Thematic Evaluation Series

Evaluation of FAO's support to climate action (SDG 13) and the implementation of the FAO Strategy on Climate Change (2017)

Sector level study in livestock

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
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Contents

Figures

Acronyms and abbreviations

CPF	Country Programming Framework
CSA	Climate-smart agriculture
CSL	Climate-smart livestock
GASL	Global Agenda for Sustainable Livestock
GCF	Green Climate Fund
GEF	Global Environment Facility
GHG	Greenhouse gas
GLEAM	Global Livestock Environmental Assessment Model
LEAP	Livestock Environmental Assessment and Performance Partnership
NAMA	Nationally Appropriate Mitigation Action
NAP	National Adaptation Plan
NDC	Nationally determined contribution
NZAGRC	New Zealand Agricultural Greenhouse Gas Research Centre
SDGs	Sustainable Development Goals
SSTC	South-South and triangular cooperation
UNFCCC	United Nations Framework Convention on Climate Change

1. Introduction

1.1 Background

1. This is the sector level study on livestock which is part of theEvaluation of FAO's support to climate action (SDG 13) and the implementation of the FAO Strategy on Climate Change (2017). Because of the strong relationship between the SDG 13 targets and the United Nations Framework Convention for Climate Change (UNFCCC), the evaluation also refers to the Paris Agreement.

2. The overall objective of the evaluation of is to assess the extent to which FAO has adopted an effective, coherent and transformative approach to its work in support of SDG 13 and the Paris Agreement in 2015–2020.

3. The sector study on livestock served as one of the thematic areas of FAO's work on climate action identified as one of the critical inputs in evaluating FAO's support to climate action. Key products and services in the livestock sector relevant to climate action were sampled and reviewed.

4. In September 2015, at the United Nations (UN) Summit on Sustainable Development, countries adopted 17 Sustainable Development Goals (SDGs) to jointly embark on a resilient and sustainable path that leaves no one behind.

5. With the historic adoption of the Paris Agreement (2016) under the United Nations Framework Convention on Climate Change (UNFCCC), the achievement of SDG 13 targets became an opportunity for countries pledged to take important steps in reducing their greenhouse gas (GHG) emissions and strengthen countries' resilience and ability to adapt to climate change, joining the cause to take common climate actions. Both transformational agendas acknowledge the critical importance of agriculture in dealing with the large climatic changes currently faced, the severity of which is likely to increase in the future. Furthermore, both the Paris Agreement and the SDGs stress the importance of safeguarding food security and ending hunger and halting climate change.

6. The role of agriculture including livestock is not only crucial in mitigating, but also in adaption to climate change. According to the Intergovernmental Panel on Climate Change (IPCC), approximately a quarter of all anthropogenic GHG emissions worldwide are caused by agriculture (Smith *et al*, 2014).

7. The livestock sector is a significant contributor to climate change with GHG emissions estimated by FAO at 7.1 gigatonnes CO_2-eq per annum, representing 14.5 percent of human-induced GHG emissions (Gerber *et al*, 2013).

8. By adopting its Climate Change Strategy in 2017, FAO is motivated to best serve its Members in achieving their commitments under the Paris Agreement and their priorities under the Sustainable Development Goals. (FAO, 2017a).[1]

9. FAO's objective is to address climate change issues through initiatives on the implementation of mitigation and adaptation to climate change (SDG 13) to target the adoption of low carbon development pathways and the achievement of climate-resilient development. Short overview of methodology for the livestock sector study

10. The livestock sector report adopted the methodology and approach of the evaluation of FAO's contribution to SDG 13 to answer the evaluation questions and produce the findings for FAO's contribution through the livestock sector to climate action (SDG 13).

11. The main methods adopted for data gathering and analysis were:

    i. Desk-reviews including relevant FAO publications in the livestock sector and the FAO livestock project portfolio, external publications addressing livestock and climate change.

    ii. Interviews of key external stakeholders, resource partners, government counterparts, international agencies, members of global platforms, civil society and academic institutions

    iii. Interviews with FAO personnel in headquarters and decentralised offices . Interviews were semi-structured to maintain the relationship with the evaluation questions, but allowed interviewees to speak freely on related issues.

    iv. Analysis of country case studies which comprehended the countries of Ecuador, Fiji, Haiti, Honduras, Jordan, Kenya, Nepal, Senegal, Turkey, Bangladesh, Viet Nam, Uganda and Uruguay.

    v. Stakeholder consultations through online workshops: workshops were facilitated to discuss and validate findings, conclusions and recommendations

    vi. Global surveys which targeted FAO personnel, key stakeholders from primary partners and indigenous peoples.

12. Three evaluation questions were answered with the information collected and collated through the aforementioned methods:

    i. Is FAO making a relevant and effective contribution to globally agreed climate action targets?

    ii. Is FAO fit for purpose to significantly contribute to globally agreed climate action targets?

    iii. Does FAO optimally engage partnerships that leverage the effect of its work on climate action towards impact generation?

2. Interactions between climate change and livestock

13. The livestock sector is growing rapidly, its contribution accounts for 40 percent of the global agricultural gross domestic product (GDP) and meat demand is expected to double by 2050 (FAO, 2018b). Livestock production systems are crucial to contribute to food security in all regions.

14. Climate change directly impacts livestock through heat stress and increased mortality and indirectly through quality and availability of feed, forages, and animal diseases.

15. Affected by heat waves caused by climate change, livestock production systems will reduce outputs of animal source foods generating global food insecurity and increase of hunger. Smallholder livestock producers and pastoralists are among the most vulnerable groups to climate change. In various sub-Saharan African countries, 20-60 percent losses in animal numbers were recorded during serious drought events in the past three decades (FAO, 2017b).

16. To meet the increasing demand of the global growing population, livestock production systems went through an intensification of production and contributed to climate change directly through GHG emissions and also through the various supply chains of the sector. FAO estimates that emissions from the livestock account for 14.5 percent of total anthropogenic emissions (Gerber *et al*, 2013).

