Nicaragua dairy systems dynamics model – public facing aspect	Research and Communication Methodologies and Tools	Stage 1: discovery/proof of concept (PC - end of research phase)	National, Nicaragua
646 - Development of mechanisms to reduce market distortions in Ethiopian small ruminant value chains	Social Science	Stage 1: discovery/proof of concept (PC - end of research phase)	National, Ethiopia
665 - Business-to-business fora to boost livestock trade in Northern Kenya	Social Science	Stage 2: successful piloting (PIL - end of piloting phase)	Sub-national, Kenya
688 - VegMeasure® computerized vegetation measurement program	Research and Communication Methodologies and Tools	Stage 3: available/ ready for uptake (AV);	Global

690 - Molecular markers for barley breeding	Research and Communication Methodologies and Tools	Stage 2: successful piloting (PIL - end of piloting phase)	Global
691 - New feed resource technologies in Tunisia	Production systems and Management practices	Stage 2: successful piloting (PIL - end of piloting phase)	National, Tunisia
692 - Module on the implementation of different livestock extension approaches in Tunisia	Social Science	Stage 2: successful piloting (PIL - end of piloting phase)	National, Tunisia
744 - Risk mapping for pig endemic diseases in Vietnam	Research and Communication Methodologies and Tools	Stage 1: discovery/proof of concept (PC - end of research phase)	National, Vietnam
745 - Online tick database for Tunisia	Research and Communication Methodologies and Tools	Stage 3: available/ ready for uptake (AV);	National, Tunisia
746 - Community based gastrointestinal parasite control in small ruminants in Ethiopia	Production systems and Management practices	Stage 2: successful piloting (PIL - end of piloting phase)	National, Ethiopia
747 - Post-mortem training module for vets in Ethiopia	Production systems and Management practices	Stage 1: discovery/proof of concept (PC - end of research phase)	National, Ethiopia
748 - Training module for vets/paravets on coenurosis control in small ruminants in Ethiopia	Production systems and Management practices	Stage 2: successful piloting (PIL - end of piloting phase)	National, Ethiopia
751 - Mobile veterinary service delivery model for pastoral systems in Kenya	Production systems and Management practices	Stage 2: successful piloting (PIL - end of piloting phase)	National, Kenya
752 - Public Private Partnerships for veterinary service delivery in Kenya	Production systems and Management practices	Stage 2: successful piloting (PIL - end of piloting phase)	National, Kenya
753 - Market assessment approaches for adoption of porcine cysticercosis vaccine in Uganda	Social Science	Stage 3: available/ ready for uptake (AV);	National, Uganda
754 - Vaccine platform for African Swine fever in Kenya	Biophysical Research	Stage 1: discovery/proof of concept (PC - end of research phase)	National, Kenya
755 - African swine fever virus replication methodology to facilitate production of vaccine candidate	Biophysical Research	Stage 1: discovery/proof of concept (PC - end of research phase)	National, Kenya
756 - Nanotechnology for East Coast fever vaccine development for cattle	Biophysical Research	Stage 1: discovery/proof of concept (PC - end of research phase)	Global
757 - New vaccine method conferring partial protection against lethal East Coast fever in cattle	Biophysical Research	Stage 1: discovery/proof of concept (PC - end of research phase)	Global
758 - A novel technique for measuring protective potential of candidate East Coast fever vaccines	Biophysical Research	Stage 1: discovery/proof of concept (PC - end of research phase)	Global
759 - In vivo role of capsular polysaccharide in Mycoplasma mycoides	Biophysical Research	Stage 1: discovery/proof of concept (PC - end of research phase)	Global
760 - Identification of targets of Mycoplasma mycoides subspecies mycoides	Biophysical Research	Stage 2: successful piloting (PIL - end of piloting phase)	Global

761 - Standardized protocols to gather information on antimicrobial use	Research and Communication Methodologies and Tools	Stage 2: successful piloting (PIL - end of piloting phase)	Global
762 - One Health antimicrobial resistance surveillance in Vietnam	Biophysical Research	Stage 2: successful piloting (PIL - end of piloting phase)	Global
763 - Herd Health packages to improve pig health in Uganda	Production systems and Management practices	Stage 2: successful piloting (PIL - end of piloting phase)	National, Uganda
785 - Electronic syndromic surveillance of livestock diseases in Marsabit, Kenya	Biophysical Research	Stage 3: available/ ready for uptake (AV);	Sub-national, Kenya
797 - National guidelines for agri-nutrition community messaging in Kenya	Social Science	Stage 3: available/ ready for uptake (AV);	National, Kenya

Table 5: Summary of status of Planned Outcomes and Milestones (Sphere of Influence-Control)

FP	Outcomes 2022	Summary narrative on progress against each FP outcome this year	Milestone 2018	Milestone status	Evidence for completed milestones or explanation for extended, cancelled or changed
F1	F1 Outcome: 1.1 - Data on livestock diversity and systems, including from a gendered lens, used to develop or refine genetic improvement and / or conservation strategies by policymakers, national research and development partners, and the private sector, in 5 CRP priority countries and other locations.	A methodology for developing environmental suitability maps has been published and maps produced for several chicken and small ruminant breeds. The flagship now has considerable new genome information on diversity and adaptation of chicken, sheep and cattle, which is being integrated in genetic improvement (e.g. for the dissemination of improved genotypes in suitable habitats) and conservation (e.g. selection of population for ex-situ conservation of primordial germ cell in chicken) in Ethiopia and Tanzania. The chicken phenotypic platform is fully functioning with the first experiment at the interphase of chicken genetics, health and nutrition due to take place in March/April 2019.	2018 - 1.1.2 Environmental suitability maps for sheep, goat and chicken available for Ethiopia by end of 2018.	Complete	Several relevant papers and publications where such environmental suitability maps are presented and being applied in relation to breed productivity and adaptability e.g. D6254, https://cgspace.cgiar.org/handle/10568/98850 and D13063, https://cgspace.cgiar.org/handle/10568/97661 .
			2018 - 1.1.3 Baseline genome characterization information of existing livestock (small ruminant, cattle, chicken) populations, including genome sequencing, available for Ethiopia and Tanzania, as well as for Ethiopian sheep, by end of 2018.	Complete	Several relevant peer-reviewed papers have been published (chicken, sheep, cattle) e.g. https://hdl.handle.net/10568/100246 , https://cgspace.cgiar.org/handle/10568/99373 , https://cgspace.cgiar.org/handle/10568/96566). Now that this baseline genome characterization is complete, the focus will be on the identification of causative polymorphism.
			2018 - 1.1.4 A poultry phenotypic characterization platform available at ILRI Ethiopia by end of 2018.	Complete	The opening of the platform, D4716, https://hdl.handle.net/10568/92429 , attracted a lot of media attention (https://www.reuters.com/article/us-ethiopia-chicken-africa/art-and-science-marry-in-ethiopias-quest-for-the-perfect-chicken-idUSKBN1HX2AS). It is fully functional with several experiments planned in 2019.

<p>F1 Outcome: 1.2 -Genetic improvement strategies for improved livestock genetics implemented by national research and development partners, and the private sector in 6 CRP priority countries and other locations.</p>	<p>A panel of suitable SNPs was identified but the new SNPs chips have yet to be produced. For now, a more expensive commercially available SNPs chip is being used to avoid delays in program implementation. It will be replaced as soon as a new, more affordable chip is produced – expected in 2019, with a new private sector partner. The tool will allow selection of the best admixed bulls, a central component of the genetic improvement strategy for dairy cows.</p>	<p>2018 - 1.2.4 Availability of zebu x taurine admixture SNPs chips for screening of dairy cattle crossbred in Ethiopia and Tanzania by August 2018.</p>	<p>Extended</p>	<p>Several deliverables e.g. D9236, https://cgspace.cgiar.org/handle/10568/98243, D12568, https://cgspace.cgiar.org/handle/10568/96904 and publications (see Table 6) have contributed to the identification of the SNPs panel. The new SNPs chips were not produced because it was not possible to reach agreement with the initial private sector partner (on price and timeframe for product availability).</p>
<p>F1 Outcome: 1.3 - Business models for multiplication and delivery of improved livestock genetics, to resource poor women and men livestock keepers, implemented by national research and development partners, and the private sector in five CRP priority countries and other locations.</p>	<p>Milestone 1.3.2 dealing with the development of a business model is key to achieving this outcome. The successful development of a business model is now attracting substantial W3 funding in 2019 and beyond, from the Bill and Melinda Gates Foundation.</p>	<p>2018 - 1.3.2 Development of a business model for the delivery and improvement of chicken relevant to Ethiopia, Tanzania and Nigeria, by end of 2018.</p>	<p>Complete</p>	<p>The business case for the multiplication and delivery of improved chickens has now been established, D9255, https://hdl.handle.net/10568/100242.</p>
<p>F1 Outcome: 1.4 - Women and men resource poor livestock keepers sustainably utilizing improved livestock genetics, both productive and adapted, in 3 priority countries and other locations.</p>	<p>Outcome 1.4 was supported by the publication of gender analysis for poultry in three countries (Ethiopia, Tanzania and Nigeria).</p>	<p>2018 - 1.4.1 Publication of a study reporting how gender dynamics may affect genetics interventions and which institutional arrangements may help ensure gender equitable outcomes of genetics interventions by August 2018.</p>	<p>Complete</p>	<p>The gender dynamics is now understood in relation to genetics interventions (multiplication and delivery of improved genotypes). See D12770, https://cgspace.cgiar.org/handle/10568/91218, D12772, https://cgspace.cgiar.org/handle/10568/91217, D12774, https://cgspace.cgiar.org/handle/10568/91216, D12820,</p>