17. On the other hand, livestock production systems offer opportunities for GHG emissions mitigation and adaptation to climate change. FAO estimates that a reduction of 30 percent of GHG emissions from livestock can be achieved through improved feed and livestock management (FAO, 2017b).

18. The FAO Climate Change Strategy includes the promotion of sustainable livestock production systems using improved management practices to reduce GHG emissions from livestock and increase adaptation to climate change.

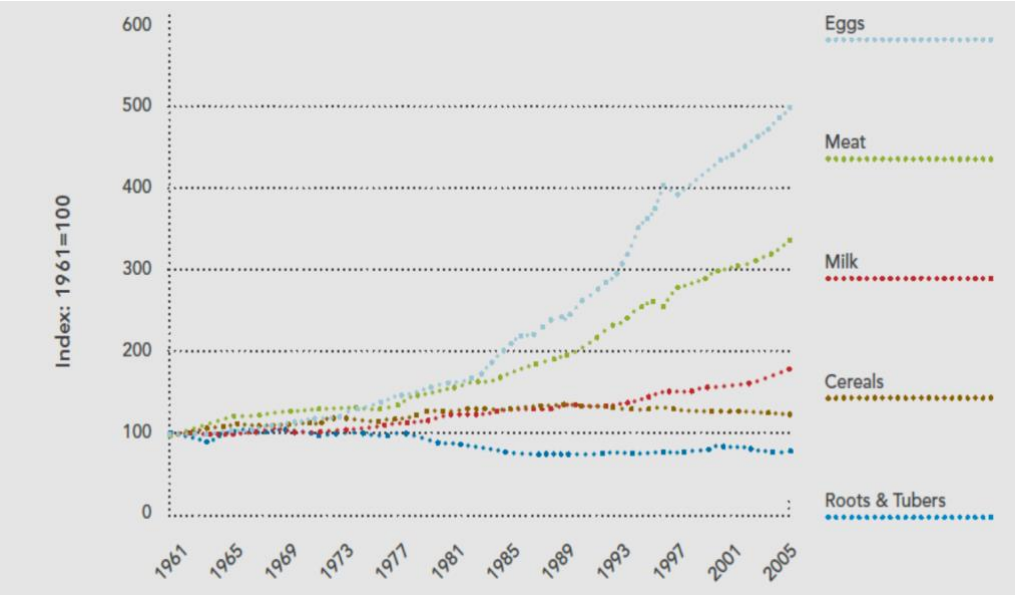
19. The following analysis addresses the impact of climate change on existing livestock production systems and FAO policies and frameworks which enable producers to adopt new strategies to achieve sustainable livestock production systems while reducing the carbon footprint of livestock.

20. As shown in Figure 1 below, livestock production systems went through different structural changes (intensification) to meet the increasing demand of the global growing population. Global demand for livestock products is expected to double by 2050, mainly due to improvement in the worldwide standard of living (Herero *et al*, 2009).

21. Livestock products are an important agricultural commodity for global food security because they provide 17 percent of global kilocalorie consumption and 33 percent of global protein consumption (FAO, 2020b). There is a rapid growth in the demand for livestock products, mainly in developing countries.

22. Worldwide milk production is expected to increase from 664 million tonnes (in 2006) to 1077 million tonnes by 2050, and meat production will double from 258 to 455 million tonnes (Alexandratos and Bruinsma, 2012).

Figure 1: Per capita consumption of major animal food items in developing countries



Source: FAO, 2009

23. The rising demand of animal source foods (meat, milk and eggs) is increasing the pressure of livestock on natural resources such as water, land and biodiversity. In intensive production systems, livestock feed could be in direct competition with human food by using crops eatable by humans such as maize.

24. Climate change is a threat to livestock production because of the impact on quality of feed crop and forage, water availability, meat and milk production, livestock diseases, animal reproduction, and biodiversity.

25. To meet future human demand for animal products, livestock numbers will have to increase significantly to produce the required amounts of animal products or livestock productivity will have to substantially improve to meet the increasing demand.

2.1 Contribution of livestock to food security and livelihoods

26. Livestock make a necessary and important contribution to global calorie and protein supplies. Livestock can increase the world's edible protein balance by transforming inedible protein found in forage and grasses into forms that people can digest. Meat, milk and eggs in appropriate amounts are valuable sources of complete and easily digestible protein and essential micronutrients for humans. However, livestock need to be managed carefully to maximize this contribution.

27. In pastoral areas, livestock are the only option to turn a sparse and erratic biomass resource into edible products. On the other hand, livestock can also reduce the global edible protein balance by consuming large amounts of edible protein found in cereal grains and soybeans and converting it into animal protein (Mottet *et al*, 2017).

28. The choice of livestock production systems (e.g. grass-based, integrated crop-livestock) and good management practices are important for optimizing the protein output from livestock (FAO, 2020c).

29. Livestock industries are also a significant source of livelihoods globally. They are organized in long market chains that employ at least 1.3 billion people globally and directly support the livelihoods of 600 million poor smallholder farmers in the developing countries (Thornton, P.K. *et al*, 2006). Keeping livestock is an important risk reduction strategy for vulnerable communities, as animals can be sold to meet urgent needs of households. Livestock are a source of income for various social groups and communities.

30. Livestock production and marketing can help stabilize the food supplies and provide individuals and communities with a buffer against economic shocks and natural disasters. However, food production and food supply can be affected by climate change.

31. Other factors related to social customs and gender are considered as barriers for access to animal source food and income generating from livestock raising activities. Gender dynamics play a part in this inequality of access to livestock services, particularly for pastoralists and small-scale farming communities, where female-headed households tend to have fewer resources and consequently own fewer and smaller livestock.

32. These barriers among others in the livestock sector should be addressed for equitable livestock contribution to provide food and income for women and men equitably for their livelihoods and well-being.

2.2 The impact of climate change on livestock production systems

33. Climate change poses serious threats to livestock production systems. Increased temperature, shifts in rainfall distribution and increased frequency of extreme weather events are expected to adversely affect livestock production and productivity around the world.

34. These adverse impacts can be the direct result of increased heat stress and reduced water availability. Indirect impacts can result from the reduced quality and availability of feed (grains and green fodder), the emergence of livestock diseases and greater competition for resources with other sectors (Thornton P.K., 2010).

35. There is a great diversity of livestock production systems worldwide determined in large part by climatic conditions, landscape and socio-cultural factors (FAO, 2006a). The classification carried out by FAO identifies three main livestock production systems (FAO, 2006b):

    i. Livestock pastoral/agro pastoral production systems: (traditional extensive systems) in which the availability of pasture dictates herd movements. In this system we meet nomadism (random movements with the shepherd's family) and transhumance (seasonal movements following precise routes);

    ii. mixed extensive livestock production systems: systems where animals are raised extensively with also crop production.

    iii. landless systems that use animal feeds such as cultivated fodder and agro-industrial by-products. They are generally practiced on suburban area.

2.2.1 Livestock production systems intensification and environmental consequences

36. To respond to an increasing demand of animal source foods, livestock production systems across the regions went through intensification processes to meet growing demand of animal source foods. While responding to the demand of the market and consumers needs, intensification of livestock production systems have negatively impacted natural resources threatened also by climate change. Livestock production-exacerbated climate change impacts (frequent droughts, floods and climate disasters) resulted in rangelands degradation, depletion of water resources, pollution of landscapes and an increase of GHG emissions. The analysis of the main causes of livestock transition may help to identify livestock production systems environmental impacts including climate change challenges and sizable opportunities offered by the sector to reduce vulnerabilities (mainly of small livestock holders) and build resilience.

2.2.2 Shifting from agro-pastoral systems to mixed crop/livestock systems with different degrees of intensification

37. This transition occurs mainly as a result of increased human population densities and associated increases in services and markets. In these systems, farm sizes usually decrease as population increases and loss of soil fertility (carbon and other nutrients) through the years, in the absence of land for fallows, significantly reduces soil carbon and subsequent farm productivity. At the same time, the role of livestock increases in the provision of manure for crops and cash flow from the sales of animal products. In places with good market access, these systems could sustainably intensify by replenishing nutrients from inorganic sources and promoting better regulated management practices and by creating market incentives to sell animal products to reduce livestock pressure on feed resources (land use and water use).

2.2.3 Shifting from mixed crop–livestock systems to specialized/industrial landless systems

38. This systems evolution is explained by market orientated smallholder production systems which have intensified to significantly close yield gaps in crop and livestock production. Increases in efficiency gains and opportunity costs for the land determine the viability of such enterprises. As a result, farms tend to specialize, produce high value commodities, or shift towards industrial and landless systems where their dependence on labor and resources produced in surrounding areas becomes more limited. These systems, however, are dependent on resources elsewhere and transport of raw materials, imports of grains, and heavy nutrient loadings owing to large concentrations of animals become important issues to increase GHG emissions. Some studies suggest that in places, these systems need to de-intensify and/or be regulated so as to ensure the viability of some ecosystems services, notably water, and minimize pollution and negative effects on human health.

2.2.4 Shifting from pastoral to agro-pastoral systems

39. In arid and semi-arid grazing systems, where higher temperatures and lower rainfall are expected to reduce yields of rangelands and increase land degradation (Hoffmann and Vogel, 2008).

40. Pastoral livestock systems are changing as a result of pastoralists having to sedentarize because rangelands become fragmented (privatization) and converted to croplands (cash crop). Pastoralists becoming sedentary may also look for other jobs in urban areas.

41. In some parts of the world this transition does not happen because pasturelands are not always suitable for cropping and the pastoral system remains the only form of livelihoods viable in these regions. In these cases, pastoralists are threatened by climate change risks while maintaining the ecological stability of their pastoral area. They need more support to maintain the ecosystem functioning to preserve their livelihoods and assets and to reduce their vulnerability to climate change.

42. In many countries pastoralists are playing an important role in preserving marginal lands which can't be used for other purposes. Pastoralists can be incentivized by their governments to preserve their assets during droughts by accessing economic services and inputs for production (veterinary services, animal nutrition, advisory services), access to markets (local, national, regional, international) for products of animal origin from these extensive systems.

43. Pastoral livestock production systems, which are characterized by their mobility and mostly regional character, need appropriate cross-border services to be created – animal health, animal rest areas, and market infrastructure. To create new opportunities for livestock keepers to add value to their livestock products, decision makers should act on trade policies to limit low-cost imports entering directly into competition with local livestock products and take incentive policies by favoring processing units sourcing from local products (milk, meat , fibre, skins).

44. Support services should be adapted to the mobility of people and strengthen the involvement of pastoralists in the development of public policies (mobile veterinary services for vaccination, satellite connection).

2.3 Livestock and the Global Sustainable Development Agenda 2030

45. The Global Sustainable Development Agenda 2030 seeks to end poverty and hunger, ensure the lasting protection of the planet and its natural resources and halt climate change, among other goals.

46. The livestock sector can contribute directly or indirectly to each of the 17 SDGs. The following examples are given to illustrate possible contributions of the livestock sector to achieve targets of SDG 1, SDG 2 and SDG 13.

47. SDG 1 targets:

i. Livestock sector acts to support poverty reduction, and contributes to food security through sustainable intensification and market access for smallholder producers, as well as contributing to economic development in different regions.

ii. Livestock sector plays a great role as a buffer against economic and climate shocks for vulnerable populations.

iii. Livestock sector supports rural households to achieve their livelihood objectives.

iv. Livestock sector supports people by providing access to safe and healthy food and getting employed in the sector.

v. Livestock sector contributes to the stock of the natural capital that provides the resources and services needed to improve livelihoods.

vi. Livestock sector increases physical capital, providing transport, draught power and alternative energy.

vii. Livestock sector increases the capital of families and provide a mechanism for savings.