					https://cgspace.cgiar.org/handle/10568/100514 , https://cgspace.cgiar.org/handle/10568/100512 .
	F1 Outcome: 1.5 - Guidelines on policy and institutional arrangements for improvement and conservation of animal genetic resources (AnGR) adopted by policymakers, national research and development partners, and the private sector, in at least 4 priority countries and other locations.	Substantial progress was made on the small ruminant side, the guidelines being a pre-requisite for the distribution of improved ram outputs from the small ruminant community-based breeding programs (CBBP).	2018 - 1.5.2 Guidelines established on institutional arrangements needed for certification of breeding rams/bucks by August 2018.	Complete	These guidelines are now available for Ethiopia (D4731) https://dx.doi.org/20.500.11766/9586 .
F2	F2 Outcome: Outcome 2.1 Assessment tools for significance of animal diseases and risk maps for emergence of animal diseases are used by 100 local and national and 50 international research partners and donors for priorities research and development interventions to reduce livestock disease risks for livestock keepers.	An assessment tool to understand disease priorities at local level is complete. Using porcine reproductive and respiratory syndrome (PPRS), a framework for epidemiological models and risk mapping has been developed and tested in Vietnam and the data used in discussions with partners. The aim is to apply the same approach for other diseases in Vietnam and for Uganda. The successful tick mapping in Tunisia has just started to expand into Kenya. Overall, the work on assessment tools and risk maps is well underway in several countries, while dialogue with national stakeholders has been initiated.	2018 - A gender-sensitive assessment tool for identifying disease priorities in CRP sites available in the public domain by the end of 2018.	Complete	Tool complete: https://cgiar.sharepoint.com/:w:/r/sites/livestock/_layouts/15/Doc.aspx?sourcedoc=%7BA6340E80-9BD6-41B7-9543-B11FF798F226%7Dfile=Disease%20Priority%20Framework.docxaction=defaultmobileredirect=true
	F2 Outcome: Outcome 2.2 Context specific herd health management	In Uganda, longitudinal data collection from pig farms on herd health management is ongoing, with	2018 - 2 epidemiological risk models (pig and small ruminant disease) developed, and modelling framework for assessment of PPR control and eradication defined, by end of 2018.	Extended	Some papers published, some drafted and distribution maps put on-line for Vietnam. The development of the PPR framework is postponed to 2019 as the start of the bilateral project supporting its development has been delayed.
			2018 - Tool to determine herd health packages for the pig value chain in	Extended	The recruitment of a suitable junior scientist for conducting the field

<p>packages adopted by farmers, extension and animal health workers in priority countries and other locations.</p>	<p>completion estimated in mid-2019. In Ethiopia, the work is more advanced and assessment of health interventions has been conducted, with promising results. In addition, evidence of behavior change and household dynamics is emerging, following implementation of community conversations around gender, division of labor, and risk of zoonotic diseases.</p>	<p>Uganda developed by the end of 2018.</p>		<p>work and collecting data took longer than anticipated.</p>
<p>F2 Outcome: Outcome 2.3 Livestock keepers have necessary knowledge of AMR and antiparasitic resistance (APR) to change their practices; piloted in two priority countries.</p>	<p>We first developed a tool for collecting data on knowledge, attitudes and practices for farmers use of antimicrobials. Data have now been collected from three countries (Ethiopia, Uganda and Vietnam, with approximately 400 farms per country) and are being analysed. Based on the data, the next step will be to tailor interventions to reduce unnecessary use of antibiotics.</p>	<p>2018 - Availability and use of antimicrobials and Knowledge, Attitudes and Practices regarding AMR recorded among smallholders in the small ruminant (Ethiopia) and pig (Vietnam and Uganda) value chains by September 2018.</p>	<p>Complete</p>	<p>https://www.dropbox.com/s/9dky7v7gjp1uby9/KAP%20AMUSE%20to%20share%20Nov%202018.docx?dl=0; https://de.slideshare.net/ILRI/isvee-barbara; https://de.slideshare.net/ILRI/isvee-alemu; https://amr.cgiar.org/case-study/collecting-data-antibiotic-use-animals</p>
<p>F2 Outcome: Outcome 2.4 National and international research partners, government agencies and the private sector use 2 novel diagnostic assays and vaccines for control of ASF, CBPP, CCPP, ECF and PPR in at least 6 priority countries.</p>	<p>A CCPP challenge model has been established that will be very helpful for testing new vaccine candidates. Progress has been made towards the development of improved vaccines against CBPP, with confirmation that the bacterial capsule polysaccharide of a goat model mycoplasma is a possible vaccine target. Several achievements have been made during ECF vaccine development to advance towards a proof-of concept stage for an ECF vaccine with sporozoite and schizont antigens and selection of methods for immunization.</p>	<p>2018 - Down selection, i.e. reduction in the number of candidate ECF, CBPP, CCPP vaccine antigens and vaccination methods.</p>	<p>Complete</p>	<p>Publications: https://ilvac.net/2018/12/17/development-of-a-challenge-model-for-contagious-caprine-pleuropneumonia-ccpp/; https://ilvac.net/2018/12/17/towards-improved-vaccines-against-contagious-bovine-pleuropneumonia-cbpp/; https://ilvac.net/2018/12/07/progress-in-developing-next-generation-vaccines-for-the-control-of-east-coast-fever/; https://www.ncbi.nlm.nih.gov/pubmed/30541131 https://www.ncbi.nlm.nih.gov/pubmed/29429808; ht</p>

					tps://www.sciencedirect.com/science/article/pii/S0020751917303454 ; https://www.sciencedirect.com/science/article/pii/S0165242717305846
			2018 - Agreements with at least 2 private partners to commercialize improved diagnostic tests for CBPP in Kenya, Uganda, Ethiopia, Tanzania and Mali by the end of 2018.	Extended	Discussions have stalled due to turnover of ILRI personnel and the lack of an obvious market for the test.
			2018 - A booting up system developed for African swine fever (ASF) virus.	Complete	The first viral genome modification using CRISPR-Cas technology is currently being confirmed, and on the synthetic component of the project, the building blocks of the complete viral genome are ready for assembly from sub-fragments. A procedure for initiating production of ASF virus from transfected viral genomic DNA is developed. https://ilvac.net/2018/12/10/establishment-of-a-vaccine-technology-platform-for-african-swine-fever-as-the-first-target/ .
F2 Outcome: Outcome 2.5 Improved access to livestock-related health services and products for female and male livestock keepers in 4 priority countries	This outcome spans several countries, with considerable progress made in majority of them. Scaling up efforts for some approaches in some countries encountered unexpected unfavorable policies, which are being addressed. In one country, activities did not start due to a delay in inception of a bilateral funded project. Thermostability tests of the PPR vaccine produced did not meet the targeted ranges – improvements have therefore been initiated. Market	2018 - Two novel delivery models of animal health services and products and cap dev/training methods tested in collaboration with partners in Kenya, Tanzania, Ethiopia and Mali by the end of 2018.	Complete	The Accelerated Value Chain Development bilateral project, ended in 2018, tested vet-runs in Kenya and in Mali, innovation platforms continued to improve participation of different stakeholders in vaccination control and the approach has been taken up by other projects (e.g. the Harande (food security) project of CARE). Link: https://www.ilri.org/publications/feed-future-mali-livestock-	

		assessment for veterinary diagnostics was not implemented due to a change in external funding arrangements, leading to unavailability of funds. As this remains an important activity, new funding is being sought.			technology-scaling-program-fff-mltsp-annual-report-october
			2018 - Market for diagnostics in Kenya, Uganda, Tanzania, Ethiopia and Mali assessed and cost effectiveness of producing thermostable PPR vaccine analysed by July 2018.	Extended	A planned market assessment for veterinary diagnostics was cancelled due to a change in external funding arrangements, and new funding is being sought. The initial batch of PPR vaccine produced did not meet the thermostability targets as per the protocol.
F3	F3 Outcome: 3.1 - Local, national and international research and development partners, the private sector, decision-makers and livestock producers are able to diagnose feed constraints and opportunities and to effectively prioritize and target feed and forage interventions, resulting in: a 10% improvement in utilization of feeds and forages, a 20% increase in animal production using improved feed and forage technologies, a 10% accuracy increase for biomass and quality estimation and at least 250,000 annual visitors to global databases, repositories, interactive tools and maps and the Tropical	The TGFT online journal reached 120,000 users and the Tropical Forages tool (SoFT) reached 180,000 users in 2018. The LegumeChoice and G-FEAST tools were launched: G-FEAST enhances the existing FEAST tool to address gender considerations in feed assessment and selection, making it more demand-oriented to specific target groups; LegumeChoice focuses on selection of high protein feed options. These tools capitalize on CCIAR research and are contributing to prioritization of feed interventions in target regions, which should result in improvements in feed utilization and biomass and quality increases. Unfortunately, the AFAWA website could not be launched as planned in 2018 due to software development setbacks.	2018 - Research and development partners, decision makers and input suppliers use at least 2 tools designed or promoted by the CRP (e.g. Legume CHOICE) for regional and national feed supply and demand scenarios in 2 priority countries (Vietnam, Ethiopia) by December 2018.	Complete	The Genderized FEAST and the LegumeChoice tool were advanced and promoted. FEAST: https://cgspace.cgiar.org/handle/10568/100244 .LegumeChoice: https://cgspace.cgiar.org/handle/10568/100152 .
			2018 - Access by research partners to CRP generated knowledge on forages increased through 3 issues of the Tropical Grasslands journal (in January, May and September 2018).	Complete	3 issues of the TGFT journal were published (January, May, October 2018). More than 130,000 people are using the journal and user statistics grew significantly. The design of the journal website was also improved to make it more user-friendly, http://tropicalgrasslands.info/index.php/tgft , https://cgspace.cgiar.org/handle/10568/99246 .
			2018 - The ICARDA Animal Feed Analysis Web Application (AFAWA) has reached at least 5,000 users by the end of 2018.	Extended	An improved version of the AFAWA website is still being finalized and will be officially launched in 2019. Thus, the expected number of users (5,000) could not be reached in