48. SDG 2 targets:

i. Livestock sector ensures access to food for all by, improving the productivity and incomes of small-scale livestock producers, promoting sustainable and resilient food production systems.

ii. Livestock sector maintains the diversity of genetic resources for food and agriculture, ensuring the proper functioning of food markets.

iii. Livestock sector contributes at different levels to achieve sustainable production of animal source foods, using sustainable intensification of livestock production systems with natural resource preservation.

49. SDG 13 targets:

i. Livestock sector strengthens resilience and adaptive capacity to climate-related hazards and natural disasters and integrates climate change measures into national policies, strategies and planning.

50. Livestock are impacted by climate change directly (through heat stress and increased mortality) and indirectly (through quality and availability of feed and fodder, and animal diseases). Small livestock holders and pastoralists are the most affected by climate change.

51. Livestock responses for adaptation may include several options already available for improvement: water management, animal husbandry and genetics, forage species tolerant to droughts, and heat management (shading).

52. At the same time, livestock supply chains contribute to GHG emissions up to 14.5 percent of total anthropogenic emissions (Gerber *et al.*, 2013). Emissions from livestock are mainly coming from ruminants (enteric methane fermentation and manure management).

53. The adoption of best practices in animal feeding, animal breeding and animal health – through using new technologies to reduce enteric methane emissions and better management of manure – make livestock more resilient and reduce GHG emissions from livestock by 30 percent.

2.4 The Paris Agreement and the livestock sector

54. In its preamble, the Paris Agreement recommends "recognizing the fundamental priority of safeguarding food security and ending hunger, and the particular vulnerabilities of food production systems" to the adverse impacts of climate hunger, and in Article 2, paragraph (b), it calls for "increasing the ability to adapt to the adverse impacts of climate change and

foster climate resilience and low GHG emissions development, in a manner that does not threaten food production".

55. The livestock sector has been identified in nationally determined contributions (NDCs) of several countries as a key sector for countries to achieve their commitments of emissions reductions.

2.5 FAO areas of work to support sustainable livestock production systems

56. FAO is working to enhance livestock's contribution to the SDGs to achieve its primary mission towards achieving SDG 2: *End hunger, achieve food security and improved nutrition, and promote sustainable agriculture* to which FAO livestock activities converge. FAO is supporting the integration of livestock policy and practices with sustainable development strategies around the world (FAO, 2018b).

57. FAO is supporting country members to enhance implementation of SDGs in the following livestock areas:

i. Animal genetic resource management for sustainable livestock production systems.

- Implementation of the Global Plan of Action for Animal Genetic Resources: FAO is supporting country members in monitoring national breed populations and measuring progress towards SDG indicators 2.5.1 and 2.5.2; to maintain the diversity of genetic resources for food and agriculture.

ii. Promoting sustainable livestock production systems.

- Planning and implementing the sustainable development of the livestock sector by supporting the preparation of livestock master plans (LMPs) to guide and implement investments and policies.
- the objectives of a LMP are:
  a. current contributions and constraints of the livestock sector;
  b. potential of the sector to contribute to national development objectives;
  c. priority livestock commodities and value chains and proposed investment options (combining both technologies and policies); and
  d. impact of targeted investments in livestock on the economic performance and livelihoods in the sector.
- Improving livestock feeding systems, by: enlarging the feed resource base, increasing feed safety, promoting the use of new feed sources and related technologies, and reducing food-feed competition (land use of growing grains for human food or for animal feed).
- Providing guidance and technical assistance on good animal husbandry practices and animal welfare.
- Reducing the use of antimicrobials in animal production.
- Facilitating the implementation of animal identification and traceability, value-chain development, animal breeding programmes and livestock farmer field schools.

iii. Livestock, climate change and natural resource use.

- Enhancing the role of livestock in agro-ecosystems and evaluating the performance of agro-ecological systems.
- Addressing the impacts of climate change on livestock, reducing the environmental footprint of livestock supply chains and assessing the impact of projects and investments on GHG emissions.

iv. Pastoralism.

- Supporting pastoralist friendly-policies and regulations and participatory decision-making.
- Supporting pastoral communities to build resilience by helping them to keep the short- and medium-term socio-economic, ecological and technical balances within and around pastoral systems.

2.6 FAO policy for climate-smart agriculture (CSA) and livestock

58. The CSA approach adopted by FAO since 2010 helps to guide actions needed to transform and reorient agricultural systems to effectively support development of agricultural sectors and ensure food security in a changing climate. It is an approach for practitioners and decision-makers to assess a range of options and identify context-appropriate solutions at farm, landscape and national levels that maximize benefits, pursuing synergies and managing trade-offs. CSA is following three main objectives:

i. sustainably increase agricultural productivity and incomes;

ii. adapt and build resilience to climate change; and

iii. reduce and/or remove GHG emissions, where possible. CSA is not a set of practices that can be universally applied.

59. The livestock sector can make a large contribution to climate-smart food supply systems. A dedicated section was developed in FAO's CSA source book to address climate-smart production in livestock.

2.7 FAO climate-smart livestock (CSL) approach for mitigation and adaptation of livestock to climate change

60. FAO's work on livestock and the environment extends to piloting and analyzing technical and policy options for sustainable livestock systems for the adoption of low carbon production systems while achieving food security and livelihoods development goals.

61. The policy framework of the climate-smart livestock (CSL) approach for adaptation and mitigation of climate change in the livestock sector is developed within CSA framework. The content of the CSL approach is based on strategies and opportunities to improve ruminant productivity and reduce enteric methane emissions per unit of animal product available for all ruminant production systems. These win-win opportunities, as they are known, can be classified into the following broad areas:

i. **Feed and nutrition**: Improving feed quality can be achieved through improved grassland management, improved pasture species, forage mix and greater use of locally available supplements. Matching ruminant production to underlying grazing

resources, ration balancing, undertaking adequate feed preparation and preservation will improve nutrient uptake, ruminant productivity and fertility.

ii. **Animal health and husbandry**: Increasing the biological efficiency of the ruminant by improving the reproduction rates and extending the reproductive life of the animal is key to reducing methane emissions, but this can be constrained by disease, and especially, production-limiting endemic disease. Reducing the incidence of endemic, production-limiting diseases that have a number of negative outcomes, including death or culling at early age of previously healthy animals, reduced live-weight gain, reduced milk yield and quality, reduced fertility, abortion and/or increased waste in the system will generally result in healthier animals that are more productive.