Grasslands/Forrajes Tropicales journal website.				2018. Near final version of the website: https://afawa.icarda.org/ .
F3 Outcome: 3.3 - National and international research and development partners and the private sector are using CRP developed forage and rangeland resources (with enhanced traits) in 30 countries, reaching producers who plant over 2 million ha, to increase the rate of genetic gain and exploit the genetic diversity of forages and rangeland species to enhance stress-tolerance, biomass productivity and nutritive value.	The commercialization of CIAT's <i>Urochloa</i> hybrids by the private sector partner is advancing significantly and by the end of 2018, the estimated area sown was 930,000 hectares in more than 25 countries in the global tropics and subtropics. Evidence for this will be available only by mid-2019 since it is dependent on private sector seed sales data.	2018 - 1 <i>Urochloa</i> hybrid commercialized by the private sector in at least 1 country and current available forage hybrids scaled with private sector partner in at least 15 countries on 100,000 hectares by the end of 2018.	Complete	CIAT <i>Urochloa</i> hybrids were scaled on 130,000 additional hectares in 15 countries. Evidence from private sector partner Papalotla based on seed sales showed that the total area sown with CIAT hybrids as at the end of 2018 was 950,000 hectares in 30 countries. https://ciatnet.ciat.cgiar.org/sites/forages/_layouts/15/DocIdRedir.aspx?ID=43FT57PHUFD2-3-21847
F3 Outcome: 3.5 - National and international development partners, government agencies and extension services, the private sector and	"FeedAssist" was modified for the state of Odisha in India by using the local language in the App and incorporating Odisha feed data as input. A second further simplified ration balancing tool was designed for and is currently being	2018 - 3 forage ontologies established and accessible (through reports and publications) to research partners and the private sector, to advance selection and breeding of forages.	Complete	An ontology for tropical grass forages was created (a web page with the consensus metric system to be used when measuring forage attributes) which is applicable to all <i>Urochloa</i> species (formerly called <i>Brachiaria</i> : <i>B. ruzisiensis</i> , <i>B. decumbens</i> , <i>B. brizantha</i>), <i>Megathyrsus maximus</i> (formerly called <i>Panicum maximus</i>) and <i>Cenchrus</i> spp. https://www.croponontology.org/ontology/CO_345/Brachiaria ; https://www.ebi.ac.uk/ols/ontologies/co_345/terms?iri=http%3A%2F%2Fwww.croponontology.org%2Frd%2FCO_345%3AROOT
		2018 - At least 2 tools developed to increase productivity while reducing feed and labor costs, considering gender-responsiveness and scalability for 1 priority country (Ethiopia) and 2	Complete	Evidence link to "FeedAssist" (downloadable only in India): https://play.google.com/store/apps/details?id=cabgrid.res.in.feedguide ; https://hdl.handle.net/10568/100359 . The FeedBase tool for Ethiopia

<p>community-based organizations in 3 priority countries are using CRP-related research outputs for better utilization of existing and novel feed and forage resources. This will be through (a) scalable processing technologies, (b) management strategies to conserve and rehabilitate rangelands and (c) diet formulation that increases productivity while reducing overall feed and forage costs and environment impacts.</p>	<p>made operational by a tool developer. The impact of ration balancing in dairy in India was explored for more than 2.7 million dairy cows. Average monetary gain after application of ration balancing was 24 Indian Rupees per dairy animal per day.</p>	<p>further countries (India, Malawi) by December 2018.</p>		<p>was presented and in Malawi feed quality and feed price data was input into a least cost feed tool which is currently being tested.</p>
<p>F3 Outcome: 3.6 - Livestock producers in 3 priority countries: apply management strategies to conserve and rehabilitate rangelands and pastures while ensuring ongoing ability to produce, preserve and store feed biomass and use diets that increase productivity while reducing overall feed and forage costs and environmental impacts (with the environment and livelihoods flagships).</p>	<p>Good advances were made for India and Malawi. However, much of the work will be done in the coming year(s) in Ethiopia and Malawi. For Ethiopia, the guidelines for decentralized feed compounding are in the final preparation stage and will be finalized in 2019.</p>	<p>2018 - Two off-farm feed processing options delivered (tested, with farmers and NARS staff trained in their use) and 1 agronomic rangeland practice developed in 1 priority country (Ethiopia) and 3 further countries (India, Malawi, Afghanistan) by December 2018.</p>	<p>Extended</p>	<p>The milestone was extended because the least cost diet designed with EthioFeed can only be mixed and tested with maize stover harvested now in the cropping season 2019. India report - https://hdl.handle.net/10568/100484</p>
<p>F3 Outcome: 3.8 - Increased delivery and uptake of feed and forage</p>	<p>Strong advances were made on the business model development, extension approaches and innovation</p>	<p>2018 - Six feed/seed business approaches developed in at least 3</p>	<p>Complete</p>	<p>Colombia: 3 economic analyses for forage technologies. Kenya: 1 economic analysis and evaluation of</p>

	resources through proof-of-concept scaling, business model development and value-chain approaches by development partners, the private sector (feed and forage traders, feed processors) and (1 million by 2022) farmers across diverse environments in priority countries and other locations in Latin America, North and East Africa and South and Southeast Asia.	platforms in Colombia, Tunisia and Kenya. This is a good basis for further work and will strongly influence the adoption of feeds and forages technologies in the future years.	countries (Tunisia, Kenya, Colombia/Nicaragua) by end of 2018.		3 different forages business cases (on-farm use, sale, forage conservation). Tunisia: 1 report on performance of feed processing technologies (hydroponic barley production) and 1 report on cactus establishment. Colombia: https://cgspace.cgiar.org/handle/10568/99204 ;Kenya: https://cgspace.cgiar.org/handle/10568/90961 ; https://cgspace.cgiar.org/handle/10568/99401 ;Tunisia: http://repo.mel.cgiar.org/handle/20.500.11766/8903 .
			2018 - At least 4 different extension approaches for feed and forages implemented in 5 countries (Tunisia, Kenya, Rwanda, Tanzania, Ethiopia).	Complete	Colombia: 1 extension approach tested; 1 manual distributed. Kenya: 2 factsheets developed; 1 training approach for forage conservation and seed marketing developed; field days and demonstration plots organized. Tunisia: 4 different

				extension approaches tested, applied and validated. Colombia: https://cgspace.cgiar.org/handle/10568/99208 ; https://cgspace.cgiar.org/handle/10568/96261 Kenya: https://cgspace.cgiar.org/handle/10568/99407 ; https://cgspace.cgiar.org/handle/10568/99408 ; https://cgspace.cgiar.org/handle/10568/99410 Tunisia: http://repo.mel.cgiar.org/handle/20.500.11766/9379
			2018 - Exchange with Innovation Platforms, roundtables and private sector around feed, forage and processing technologies consolidated (e.g. through meetings, workshops, fairs, information events) in at least 3 countries (Tunisia, Kenya, Colombia) by the end of 2018.	Complete Kenya: Advances were made towards establishing the Brachiaria Roundtable. Colombia: CIAT contributed strongly to the Colombian Roundtable for Sustainable Beef through knowledge sharing/validation and inputs to a national policy. Tunisia: evaluation of the established innovation platforms provided valuable insights for future activities. Kenya: https://cgspace.cgiar.org/handle/10568/99411 Colombia: https://cgspace.cgiar.org/handle/10568/99205 Tunisia: http://repo.mel.cgiar.org/handle/20.500.11766/9188
F4	F4 Outcome: 4.1 - Environmental concerns are considered in decision making across at least 10 priority countries and	GHG baselines for Kenya were published in collaboration with CCAFS. Without these baselines, countries cannot monitor progress towards their Nationally Determined Contribution	2018 - GHG baseline emissions are published for Kenya and Vietnam by the end of 2018.	Completed The first papers of GHG emissions baselines for African Livestock Systems are published: Ndung'u et al (2018) Animal Production Science https://doi.org/10.1071/AN17809;O

<p>other locations, by national and international development partners, government agencies and extension systems, including technology developers seeking to improve cattle, small ruminant and pig production.</p>	<p>(NDC) commitments. Additional environmental footprint baselines (hydrology and soils) were also published for Kenya. In Vietnam (with CCAFS) a report was written on the GHG emissions baseline undertaken there – a publication is forthcoming; the data have been handed over by the national partner and will be available in 2019. A third country, Tanzania, has been added: the data collection has finished and is being written up. Delays are due to lengthy processing of research permits.</p>			<p>nyango et al (2018) Asian-Australasian Journal of Animal Sciences https://doi.org/10.5713/ajas.18.0114;Zhu et al (2018) Global Biogeochemical Cycles https://doi.org/10.1029/2018GB005949 Published papers on additional footprints:https://doi.org/10.1002/2017WR021592;https://doi.org/10.1186/s12898-018-0202-z;https://doi.org/10.1186/s13021-018-0114-4;https://doi.org/10.1016/j.scitotenv.2017.12.081;https://doi.org/10.1002/2017JG003856.</p>
<p>F4 Outcome: 4.2 -Targeted solutions are used by research and development partners, across at least 10 priority countries and other locations, to increase the productivity of cattle, small ruminants and pigs in the face of ongoing environmental changes.</p>	<p>Forage intensification options have been identified and disseminated in Tanzania and Rwanda (under the Environment Flagship) and will be disseminated in Kenya and Ethiopia through the Feeds and Forages flagship. This shows how the Environment Flagship works with the technology generating flagships to assess the possible impact of environmental change on the technologies such as forage intensification. In Kenya and Ethiopia, farmers are starting to express preferences for <i>Brachiaria</i> Hybrids cvs. Cobra and Mulato II and <i>Panicum maximum</i> cv. Mombasa, and asking for support to plant more of these species across many farms.</p>	<p>2018 - Three forage intensification options adapted to climate change are disseminated in Tanzania, Kenya and Ethiopia by the end of 2018.</p>	<p>Completed</p>	<p>The dissemination under the Environment Flagship is taking place in Kenya and Ethiopia, with funding from BMZ and SNV. Many farmer demonstrations are ongoing and about 7500 farmers are being reached in Kenya.https://doi.org/10.7910/DVN/FNEGDPhttps://doi.org/10.7910/DVN/ESK6BBhttps://ciatshare.ciat.cgiar.org/sites/climatesmartdairy/SitePages/Field-Trials.aspx</p>