iii. **Animal genetics and breeding**: Genetic selection for local conditions and improved breeding management practices (using artificial insemination for example) will improve the production efficiency of the ruminant, and will also address issues associated with reproduction, vulnerability to stress, adaptability to climate change, and disease incidence.

iv. **Management of manure:** Another area with great potential for creating offsets is in the generation of renewable energy on livestock farms. This includes using manure and other waste to generate biogas, prior to recycling as a source of nutrient replenishment that can offset the use of energy-intensive chemical fertilizers. There is also scope for more widespread use of the land and buildings linked to livestock farms to install solar and wind power facilities. Solar panels can even be used to shade livestock from the sun. The economics of such offsets would need to be made favorable to livestock keepers, and appropriate carbon-accounting mechanisms put in place, for the resulting emission savings to be offset against those produced by livestock. This is a promising area that warrants attention.

2.7.1 FAO global assessment of GHG emissions from livestock

62. In 2013, FAO using the Global Livestock Environmental Assessment Model (GLEAM) tool to estimate GHG emissions from livestock supply chains, estimated the global GHG emissions from livestock to be 7.1 gigatonnes CO_2-eq per annum for the 2005 reference period. They represent 14.5 percent of all human-induced emissions using the most recent IPCC estimates for total anthropogenic emissions (49 gigatonnes CO_2-eq for the year 2004; IPCC, 2007).[2]

2.7.2 Main sources of GHG emissions from livestock and supply chains

63. The GHG emissions from livestock are originating from four main processes: enteric fermentation, manure management, feed production and energy consumption.

2.7.3 Methane emissions from enteric fermentation (CH_4)

64. Ruminant animals (cattle, buffalo, sheep and goat) produce CH_4 as part of their digestive process. In their rumen (stomach), microbial fermentation breaks down carbohydrates into simple molecules that can be digested by the animals. Methane is a by-product of this

[2] Gerber, P.J., Steinfeld, H., Henderson, B., Mottet, A., Opio, C., Dijkman, J., Falcucci, A. & Tempio, G. 2013. *Tackling climate change through livestock – A global assessment of emissions and mitigation opportunities.* Food and Agriculture Organization of the United Nations (FAO), Rome.

process. Poor animal feed, i.e. rations rich in fibres (cellulose), cause higher CH_4 emissions per unit of ingested energy/dry matter (DM).

65. Non-ruminants like pigs produce CH_4 emissions but with lower amounts compared to cattle.

2.7.4 CH_4 and NO_2 emissions from livestock manure

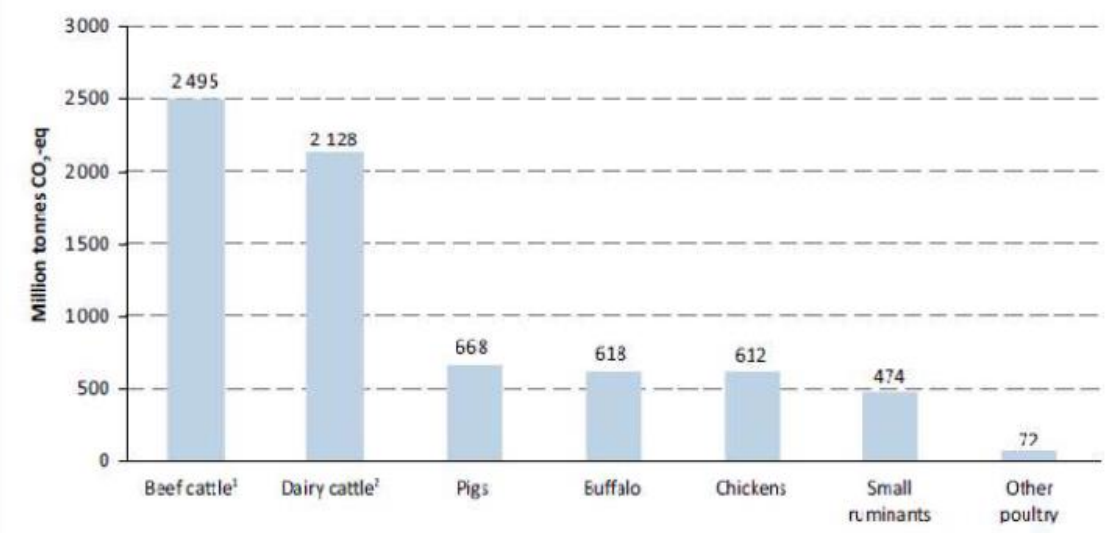
66. Manure contains two chemical components that can lead to GHG emissions during storage and processing: organic matter that can be converted into CH_4, and nitrogen that leads to NO_2 which happens during the anaerobic conservation of manure. Feed production, processing and transport for livestock can produce CO_2 and NO_2. Energy consumption along the whole supply chain for livestock also produces CO_2 gas.

2.7.5 Breakdown of GHG emissions by species, production system and by region

67. GHG emissions from livestock presented by species and commodity showed that large ruminants, like cattle for beef and milk, are the highest contributor to GHG emissions from livestock (up to 65 percent of total GHG emissions), followed by pig meat production, buffalos and chicken. Small ruminants are not high emitters of GHG.

68. This is an indicator for policy makers and project and program designers on how to address and use the information on livestock emissions to design reduction of GHG emissions scenarios by better targeting the species and the commodities to achieve climate action mitigation of GHG emissions from livestock. FAO, using GLEAM and other tools, is supporting countries to estimate GHG emissions from the agriculture sector (including livestock) and identifying mitigation options. GHG inventories are used for reporting to the UNFCCC and Paris Agreement commitments.