F4 Outcome: 4.3 - Government agencies and development partners at local and national levels, across at least 10 priority countries and other locations, are promoting environmental management options.	The rangeland interventions are all identified, and dissemination is ongoing in Tunisia, and will start in Kenya and Ethiopia in 2019. In Tanzania the focus has been on land use planning to secure grazing lands and management interventions have not yet started.	2018 - Five sustainable rangelands interventions in Kenya, Tanzania, Tunisia and Ethiopia are identified, tested and disseminated to livestock producers by the end of 2018.	Extended	The evidence of the dissemination is covered in the following: http://repo.mel.cgiar.org/handle/20.500.11766/8493 ; http://repo.mel.cgiar.org/handle/20.500.11766/9076 ; http://repo.mel.cgiar.org/handle/20.500.11766/8805 ; http://repo.mel.cgiar.org/handle/20.500.11766/9078 ; http://repo.mel.cgiar.org/handle/20.500.11766/9397 ; http://repo.mel.cgiar.org/handle/20.500.11766/9396 ; http://repo.mel.cgiar.org/handle/20.500.11766/9174 .
F4 Outcome: 4.4 -Gender responsive environmental management options that are well adapted to Global Environmental Change are adopted by households (women and youth) in 6 countries.	Our progress has been delayed due to personnel change in 2018. A full time gender specialist (2/3 funded by CCAFS) has now been recruited. She has almost finished the global review and it will be published in 2019.	2018 - Tools to enhance gender inclusion in environmental management identified: four tools identified by end of 2018 across five types of sustainable land management projects, based on a global review.	Extended	To be published in 2019.
F4 Outcome: 4.5 -National government agencies across at least 5 priority countries design and implement key policies to improve the environmental management of livestock systems	Both milestones have been achieved in 2018, meaning the flagship is on track in three countries to see government agencies design and implement policies to support the improved environmental management of livestock systems, e.g, use of grazing to improve rangeland condition. This approach is based on strong collaborations with key government partners who are willing to consider the importance of land use planning to support improved rangeland management at local, district and national levels.	2018 - National environmental policy for Tunisia completed by the end of 2018.	Complete	Please see "A new pastoral code for Tunisia: Reversing degradation across the country's critical rangelands" http://repo.mel.cgiar.org/handle/20.500.11766/8806 This is exciting because the Tunisian government is providing policy support for sustainable livestock production. The code also offers a framework for other countries experiencing degradation in rangeland areas.
		2018 - Dissemination of manuals/ tools for rangeland and land use planning processes in Tunisia, Kenya	Complete	Government staff were trained to use the manuals which have been published and shared. See the

			and Tanzania to community leaders, local government officials and national line ministry staff by the end of 2018.		following for evidence: http://hdl.handle.net/20.500.11766/8262 ; http://hdl.handle.net/20.500.11766/8261 ; http://hdl.handle.net/20.500.11766/8266 ; https://hdl.handle.net/10568/99262 ; http://hdl.handle.net/20.500.11766/8268 ; http://hdl.handle.net/20.500.11766/8911 ; http://repo.mel.cgiar.org/handle/20.500.11766/9412 ; http://repo.mel.cgiar.org/handle/20.500.11766/8906 .
	F4 Outcome: 4.6 -Evidence generated by the flagship influences key global livestock agendas (IPCC, Global agenda for Sustainable Livestock)	The Global Forum for Food & Agriculture (GFFA) ministerial communication in January 2018 mentioned environmental issues specifically. Through engagement with the Global Landscapes Forum in Nairobi in August 2018, and ongoing engagement with the International Land Coalition Rangelands Initiative as well as the Land Portal, research results have been shared and policymakers and advocates engaged, identifying approaches to creating enabling environments for effective rangeland management. The push in these engagements is for landscape restoration initiatives to also consider rangelands, not only forests.	2018 - Two events will be influenced by the end of 2018. High level communication on livestock and environment at the GFFA (January 2018); side event on livestock and environment at UNFCCC COP 24 in November 2018.	Complete	These engagements were publicized through blog posts as follows. Engagements on policy for rangelands included: https://cgspace.cgiar.org/handle/10568/99173 ; https://landportal.org/debates/2018/making-rangelands-more-secure ; https://cgspace.cgiar.org/handle/10568/99174 ; https://landportal.org/book/thematic/rangelands-drylands-pastoralism ; https://www.youtube.com/watch?v=leTI4W2YHeE&index=15&list=PL8FXDnWRzz0LIMmciGxf28E8YVaq-Olcgt=0s .The GFFA communication is described here: https://news.ilri.org/2018/03/05/bmzs-stefan-schmitz-on-sustainable-solutions-for-the-livestock-sector/ .
F5	F5 Outcome: 5.1 -National and international research partners and policymakers	Progress includes the engagement, including capacity development, with national decision makers, researchers,	2018 - Livestock Master Plans completed in Bihar and Tanzania by December 2018.	Complete	For Bihar, the documents were completed in 2018, although the official launch only took place in

use analyses of livestock-sector dynamics, investment and ex-ante impact assessments to guide priority setting, investment and policy development for the livestock sector in 5 priority countries and within the Livestock CRP	development agencies and donors, through work on Livestock Master Plans (LMPs) and through the 'why livestock matter' website that was completed, with evidence generated for 5 topics: nutrition, health, economic opportunity, gender and climate environment. Setbacks includes the delay in launching the LMPs in Bihar and Tanzania. In Ethiopia, the LMP guided both public and private sector investments.			January 2019. See https://news.ilri.org/2019/04/18/a-livestock-master-plan-is-mission-critical-for-indias-state-of-bihar .The same applies to Tanzania with the launch taking place in March 2019, see https://news.ilri.org/2019/04/10/tanzania-launches-usd596-million-livestock-master-plan/ .
		2018 - LMP Bihar, completed in December 2018, includes a gender analysis section (objective and data).	Complete	Same as above.
		2018 - GLAD message map on key livestock facts generated and dissemination on global portal by end of 2018.	Complete	The website www.whylivestockmatter.org is up and running.
		2018 - Gov of Ethiopia uses completed LMP to share major livestock loan request with WB during 2018.	Complete	The World Bank loan of about \$170M was launched in 2018, based on the completed Livestock Master Plan. Section 8 in: http://documents.worldbank.org/curated/en/392591478726570546/pdf/ITM00184-P159382-11-09-2016-1478726567434.pdf
F5 Outcome: 5.2 - International researchers and agencies use improved livestock system modelling tools and apply them to new problems based on their mandate areas	Discussions are ongoing to revise the Livestock Sector Investment and Policy Toolkit (LSIPT), working within a consortium (ILRI, FAO and CIRAD). The process of redesign began in December 2018 to support larger consortium efforts on LSIPT and LMP, looking at ways to improve the interface and add new modules. It is anticipated that a Memorandum of Understanding will be signed to formalize the collaboration.	2018 - Scenarios and modeling approaches agreed upon for integrated macro-meso analyses	Extended	Work is ongoing on the improvement of the LSIPT. Modeling approaches have converged on integrating herd models with multi-sector modeling. Proof of concept models have been developed to show these links, but the work took longer than expected, to allow for better alignment.

		Within the integration of modeling platforms, progress is also being made towards the use of participatory tools to develop systems models for ex-ante impact assessment of value chain interventions, e.g. the dairy value chain in Nicaragua.			
F5 Outcome: 5.3 -Policy- or decision-makers in 4 countries use the packages developed and the evidence on the benefits of including gender equity considerations in the development of livestock projects and planning at community and national level (Ethiopia, Kenya, Nicaragua, Vietnam)		While the benchmark publication on gender and livestock is delayed, work is ongoing regarding this outcome. For example, ILRI was requested to conduct the gender mid-term review of the World Bank funded project PRAPS in West Africa, that is expected to guide the gender activities in the next 3 years of this 6-country project. Also in Ethiopia, ICARDA and ILRI, with CIMMYT, provided training on gender to Ethiopia Institute of Agricultural Research (EIAR) staff who then used a Training of Trainers approach to further train other staff in their regional centres. At the CRP level, gender has been embedded in all the flagships.	2018 - Benchmark publication on gender and livestock to identify frontiers in research and development published by December 2018.	Extended	The work couldn't be completed due to the need to conduct a broader literature review. The team will prioritize this publication in 2019.
			2018 - CRP Gender strategy published by June 2018.	Extended	The strategy document has not been finalized. The main points of the gender strategy are available in PowerPoint presentations and have been embedded in all flagships, through: agreeing on gender outputs for some projects (e.g. poultry genetics); gender staff as contact person to each flagship; and joint fundraising.
			2018 - CRP Youth strategy published by June 2018.	Complete	The document has been discussed through an online consultation that resulted in the finalisation of the strategy. The document is being English edited. The SharePoint link for the online consultation is https://cgiar.sharepoint.com/sites/YouthStrategy .
F5 Outcome: 5.4 - Local or national development partners in four priority countries adopt gender-transformative and youth-supportive approaches		The Women's Empowerment in Livestock Index (WELI) tool, and paper, have been finalized. The uptake has been great, as the tool may be used in a set of IDRC livestock projects and also within ILRI. ILRI is about to start a	2018 - Finalized version of the WELI produced by September 2018.	Complete	The paper and tool have been published, see https://www.cgiar.org/research/publication/womens-empowerment-livestock-index/ . The tool aims at measuring the level of women

(using the evidence from the strategic gender research done under the CRP)	project with CARE in Ghana on assessing the feasibility to implement gender transformative approaches in vaccine delivery systems for goats and chicken. A women-driven project on chicken is also about to start in Tanzania and Ethiopia, that includes a strong capacity development component.			empowerment to be used in systems where livestock is an important agricultural activity. This fills a gap, with other tools not adequately capturing the livestock considerations.
F5 Outcome: 5.5 - Local and national development actors, government agencies, and the private sector invest in and adopt the most successful approaches for enhancing livestock-mediated nutritional impact, including institutional arrangements and behavioural change, in 3 priority countries.	Progress on this outcome was achieved through the combination of (a) the publication of a major report on the importance of animal source foods during the first 1,000 days, written in collaboration with A4NH and a major UK think tank, and (b) the on-the-ground work in the dairy and livestock value chains of ILRI-led development project, Accelerated Value Chain Development (AVCD).	2018 - Social and Behavioural Change Communication (SBCC) strategy for nutrition-related behaviour implemented among 5,000 households, (targeting women and children aged 6-23 months in Kenya) by October 2018.	Complete	The target was met and surpassed. Moreover, the project developed community cards to support the work, in collaboration with the government of Kenya (https://cgspace.cgiar.org/handle/10568/98538). Note that the Accelerated Value Chain Development project report where the figures can be found is not in the public domain but is available on request.
		2018 - Major report on influence of animal-sourced foods on child and mother nutrition published by June 2018.	Complete	The report (https://cgspace.cgiar.org/handle/10568/92907) has been published and a blog (https://news.ilri.org/2018/06/19/livestock-enhanced-diets-in-the-first-1000-days-of-life-pathways-to-better-futures-in-low-income-countries/) was also written. A series of events was organized to disseminate the results, for example the joint ILRI-Chatham side event at the EAT Stockholm Food Forum on 11 Jun 2018.