Figure 2: Global GHG emissions by livestock species

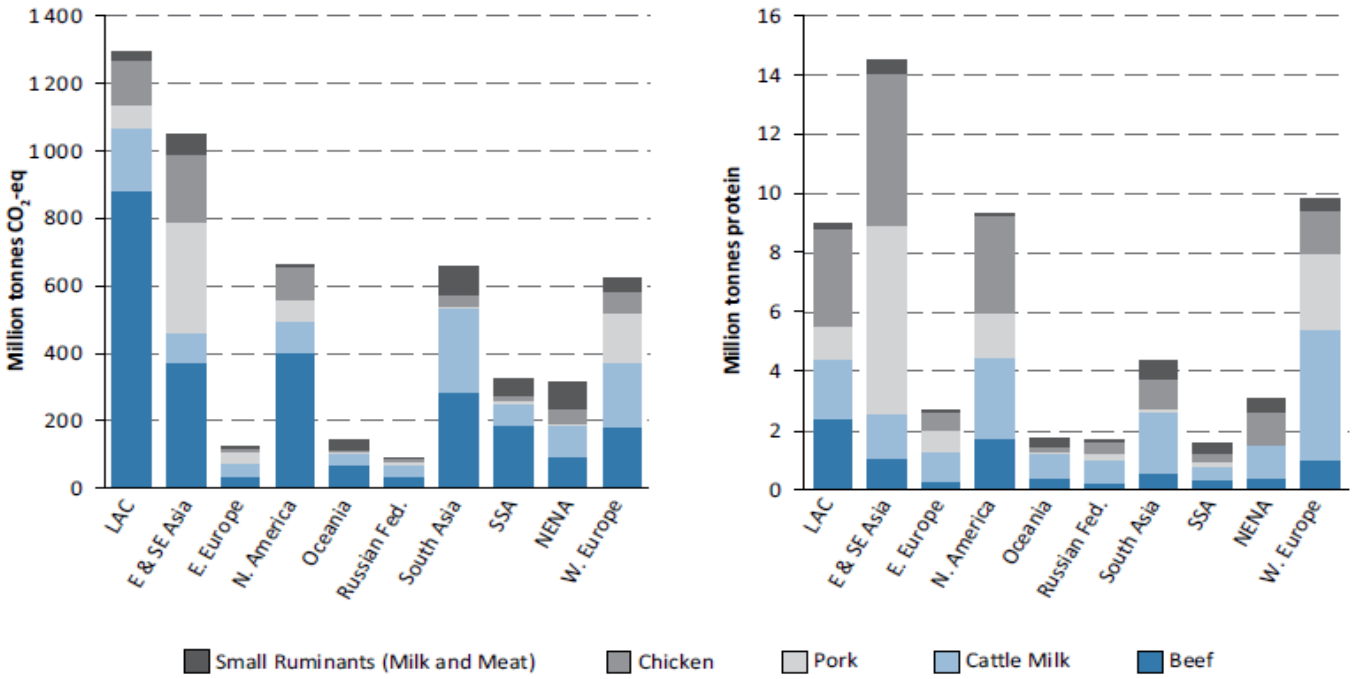


Source: Gerber et al. 2013.

2.7.6 Variations of GHG emissions by regions and meaning

69. Regional emissions from livestock are presented by dominant livestock industry in each region, as shown in Figure 3 below.

Figure 3: Variation of GHG emissions from livestock by region and livestock industry (commodity)



Source: Gerber et al. 2013.

70. Patterns of GHG emissions, as shown in Figure 3 above, are related to the importance of livestock population and dominant production systems for meat, milk, and eggs:

i. In Latin America and the Caribbean, the highest level of emissions was recorded by the large ruminant population (cattle) exploited for meat and milk production systems with high land use change for pasture and fodder production for livestock.

ii. In East Asia, where the highest livestock production and relatively high emission intensities were recorded, most emissions are coming from its beef and pork has the second highest level of emissions (more than 1 gigatonnes CO_2-eq).

iii. North America and Western Europe have similar GHG emission totals (over 0.6 gigatonnes CO_2-eq) and also fairly similar levels of protein output. However, in North America, livestock emissions originate from beef production which has high emission intensities, while for in Western Europe the bulk of emissions originates from dairy herds with much lower emission intensities.

2.7.7 The Global Livestock Environmental Assessment Model (GLEAM) tool to generate update inventory of GHG emissions from livestock production

71. The implementation of the FAO Climate Change Strategy produced effective policies, guidelines and methods to tackle mitigation and adaptation of the agriculture sector, including livestock, to climate change.

72. Within FAO's work on livestock to reduce emissions and improve livestock production systems resilience, FAO took the initiative to develop GLEAM, a GIS framework that

simulates the bio-physical processes and activities along livestock supply chains under a life cycle assessment approach (FAO, 2018a).

73. Developed by FAO, the aim of GLEAM is to quantify production and use of natural resources in the livestock sector and to identify environmental impacts of livestock to contribute to the assessment of adaptation and mitigation scenarios to move towards a more sustainable livestock sector.

74. GLEAM differentiates key stages along livestock supply chains such as feed production, processing, and transport; herd dynamics, animal feeding and manure management; and animal products processing and transport. The model captures the specific impacts of each stage, giving a comprehensive and disaggregated picture of livestock production and its use of natural resources.

75. Features: GLEAM is designed to analyze multiple environmental dimensions, such as feed use, GHG emissions, land use and land degradation, nutrient and water use and interaction with biodiversity.

76. GLEAM is a highly performing tool to achieve tasks and generate information for decision makers to identify technical options for mitigation of GHG emissions from livestock.

77. GLEAM can simultaneously process data collected from six livestock species and their edible products: meat and milk from cattle, buffalo, sheep, and goats; meat from pigs and meat and eggs from chicken. Main performances of GLEAM include:

    i. Spatially explicit modeling of livestock distribution, climatic data, feed yields and biophysical processes that allows the capture of local production drivers and/or constraints, environmental impacts, and identification of intervention measures.

    ii. Estimation of GHG emissions from each stage of production. The model covers emissions of methane (CH_4), carbon dioxide (CO_2) and nitrous oxide (N_2O), using an IPCC Tier 2 methodology, providing more accurate information on how animal feeding, herd and manure management options can help in mitigation.

    iii. The tool can be used to run scenarios of interventions in the livestock sector and can be coupled with other models (e.g., grassland models for sequestration, economic data for cost of mitigation etc.).

78. FAO is committed to helping countries to meet their obligations to the Paris Agreement and the Koronivia Joint Work on Agriculture (KJWA) (FAO, 2019d) decision by building capacity for national measurement, reporting and verification (MRV). These capacity-building initiatives, such as the project, "Creating the enabling environment for enhanced climate ambition and climate action through institutional capacity building" – funded by the Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants (CCAC), the New Zealand Agricultural Greenhouse Gas Research Centre (NZAGRC) and the Global Research Alliance on Agricultural Greenhouse Gases (GRA) – help countries to assess different mitigation action scenarios and to access international climate finance to speed progress towards a more resilient livestock sector. FAO is committed to assisting Members working towards low-carbon livestock as part of achieving the 2030 Agenda for Sustainable Development systems, as well as on crop and feed production and distribution, which allows spatial variability to be accounted for an analysis of livestock GHG emissions at different scales.

3. FAO's work on climate change and the livestock sector from 2015–2020

3.1 FAO's work on livestock in a changing climate

79. FAO's work on climate change in the livestock sector is to improve livestock contribution to food security and resilience of small livestock holders. The assessment below regarding FAO's work on livestock under the Climate Change Strategy focuses on how FAO is addressing GHG emissions reduction from livestock (mitigation) using a CSL approach.

3.2 The FAO Strategy on Climate Change and livestock sector

80. The Climate Change Strategy notes that "98 percent of all Intended Nationally Determined Contributions (INDCs) include priority areas for adaptation and/or adaptation actions in the agriculture sectors. Of these countries, 97 percent refer to crops and livestock" as area to mitigation and adaptation. The strategy recognizes that climate change stands to undermine food security in different ways: "Food availability will be compromised by projected yield declines across the crop, livestock and fisheries". FAO strategy also recognizes that: "Livestock, including feed crops, contributes approximately a third of GHG emissions from the Agriculture, Forestry and Other Land Use (AFOLU) sector. However, FAO estimates that a reduction of up to 30 percent can be achieved" through improved feed and stock management.

81. FAO strategy has also in its first principle: "Give precedence to food security, poverty reduction and sustainability". Climate change undermines food security, nutrition, poverty reduction and sustainability in many contexts, and creates opportunities for improvement in others. FAO applies its core functions through its Strategic Programmes to address climate change, the strategy also highlighted in the last principle "Support policy integration and mainstreaming". FAO promotes both the integration of climate change adaptation and mitigation (CCAM) into policies and strategies relating to the food and agricultural sectors, the strategy notes that "the livestock sector experiences important negative climate impacts in animal productivity, yields of forage and feed crops, animal health and reproduction, and biodiversity. For example, in various sub-Saharan African countries, 20-60 percent losses in animal numbers were recorded during serious drought events in the past three decades."

82. FAO's Climate Change Strategy under SP2 considers: "Promoting sustainable production systems for crops, livestock, forestry, fisheries and aquaculture that are climate-resilient and address climate change adaptation and mitigation, and thereby promoting the Implementation of the 2030 Agenda for Sustainable Development and the Paris Agreement".

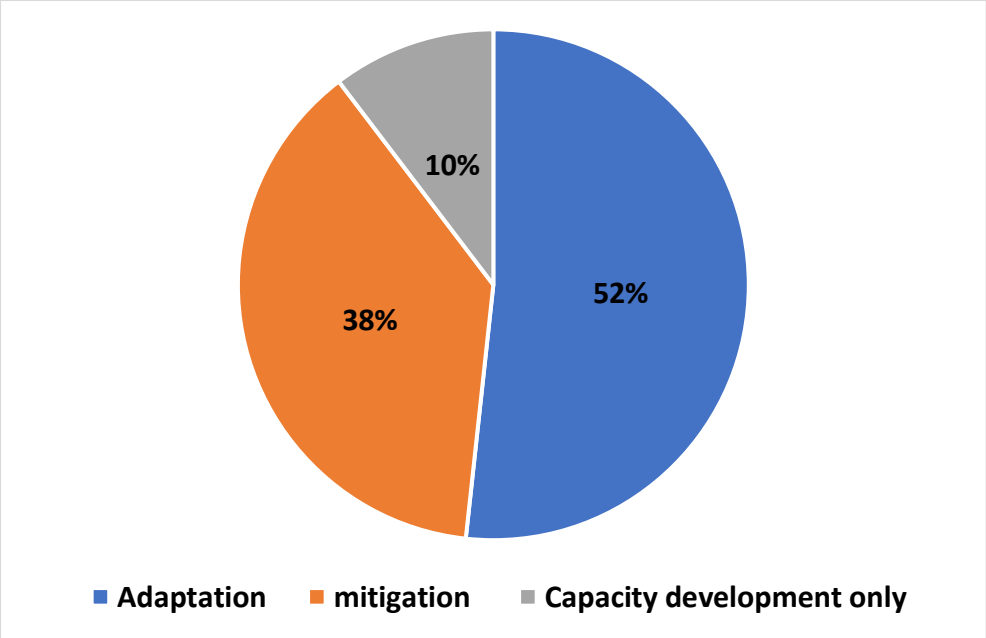
3.3 Analysis of FAO climate-smart livestock (CSL) portfolio

3.3.1 Climate action activities (SDG 13) addressed by the portfolio

83. The portfolio of FAO livestock projects implemented from 2015 to 2020 using the CSL approach is composed of 18 projects, as summarized in table 2 of Appendix 2, with a total investment amount of USD 129 454 583.

84. The analysis of the 18 projects of CSL in the portfolio shows that three main groups of activities related to climate action (SDG 13) are addressed. The first group of livestock projects – addressing the adaptation of the livestock sector to climate change – represents 52 percent of the portfolio. The second group of livestock projects – addressing GHG emissions reduction from livestock and from land degradation – represents 38 percent of the portfolio, and the third group of projects – addressing capacity building in climate change – represents 10 percent of the portfolio (Figure 4).