F5 Outcome: 5.6 -Livestock communities across 4 priority countries apply tested technologies, management strategies and institutional arrangements, taking the multiple functions of livestock into account	The first milestone reports on the CRP supported work with respect to the promotion of livestock technologies in Kenya (Accelerated Value Chain Development–AVCD project), Uganda and Tanzania (East Africa Dairy Development (EADD) project). Both these projects ended in December 2018. The fact that the protocol to guide testing, evaluation and scaling of technologies was not delivered has been a setback. Moving forward, the principles set in the other protocol, on institutional innovations, can also be applied here.	2018 – By December 2018, target dairy/livestock communities under AVCD and EADD projects in Kenya, Tanzania and Uganda apply tested feed, health and breeding technologies and/or management strategies (combined total of over 140,000 households: 78,000 in Kenya, 26,000 in Tanzania and 36,000 in Uganda).	Complete	The number of farmers registered to EADD-supported hubs are 46,671 in Uganda and 21,957 in Tanzania. In Kenya, the number of farmers who applied improved technologies or management practices are 92,762 in the AVCD livestock component and 79,947 in the dairy component (project lifetime - report not in public domain).
		2018 - Protocol to guide testing, evaluation and scaling of technologies, for use by Livestock CRP and other researchers, developed by December 2018.	Cancelled	Due to a misunderstanding, the protocol wasn't written: one team thought it was being done, the other thought that another tool would be adapted. However, another protocol focused on evaluating of institutional innovations was finalised (see 5.7), the principles of which can also be used for the evaluation of technologies.
F5 Outcome: 5.7 - Development partners, private sector and government agencies across 4 priority countries apply innovative institutional arrangements to enhance competitiveness and inclusiveness	The first milestone reports on the AVCD (Kenya) and EADD (Kenya, Uganda and Tanzania) projects, where CRP scientists are applying past research expertise to guide the implementation of new institutional arrangements (e.g. agent networks in AVCD, hub approach in EADD). The protocol is expected to be used from 2019, to identify lessons learned and allow synthesis when testing institutional innovations across countries and value chains.	2018 – Target dairy/livestock communities under AVCD and EADD in Kenya, Tanzania and Uganda apply tested organizational and business models among over 133,000 households combined.	Complete	The number of farmers using EADD-supported hubs are 8,717 in Tanzania, 17,824 in Uganda and 60,081 in Kenya (Heifer email communication). For AVCD Kenya, 4,561 farmers are members of 5 dairy business hubs (Heifer); 10,447 smallholder farmers from 29 dairy businesses have enhanced access to finance, inputs and services (Technoserve).
		2018 - Protocol to guide testing, evaluation and scaling of technologies, for use by Livestock CRP and other researchers, developed by December 2018.	Complete	The objective of testing integrated packages of technological and institutional innovations in the four priority CRP countries puts the Livestock CRP in a unique position to

				<p>generate lessons from different 'experiments'. The protocol has been circulated amongst the team and is available to them on SharePoint: https://cgjar.sharepoint.com/:w:/r/sites/livestock/_layouts/15/Doc.aspx?sourcedoc=%7B5B01CC99-0850-42A1-9F4E-A3769E662B3A%7Dfile=ProtocolTestEvaluateInnovations-LivestockCRP%20Feb%202019.docx&action=defaultmobileredirect=true</p>
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Table 6: Numbers of peer-reviewed publications from current reporting period (Sphere of control)

	Number	Percent
Peer-Reviewed publications	174	100.0%
Open Access	140	80.5%
ISI	157	90.2%

Table 7: Participants in CapDev Activities

Number of trainees	Female	Male
In short-term programs facilitated by CRP/PTF	1,020	1,213
In long-term programs facilitated by CRP/PTF	15	20

Table 8: Key external partnerships

Lead FP	Brief description of partnership aims (30 words)	List of key partners in partnership. Do not use acronyms.	Main area of partnership (may choose multiple)
F1	A new artistic platform for disseminating poultry genomics research outputs to the general public and donors	• Cosmopolitan Chicken BVBA	• Other - Communication
F1	Policy guidelines for informing livestock breed/population improvement and conservation options in developing countries	• AU-IBAR - African Union - Interafrican Bureau for Animal Resources	• Policy
F1	Development of new tools (chicken and cattle DNA SNPs chips)	• CTLGH - Centre for Tropical Livestock Genetics and Health	• Research • Development • Delivery
F2	Address issues of animal welfare within the CRP Livestock	• University of Melbourne	• Capacity • Policy
F2	Testing public-private partnership business models and facilitating the creation of an enabling environment with a strong focus on institutional adjustments and capacity development in the Ethiopian veterinary sector	• Ethiopian Veterinary Association	• Capacity • Policy
F2	Quality assurance for thermostable PPR vaccines	• PANVAC - Pan African Veterinary Vaccine Centre of African Union	• Delivery
F2	Mycoplasma research and genomics	• JCVI - J Craig Venter institute	• Research
F3	Forages Network for Colombia to coordinate forage development and scaling. In 2018, a first cultivar was released and seed is being multiplied by the private sector partner for scaling.	• AGROSAVIA (formerly CORPOICA) - Corporación Colombiana de Investigación Agropecuaria	• Research • Development • Delivery
F3	Private forage seed sector agreement for forage hybrid development, testing, commercialization and dissemination	• Papalotla - Semillas Papalotla SA de DV	• Delivery • Research • Development
F3	Partnership with several UK universities in the context of BBSRC funded projects	• Bangor University	• Research • Capacity
F3	Renewal of membership in Colombian Roundtable for Sustainable Cattle	• AGROSAVIA (formerly CORPOICA) - Corporación Colombiana de Investigación Agropecuaria	• Capacity • Policy
F4	To convene regional information sharing and priority setting in East and West Africa and Latin America	• Global Research Alliance on Agricultural Greenhouse Gases	• Capacity

F4	To share successes in rangeland management	<ul style="list-style-type: none"> • ILC – International Land Coalition 	<ul style="list-style-type: none"> • Policy
F5	Develop livestock master plans, by creating more robust and user-friendly modelling tools, building capacity and supporting the implementation of these plans	<ul style="list-style-type: none"> • ICARDA - International Centre for Agricultural Research in the Dry Areas • CIAT - Centro Internacional de Agricultura Tropical • ILRI - International Livestock Research Institute • FAO - Food and Agriculture Organization of the United Nations • CIRAD - Centre International de Recherche Agricole et du Developpement 	<ul style="list-style-type: none"> • Policy
F5	Collaborating on analysis of Infection and Treatment Method (ITM) impact study to determine herd and farm effects as well as the household livelihood impacts of ITM vaccinations	<ul style="list-style-type: none"> • ILRI - International Livestock Research Institute • GALVmed - Global Alliance for Livestock Veterinary Medicines 	<ul style="list-style-type: none"> • Research • Delivery
F5	AgriFoSe2030 (Agriculture for Food Security)- Develop the capacity of recent PhD graduates to undertake policy relevant research and analysis in East Africa	<ul style="list-style-type: none"> • ILRI - International Livestock Research Institute • SLU - Swedish University of Agricultural Sciences • Lund University • SEI - Stockholm Environment Institute 	<ul style="list-style-type: none"> • Policy • Research
F5	Complementary expertise - research and development activities in the dairy value chains, with possibility to expand to poultry	<ul style="list-style-type: none"> • ILRI - International Livestock Research Institute • Heifer International 	<ul style="list-style-type: none"> • Development • Research

Table 9: Internal Cross-CGIAR Collaborations

Brief description of the collaboration	Name(s) of collaborating CRP(s), Platform(s) or Centre(s)	Optional: Value added, in a few words
Developing business cases for African Chicken Genetic Gains and African Dairy Genetic Gains projects.	IFPRI	Scientific
Addressing anti-microbial resistance (AMR) within a One Health framework, and joint risk assessments and studies on emerging zoonotic diseases.	A4NH	Scientific benefits, understanding links between animal health and human health
Strong synergies were sought with CCAFS, i.e. with the LivestockPlus project and bilateral projects mapped to the Livestock CRP; on greenhouse gas emissions work – including reducing methane emissions per unit livestock, reducing nitrous oxides through Biological Nitrification in inhibition and mitigation through carbon accumulation; and on the exchange of a wide range of down-scaled climate projections for better assessments of adaptation needs and potentials.	CCAFS, CIAT	Scientific: collaboration with researchers from CCAFS on climate change mitigation and adaptation; Efficiency: Synergies between LivestockPlus project, bilateral CCAFS projects and the Livestock CRP
There is a close connection with the genebank platform, with ongoing efforts to identify the key forage species for conservation and use and linkages with the update of the SoFT tool. CIAT is closely connecting with ILRI and the CropTrust to define the strategy for forage conservation.	Genebank, CIAT, ILRI	Efficiency: linking genebank efforts with the forages selection tool
CIAT scientists attended the 3rd International Biological Nitrification Inhibition (BNI) Meeting in Japan for defining collaboration among and participation of several CGIAR centres and JIRCAS in BNI research. Participants: CIAT, JIRCAS, CIMMYT, ICRISAT, ILRI, several UK, US, Chinese, French and German universities, NARO Japan, BNI Consortium.	CIMMYT, CIAT, ICRISAT	Scientific: Access to research findings, plans for research, joint methodology development (e.g. ex-ante analysis); Efficiency: Collaborating on BNI research and less duplication of efforts.
CIAT participated successfully in the Breeding Program Assessment Tool (BPAT) evaluation in 2018 and is currently implementing recommendations that will lead to more efficient breeding and better targeting of breeding programs in specific production and market niches, including in tropical America, Asia and Africa. CIAT was in touch with EiB to prepare for their breeding program evaluation in 2019.	EiB, CIAT	Efficiency: The implementation of the recommendations from BPAT will lead to substantial efficiency gains in the future
A workshop took place in Colombia to bring together researchers from Colombia, Costa Rica, Dominican Republic and Honduras to discuss the development of a Monitoring, Reporting and Verification (MRV) tool for the	CIAT, CCAFS, ICRAF	Scientific: Collaboration with researchers of ICRAF and the LAC region; Efficiency: Strengthened networks for the development and implementation of NAMAs in the livestock sector.

LivestockPlus project, and the inclusion of silvopastoral ('trees and pasture') systems in national greenhouse-gas inventories.		
Strong cooperation on barley research. The Feeds and Forages Flagship decided to include barley research into its feed portfolio from 2019 onwards to address feed demand in semi-arid and highland environments.	ICARDA, GLDC	Scientific and efficiency
Standardizing and applying plant breeding advances in genotyping/sequencing, phenotyping, logistics and allocation of resources.	EiB, ILRI	Scientific benefits and learning about work with wild species
Generating Digital Object Identifiers for 100% of the ILRI genebank collection, contributing data on three new traits on common subsets of accessions, and encouraging users to focus in-depth phenotyping efforts.	Genebank, ILRI	Scientific benefits, efficiency benefits through creating synergies among different studies
Developing a Near Infrared Spectroscopy (NIRS) platform and supporting collation of databases on smallholder farm typology/characterization.	BigData, ILRI	Scientific benefits using big data to understand regional/global patterns of household typologies and how these affect food security outcomes
Multidimensional crop improvement has gained further traction through cross CRP-GLDC collaboration supported by the GLDC CRP.	GLDC, ILRI	Scientific, efficiency
Work on Napier grass—targeting the identification of subsets with enhanced potential to withstand abiotic and biotic stresses, reduce soil degradation and curb GHG emissions—is being undertaken in collaboration with the use module of the Genebank platform.	Genebank, ILRI	Scientific
Policy dialogue and capacity building for rangeland management and land use planning in pastoral areas in Ethiopia, Tanzania and Tunisia	PIM	The collaboration enabled this work to take on new issues (e.g. gender), to receive greater visibility (e.g. outputs are reported under two CRPs), and to be intellectually enriched through discussions between Livestock and PIM researchers.
Joint work on low greenhouse gas emissions strategies	CCAFS	Scientific benefits
Joint agenda on animal source food and the role of livestock systems in improving human nutrition. Bilateral funding efforts were pursued but with no success. It was however the opportunity to share ideas	A4NH	Exchange of ideas; building common agenda on agri food systems
Methodology and publication on GLDC foresight analysis	GLDC, PIM	Scientific benefits
Joint work on foresight- various research topics, across centres	PIM	Scientific benefits; sharing of lessons on data and modelling expertise; joint papers
Evaluation of a check off system in the dairy sector (input credit received against milk delivery): LIVESTOCK contributes to the roll out of the check off systems and the 2 CRPS contribute to the evaluation	PIM	Scientific benefits

Table 10: Monitoring, Evaluation, Learning and Impact Assessment (MELIA)

Studies/learning exercises planned for this year (from POWB)	Status	Type of study or activity	Please include links to MELIA publications here.
S1741 - Evaluation of Index Based Livestock Insurance Payouts supported by ILRI on Pastoralists' Coping Strategies: Lessons from Ethiopia and Kenya	On Going	Program evaluation (including project evaluations)	The evaluation tracks self-reported expenditures and changes to coping strategies related to IBLI insurance payouts during the 2016 drought. A journal article on the results will be published in 2019.
S1771 - A global approach to improving the estimation of forage adoption based on seed distribution studies	Cancelled	Adoption study: Ex-post adoption survey (at scale)	The first part of the study was developed (country profiles on forage seed sector, selection of focus countries and elaboration of proposal). However, the second phase was not approved and we need to change focus. This will be done during 2019.
S1781 - Impact assessment of East Cost fever immunisation with the Infection and Treatment Method in Tanzania	Complete	EPIA: Ex-post Impact assessment (at scale)	<p>ILRI has been promoting the adoption of the Infection and Treatment Method (ITM) in Tanzania and an impact assessment was carried out which showed clear impact of ITM on cattle productivity leading to impacts on poverty at the household level:</p> <p>https://cgspace.cgiar.org/handle/10568/100489;</p> <p>https://cgiar.sharepoint.com/sites/livestock/Shared%20Documents/Forms/AllItems.aspx?viewpath=%2Fsites%2Flivestock%2FShared%20Documents%2FForms%2FAllItems%2Easpx&id=%2Fsites%2Flivestock%2FShared%20Documents%2FAnnual%20Reports%2F2018%20Annual%20Report%2FEvidence%20%28Deliverables%2C%20Innovations%2C%20Policies%202018%29%2FMELIA%20%2D%20ECF%2DITM%20Impact%20Study%20Tanzania%2Epdf&parent=%2Fsites%2Flivestock%2FShared%20Documents%2FAnnual%20Reports%2F2018%20Annual%20Report%2FEvidence%20%28Deliverables%2C%20Innovations%2C%20Policies%202018%29</p>

Table 11: Update on Actions Taken in Response to Relevant Evaluations

Name of the evaluation	Recommendation number (from evaluation)	Text of recommendation (can be shortened)	Status of response to this recommendation	Concrete actions taken for this recommendation.	By whom (per action)	When (per action)	Comments (including expenditure, where relevant – relate this back to predicted budgetary implications in the management response to the evaluation)
IEA Independent External Evaluation of Livestock & Fish CRP	1	Capitalize on the benefits of being a CRP	Ongoing	Proposal development for very large CRP-related cross-centre initiatives: one on 'More Feed for Less' on the feed nexus; and one on a foresight study on Animal Source Food supply and demand and research needs	CRP director, together with relevant flagship leaders	Dec 2019	Minor investment in proposal development anticipated from CRP management budget
IEA Independent External Evaluation of the Livestock & Fish CRP	2	Increase synergies between livestock and aquaculture	Ongoing	Continue to encourage development of cross-CRP collaborative activities between Livestock CRP and Fish CRP	Livestock CRP and Fish CRP directors	open	Ability to support cross-CRP activities has been limited by funding restrictions in 2017 and lack of high priority activities identified. Discussions are currently underway to develop a joint activity on Animal Source Food systems foresight.
IEA Independent External Evaluation of the Livestock & Fish CRP	3	Streamline the portfolio	Complete	The Livestock & Fish CRP portfolio was restructured during the development of separate Livestock CRP and Fish CRP proposals for the current phase. This allowed the Livestock & Fish CRP portfolio to be streamlined, but also involved broadening the agenda for each CRP, leading to a new mix of activities that were carefully reviewed by the ISPC.	n/a	n/a	n/a

IEA Independent External Evaluation of the Livestock & Fish CRP	4	A higher profile for environment/NRM	Complete	A flagship dedicated to environmental issues created as part of the Livestock CRP in the new phase.	n/a	n/a	n/a
IEA Independent External Evaluation of the Livestock & Fish CRP	5	Establish an ME system based on the TOC	Complete	Adopt MARLO as the ME system for the CRP planning and reporting	n/a	n/a	The Livestock CRP invested \$90,000 for the adaptation of MARLO to the new CRP phase with a Livestock CRP component, plus \$25,000 annually for continued development
IEA Independent External Evaluation for the Livestock & Fish CRP	6	Build private sector partnerships for technology delivery	Complete	Work with private sector partners in developing technology delivery strategies and actions as part of the BMGF funded African Dairy Genetic Gains and African Chicken Genetic Gains projects.	n/a	n/a	The involvement with private sector partners is funded by BMGF Window 3. Additional opportunities for private sector collaboration continue to be explored.
IEA Independent External Evaluation for the Livestock & Fish CRP	7	Maintain the governance arrangements but with some adjustments	Complete	Maintain a CRP management committee constituted to serve a partnership governance function among the implementing partners, and the CRP Independent Steering Committee to maintain a largely advisory function, for the Livestock CRP in the second phase.	n/a	n/a	n/a
IEA Independent External Evaluation of the Livestock & Fish CRP	8	Modernize the financial management system	On Going	Establish a basic online system for submission of partner financial information related to implementing the CRP, that allows aggregation and monitoring of burn rates.	CRP director with ILRI ICT director	Dec 2019	This has been delayed by recommendation to develop the system within OCS rather than independent stand-alone, which is challenging given inter-operability limitations and data quality issues.

IEA Independent External Evaluation of the Livestock & Fish CRP	9	Maintain the value chain approach but manage it much more effectively	Complete	Strengthen the priority country programs focusing on selected value chains and livestock- based livelihood systems.	n/a	n/a	Implementation was delayed due to reduced CRP management funding in 2017, but has now been initiated under the Livestock CRP. The number of priority countries was reduced from nine to four to ensure sufficient financial and human resources are dedicated to them. Arrangements in how the work is supported by and contributes to flagship outcomes has been clarified. Carry-over W1/2 funding (\$2.9 million) from the Livestock & Fish CRP is being dedicated to supporting this work.
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Table 12: Examples of W1/2 Use in this reporting period (2018)

Please give specific examples, one per row (including through set aside strategic research funds or partner funds)	Broad area of use of W1/2
Establishing and maintaining links with public and private sector partners in the livestock sector in Colombia and East Africa (e.g. innovation platforms, round tables)	Partnerships
Strengthening herd health capacity development in Ethiopia and Uganda	Capacity development
Studying gendered participation in sheep and goat community-based breeding program (cross-flagship activity for Livestock Genetics and Livestock Livelihoods and Agri-Food Systems)	Other cross-cutting issues
Developing information and dissemination materials on forage establishment, management and conservation	Capacity development
Adapting the Global Geo-Informatics Options by Context (GeOC) tool for targeting and evaluating sustainable livestock management options in Kenya and Ethiopia	Research
Adoption and seed value chain study of a CG-developed dual-purpose groundnut variety in Odisha, India	Research
Discovery of molecular markers (quantitative trait loci) for detection of net blotch, spot blotch and yellow rust in Barley with National Agricultural Research Systems partners	Research
Mapping of tick distribution in Africa	Research
Implementation of different livestock extension approaches with smallholder farmers in Tunisia	Delivery
Training livestock producers on forage establishment, management and conservation, plus organizational and commercial issues	Capacity development
Exploring diagnostics for when to use antibiotics	Research

Table 13: CRP Financial Report

	Planned Budget 2018*			Actual expenditure*			Difference*			Comments
	W1/W2	W3/ Bilateral	Total	W1/W2	W3/ Bilateral	Total	W1/W2	W3/ Bilateral	Total	
F1 - Livestock Genetics	US\$ 2,670,079	US\$ 7,925,915	US\$ 10,595,994	US\$ 3,346,000	US\$ 6,516,000	US\$ 9,862,000	US\$ - 675,921	US\$ 1,409,915	US\$ 733,994	FP1 was in good financial health in 2018, with twice as much W3/bilateral funding as W1/2 funding. Additional funds available in 2018 allowed expansion of the genome characterization work, support to graduate research fellows and expansion of cross-partner collaborative work (e.g. with the Centre for Tropical Livestock Genetics and Health).
F2 - Livestock Health	US\$ 2,679,999	US\$ 3,663,067	US\$ 6,343,066	US\$ 3,342,000	US\$ 2,880,000	US\$ 6,222,000	US\$ - 662,001	US\$ 783,067	US\$ 121,066	The additional W1/2 funding was used to support promising activities that the flagship wants to expand, such as capacity development activities within the herd health activities in Ethiopia.
F3 - Livestock Feeds and Forages	US\$ 1,844,808	US\$ 4,715,820	US\$ 6,560,628	US\$ 1,980,000	US\$ 2,921,000	US\$ 4,901,000	US\$ - 135,192	US\$ 1,794,820	US\$ 1,659,628	The Feeds and Forages FP3 is in good financial health. The additional funds made available to the flagship in 2018 helped to emphasize priority setting, tool development and scaling activities.
F4 - Livestock and the Environment	US\$ 1,375,559	US\$ 6,293,350	US\$ 7,668,909	US\$ 1,629,000	US\$ 9,423,000	US\$ 11,052,000	US\$ - 253,441	US\$ - 3,129,650	US\$ - 3,383,091	
F5 - Livestock Livelihoods	US\$ 1,506,522	US\$ 11,295,691	US\$ 12,802,213	US\$ 1,600,000	US\$ 12,785,000	US\$ 14,385,000	US\$ - 93,478	US\$ - 1,489,309	US\$ - 1,582,787	The LLAFS flagship was in better financial health in 2018 than in the 2 previous years, but more

and Agri-Food Systems										bilateral funds are still required to meet its ambitious targets. The additional W1/W2 funds made available to the flagship during the year helped to emphasize tool development, harmonized protocols, and cross-centre collaborative work. The difference between planned and actual expenditures is also due to new bilateral funding secured during the year with activities already being executed.
Strategic Competitive Research grant	US\$ 1,355,000	US\$ 0	US\$ 1,355,000	US\$ 649,000	US\$ 0	US\$ 649,000	US\$ 706,000	US\$ 0	US\$ 706,000	
CRP Management & Support Cost	US\$ 2,317,919	US\$ 0	US\$ 2,317,919	US\$ 1,450,000	US\$ 0	US\$ 1,450,000	US\$ 867,919	US\$ 0	US\$ 867,919	
CRP Total	US\$ 13,749,886	US\$ 33,893,843	US\$ 47,643,729	US\$ 13,996,000	US\$ 34,525,000	US\$ 48,521,000	US\$ -246,114	US\$ -631,157	US\$ -877,271	

Footnote

Centre Own Funds (ILRI) not shown in Table:

Planned	US\$ 1,104,624	[FP3 US\$ 101,632	FP5 US\$ 0	FP5 US\$ 811,012	CRP Management US\$ 191,980]
Actual	US\$ 681	[FP3 US\$ 119	FP4 US\$ 204	FP5 US\$ 358	CRP Management US\$ 0]
Difference	US\$ 1,103,943	[FP3 US\$ 101,513	FP4 US\$ -204	FP5 US\$ 810,654	CRP Management US\$ 191,980

Part C. DETAILED ANNEXE

FP1 Livestock Genetics

There is no change to report for the Animal Genetics flagship ToC. However, compared to 2017, besides making a major contribution to Outcome 1.2, 2018 saw important progress made towards Outcome 1.1. and Outcome 1.3 as detailed below. Outcome 1.1 had three Milestones. An important step was achieved with the opening of a platform for poultry research in Ethiopia (Milestone 1.1.4). This unique facility, at the ILRI Addis Ababa campus in an agro-ecological zone representative of the main poultry production area of the Ethiopian highlands, allows breed characterization and comparison studies to be performed, in the areas of chicken genetics, health and nutrition, in support of the development genetic improvement strategy for African chicken (Outcome 1.2). The official opening of this poultry platform attracted major attention from the national and international press (<https://news.ilri.org/2018/04/26/art-and-science-bring-poultry-genetics-to-life-in-ethiopia-while-celebrating-local-diversity-in-all-its-forms/>). It offers a unique window to present CRP research activities to various stakeholders including the public, project's collaborator and donors. Milestone 1.1.2, the building-up of environmental breed suitability maps (chicken, small ruminant) for optimization of genotype-environment interaction was also completed. A methodological paper was published and the proposed methodology illustrated in a major multidisciplinary paper published in Nature Communication (the Livestock CRP 2018 paper with the second highest altmetric score (<https://cgspace.altmetric.com/details/49708305>)). For small ruminants, a case study on Ethiopian indigenous sheep and goats has been published. These environmental suitability maps will guide genetic improvement strategies (Outcome 1.2) and contribute to the implementation of business models for the multiplication and delivery of improved genetics (Outcome 1.3). Milestone 1.1.3 has been achieved for chicken with a PhD thesis reporting the genome characterization of Ethiopian chicken as well as several papers reporting their adaptabilities to local environmental challenges, and for cattle with two papers peer-reviewed papers published on the genetic diversity and adaptability of East African cattle. Last but not least, through a joint collaboration between ILRI and ICARDA, the genome characterization of Ethiopian sheep has been achieved. A major output of Milestone 1.1.3 is the identification of candidate DNA polymorphisms and haplotypes for gene editing and marker-assisted selection (Outcome 1.2).

Substantial progress has been made towards the delivery of Outcome 1.2 which relies on outputs from Outcome 1.1, and on the development of new tools (genomic tools, breeding, field recording tools). Progress highlights for 2018 include: (i) the collection of milk production data for more than 6,000 crossbred dairy cows in Ethiopia and Tanzania, to identify the best crossbred genotype for milk production in relation to agro-ecologies as support for the development of new breeding schemes; (ii) availability of a functional mobile recording system for productivity data of Community Based Breeding Programs (CBBPs) developed with a private company, as an essential tool for the upscaling of CBBP program in Ethiopia and Tanzania. However, Milestone 1.2.4 has been extended. While the identification of the SNPs panel for accurate zebu x taurine admixture has been achieved, the building-up of the SNPs chips was delayed as the private company contacted initially for the work pulled out and a new provider has to be identified. It is expected now to be available and in use for the selection of reproductive bulls in the first half of 2019.

Contributing significantly to Outcome 1.3, the first business models for multiplication and delivery of improved chicken (Milestone 1.3.2), dairy cow and small ruminants were developed in collaboration for the former two with IFPRI. They will now be implemented to optimize the delivery of improved chicken, dairy cow and small ruminant genetics. In support to Outcome 1.4, the African Chicken Genetic Gains (ACGG) gender strategy with technical support from KIT, was developed to provide a basis for selection of indicators to measure women's and men's empowerment, identify interventions to close the gaps and to also enhance gender unity (Milestone 1.4.1). Also, a report on strengthening

women's participation in small ruminant breeding cooperatives in Ethiopia, in a context where the formation of cooperatives is crucial for CBBPs and women's participation in agricultural cooperatives is generally low, was published. Finally, to help adoption and dissemination of improved rams within the scope of our CBBPs, the technical and institutional requirements for certification of improved rams have been described (Milestone 1.5.2, Outcome 1.5).

FP2 Livestock Health

On evaluating livestock health constraints and developing tools to assess significance of animal diseases and disease risk models and maps (Outcome 2.1), in cooperation with FP5, an epidemiological modeling framework was developed for endemic pig diseases in Vietnam, e.g. porcine reproductive and respiratory syndrome (PRRS) virus, and a risk map for PRRS was developed to help policy makers targeting surveillance and vaccination programs. In Uganda, two studies provided insight on why farmers, traders and veterinarians do not comply with disease reporting and assessed the potential for market-based control of pig tapeworm (concluding that this was not viable). Additional studies provided insights on improving animal health service delivery in difficult to reach communities. A novel eSurveillance system was implemented in northern Kenya and proved highly effective at improving response to disease outbreaks. A tool for collecting data on knowledge, attitudes and practices (KAP) on farmers' use of antimicrobials was developed and applied in three countries; initial results revealed high levels of medically irrational drug use. With CRP A4NH, a CGIAR strategy for Anti-Microbial Resistance (AMR) was agreed, progress made to establish an AMR hub at ILRI and a major AMR conference held in India.

On herd health packages (Outcome 2.2) work on reproductive diseases is well underway in Ethiopia with 1500 blood samples collected from five districts to determine the sero-prevalence of Chlamydia, Coxiella, Brucella, Leptospira, Toxoplasma, Neospora and Border Virus Diseases. This was combined with a household KAP survey on reproductive health management and zoonotic risks abortion-causing agents to inform the design of future herd health interventions. The intervention on targeted feeding of pregnant ewes gave promising results and, for respiratory diseases, longitudinal data collection is ongoing with over 2,000 samples to be tested in 2019. Good progress was made on promoting herd health in small ruminant smallholder production in Ethiopia through community based gastrointestinal parasite control programs that significantly improved morbidity and production parameters, and the novel participatory community conversation approach demonstrated evidence of behavior change in division of labour in animal health management and handling of livestock products with zoonotic risks.

On novel livestock vaccines and diagnostics (Outcome 2.4), a laboratory challenge model was established, which will allow efficient testing of new generation Contagious Caprine Pleuro-Pneumonia (CCPP) vaccines. For *Mycoplasma mycoides* subsp. *capri* (Mmc), a small ruminant model for Contagious Bovine Pleuro-Pneumonia (CBPP), the capsular polysaccharide was shown to be a virulence factor and hence a potential vaccine target. Progress was also made towards getting proof-of-concept for an east Coast Fever (ECF) vaccine. For example, it was demonstrated that dose reduction of soluble p67C antigen in an experimental vaccine formulation was not possible, and a more immunogenic format of the p67C antigen will be required. With this goal, various nanoparticle technologies were explored and three promising ones have been taken forward into challenge experiments. The flagship also demonstrated that HuAd and MVA viral vectors used in a prime-boost immunization strategy induce strong antigen-specific cell-mediated immune responses and result in partial protection on challenge. Production of a thermo-tolerant Peste des petits ruminants (PPR) vaccine was successful, but the batch did not meet thermostability targets (at least 30 days at 37°C), probably due to a higher than expected residual moisture level caused by poor quality bottle corks. These issues have been addressed and a new batch production is underway.

On improving access to livestock health products and services (Outcome 2.5), the flagship conducted a review of the availability of veterinary vaccines for cattle, poultry, sheep and goats in Kenya, Uganda, Tanzania, Ethiopia, Mali and Vietnam. The study indicated that Ethiopia, Kenya and Mali have the capacity to manufacture most of the main livestock vaccines and often export to other countries in the region. Whilst Uganda and Tanzania do not have capacity to manufacture many vaccines, this was not the key constraint because in the East African Community distribution of veterinary products is possible; delivery of animal health services is constrained by lack of capacity in the public sector and the absence of private sector actors. The flagship has piloted two models in Kenya for improving delivery: mobile veterinary services with the support of community disease reporters; and public private partnerships (PPPs). The study concluded that although there is potential for greater private sector involvement, current policies are not conducive to such investments and legal frameworks are required to ensure sustainability of PPPs. In Mali, participation of different stakeholders in vaccination programs was improved through 23 ongoing innovation platforms, increasing vaccination coverage for PPR in some villages tenfold, but still below the needed coverage of 80% to control the disease.

For the milestones that have been extended from 2018 to 2019, the extension is attributable to scientific and financial challenges due to the deferred start of two major bilateral projects, which was out of our control.

FP3 Feeds and Forages

In 2018, the Feeds and Forages Flagship promised to achieve 10 milestones contributing to 5 Flagship outcomes (3.1, 3.3, 3.5, 3.6 and 3.8) and 2 Sub-IDOs (1.3.4 and 1.4.2) until 2022. Eight of the milestones were achieved, one was partially achieved and will be finished in 2019 and one was extended to 2019.

Regarding Outcome 3.1, two milestones were achieved and one was extended. For the first milestone on the use of tools designed or promoted by the CRP, the genderized FEAST and the LegumeChoice tools were made available and promoted. For the second milestone, the Online Journal TGFT launched three issues reaching 0.13m users in 2018. The access to the Tropical Forages (formerly SoFT) tool was enhanced through IT improvements resulting in 0.19M unique visits in 2018, and the tool was further developed in content and mobile application and a beta version is available for testing and release in 2019. The third milestone was extended to 2019 due to delays in the software development process for the Animal Feed Analysis Web Application (AFAWA) tool. In addition, we advanced on a) the development and employment of low cost mobile NIRS devices for forage grasses, b) the FeedBase database for Ethiopia, c) identifying gender dimensions of fodder technology adoption, and d) conducting ex-ante analyses of the economic impact of adopting improved forages. All milestones enhance the delivery of technologies that promote more efficient use of feed resources (sub-IDO 1.3.4).

Regarding Outcome 3.3, both milestones were achieved. For milestone one, CIAT's existing Urochloa hybrids were scaled through the private sector partner on at least 100,000 additional hectares in 15 countries in 2018. In addition, advances were made on Megathyrsus and Urochloa breeding where e.g. new generations of hybrids were developed, site-specific best bet forage options and a dissemination plan for piloting in East Africa were assessed, and physiology work continued. Milestone two was achieved by establishing the annotated reference genome of diploid Urochloa and the development of a) drought and b) agronomic performance protocols for Cenchrus purpureus resulting in a contribution to increasing the efficiency in forage breeding. With regard to food-feed crops, advances were made on the development of new superior dual-purpose maize, sorghum, millet and groundnut in India and on genetic selection in maize and pearl millet (<https://doi.org/10.3390/agriculture9050097>). In addition, the flagship started to align ICARDA's barley breeding work as a basis for full incorporation into the workplan in 2019. The milestones

enhance the delivery of technologies that promote more efficient use of feed resources (sub-IDO 1.3.4).

Regarding Outcome 3.5, the milestone on developing tools for increasing productivity while reducing feed and labor costs, considering gender-responsiveness and scalability was achieved through modifying the "FeedAssist" tool for the state of Odisha in India (changing the App to local language and using Odisha feed data as input). A second further simplified ration balancing tool was designed for and is currently made operational by a tool developer in Ethiopia. In addition, we continued our work on spin-off technologies from 2nd generation biofuel (<https://cgspace.cgiar.org/handle/10568/100281>), and for India advanced on the dissemination of dual-purpose maize and groundnut cultivars and developed business plans around feed production and processing (<https://cgspace.cgiar.org/handle/10568/100484>). This milestone enhances the delivery of technologies that promote more efficient use of feed resources (sub-IDO 1.3.4).

Regarding Outcome 3.6, the planned milestone was extended to 2019 although strong advances were made on off-farm feed processing options for India and Malawi. For Ethiopia the guidelines for decentralized feed compounding are in the final preparation and will be finalized in 2019. In addition, we advanced on our cactus research in India regarding its establishment, promotion and analysis of behavioral changes related to its production. This milestone enhances the delivery of technologies that promote more efficient use of feed resources (sub-IDO 1.3.4).

Regarding Outcome 3.8, all three milestones were achieved. The first milestone on developing six feed/seed business approaches in Kenya, Tunisia and Colombia was achieved through a) providing several economic analyses for forages in Colombia and Kenya, b) developing several forage business cases for Kenya, and c) providing feed processing options for Tunisia. In addition, we conducted seed systems analyses for Kenya and Ethiopia. The second milestone on extension approaches was achieved through a) applying and validating four extension approaches for Tunisia and one for Colombia, b) developing a training approach for forage conservation for Kenya, and c) developing training materials/factsheets and conducting field days on forage conservation and management in Colombia and Kenya. The third milestone on innovation platforms was achieved by strongly contributing to the Colombian Roundtable for Sustainable Cattle, evaluating the existing innovation platforms in Tunisia, and advancing on establishing a Brachiaria Roundtable for Kenya. These milestones contribute to the more efficient use of feed resources (sub-IDO 1.3.4).

FP4 Livestock and the Environment

The flagship completed 6 milestones and extended 2. The extensions are due to the time needed to engage partners for dissemination of interventions and personnel changes for our gender work (a postdoctoral fellow left and a scientist was recruited). For Outcome 4.1 on getting environmental concerns considered in decision making, GHG baselines were published for Kenya in collaboration with CCAFS. Without these baselines countries cannot monitor any progress towards their Nationally Determined Contributions (NDC) commitments; these are the first such baselines for Africa. A key outcome therefore has been Kenya adopting these data as the basis for establishing its NDC. Additional environmental footprint baselines (hydrology and soils) were published for Kenya. In Vietnam (also with CCAFS) a report was produced on the GHG emissions baseline undertaken there, and a publication is forthcoming; the data have been handed over by the national partner and will be available in 2019. The flagship also added a third country, Tanzania, where the data collection was delayed due to a long process for research permits but has now finished and the results are being written up. A milestone extended from 2017 was completed: a framework for assessing environmental footprints of technologies and interventions was developed, tested and refined. First results have been documented and two associated tools disseminated (CLEANED X in Rwanda, Ethiopia, Kenya and CLEANED R in Burkina Faso and Ethiopia. Using these ex-ante tools technology

developers and development practitioners can assess challenges in terms of environmental issues. The framework clearly identifies tradeoffs among different objectives, including environmental risks and benefits.

For Outcome 4.2, use of solutions to increase productivity in the face of environmental changes, in 2016 and 2017 forage intensification options were identified for features that make them better adapted to future climate conditions. Through the IFAD-funded climate smart diary project they are being disseminated in Tanzania and Rwanda. Through collaboration with FP3 (supported by BMZ) they are also being disseminated in Kenya and Ethiopia. This shows how the Environment Flagship FP4 works with the technology generating flagships to assess the possible impact of environmental change on technologies such as forage intensification.

For Outcome 4.3, to help government agencies and development partners promote environmental management options, rangeland management intervention options in Tunisia, Kenya and Ethiopia were identified. Dissemination is ongoing in Tunisia and will start in Kenya and Ethiopia in 2019. In Tanzania the focus has been on land use planning to secure grazing lands and work on management interventions has not yet started. The dissemination has included training of government partners and published manuals, along with a number of workshops.

For Outcome 4.4 on gender responsive environmental management options, the global review of gender and sustainable land management interventions was delayed due to personnel changes. Publication is planned in 2019.

Support to national government agencies to improve the environmental management of livestock systems (Outcome 4.5) is on track in three countries to see government agencies design and implement policies to support the improved environmental management of livestock systems, e.g. use of grazing to improve rangeland quality. This approach is based on strong collaborations with key government partners who are willing to consider the importance of land use planning to support improved rangeland management at local, district and national levels. A key highlight was the release of the Tunisia pastoral code which provides a framework for other governments to give policy support to reverse rangeland degradation. Government partners in Tanzania, Kenya and Ethiopia have also been trained in participatory land use planning for rangeland management.

Finally, for Outcome 4.6, generating evidence to influence global agendas, the GFFA ministerial communication in January 2018 mentioned environmental issues specifically. Through engagement with the Global Landscapes Forum in Nairobi in August 2018, and ongoing engagement with the International Land Coalition Rangelands Initiative as well as the Land Portal, the flagship has shared research results and engaged with policymakers and advocates, identifying approaches to create enabling environments for effective rangeland management. In these engagements, researchers are pushing for landscape restoration initiatives to also consider rangelands, not only forests.

FP5 Livestock Livelihoods and Agri-Food Systems

To guide priority setting, investment and policy development (5.1), two milestones were achieved, including the 'whylivestockmatter.org' website that provides detailed evidence on the role of livestock. The two milestones relative to the Livestock Master Plans for Tanzania and Bihar, including a gender component for Bihar were also met, although the official launches only took place early 2019. To support decision making with livestock modelling (5.2), the milestone related to the improved platform used in the development of the Livestock Master Plans was extended, to allow more time for discussions with the other partners on the approach and roles. Moving to gender and social equity (5.3), the CRP youth strategy has been finalized using an online consultation while the other two milestones will be completed in 2019 to allow for additional consultations and consolidation. On

gender transformative approaches (5.4), the Women Empowerment in Livestock Index (WELI) paper and tool were completed and a couple of opportunities have already emerged for its application. The two milestones relative to nutrition sensitive interventions were achieved (5.5): a well-publicized report on the role of animal source foods in the first 1,000 days and the implementation of a nutrition intervention in livestock value chains in Kenya. With respect to CRP research supporting the adoption of improved technologies and management strategies (5.6), one milestone out of two was achieved, through two development-oriented projects that used past research to guide the identification and implementation of improved technologies. Lastly, on institutional arrangements (5.7), the two milestones were completed, including the development of a protocol to guide the evaluation of such innovations that would support cross-country and cross-system learning and synthesis.