Figure 4: Contribution of FAO CSL initiatives to adaptation, mitigation and capacity building for climate change integration



Source: Evaluation team

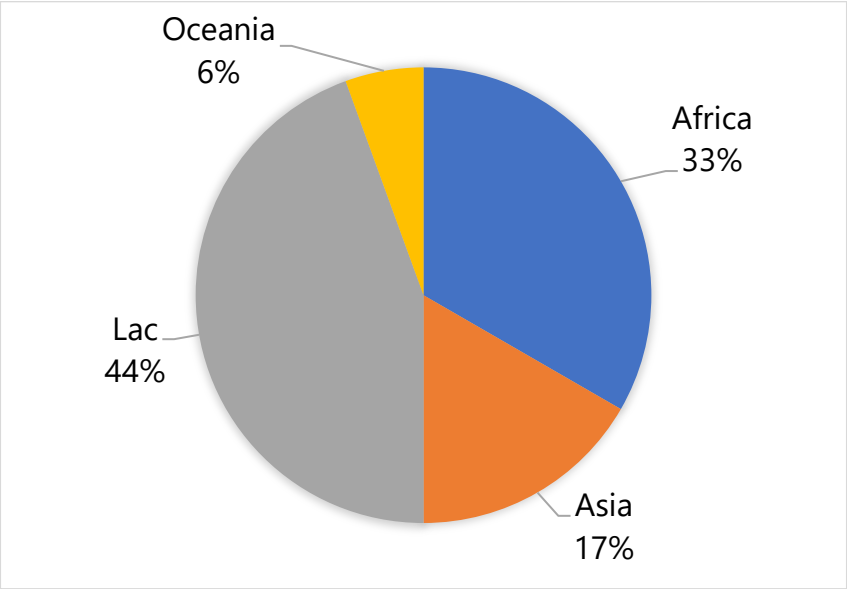
85. Among the 18 CSL initiatives, 38 percent of them aimed at reducing GHG emissions from livestock, these initiatives were mainly initiated by countries that list livestock under their NDCs or National Adaptation Plans (NAPs) to be reported within the Paris Agreement and UNFCCC processes. The existence of financial support from GEF and the Green Climate Fund (GCF) is an incentive for countries to undertake climate mitigation practices for the livestock sector.

86. Within the 18 CSL initiatives in the portfolio, capacity building in CSL practices is considered as a cross-cutting theme in almost all. Only two initiatives were mainly dedicated to capacity development at global and regional level.

87. Geographical distribution: the 18 CSL projects in the portfolio (Table 2, Appendix 2) are distributed by region as follows: Africa (33 percent), Asia (17 percent), Latin America (44 percent) and Oceania (6 percent).

88. As shown in Figure 5 below, most CSL projects are initiated in the Latin America and the Caribbean region (LAC) followed by Africa and Asia. This can be explained by the importance of grazing beef production systems (beef production on pasture lands) practiced in the LAC region and producing a high level of GHG emissions from the livestock sector, as shown in Figure 2 above.

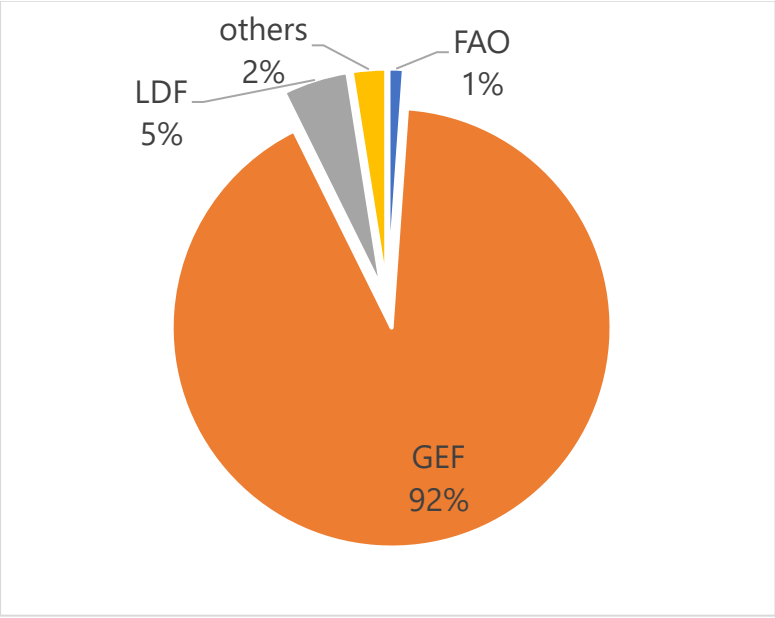
Figure 5: Geographical distribution of CSL projects



Source: Evaluation team

89. Investment costs and sources of financial support of CSL project's portfolio: The total investment costs of 17 projects out of the 18 CSL projects in the portfolio consolidated by the evaluator from project documents (as summarized in Table 2 in Appendix 2) amounts to USD 129 454 583. As shown in Table 2, 91 percent of this funding comes from the Global Environment Facility (GEF), 5 percent from LDF (TCP), 1 percent from FAO and 5 percent of funding from various sources such as South-South and triangular cooperation (SSTC) and the European Commission.

Figure 6: Financing of livestock portfolio



Source: Evaluation team

4. Findings

4.1 Is FAO making a relevant and effective contribution to globally agreed climate action targets?

4.1.1 What have been FAO's main contributions (direct and indirect through other SDGs) to SDG 13 and the Paris Agreement, and how relevant are such contributions?

Finding 1. Through the implementation of its CSL projects and initiatives, FAO has achieved relevant and effective contributions to SDG 13-related SDGs and globally agreed climate action targets by promoting a low carbon development approach in the livestock sector for mitigation of GHG emissions and adaptation of livestock to climate change.

90. Among the 18 CSL initiatives launched by FAO at global, regional, and national levels to promote CSL systems, there are implications for more than 40 developing countries in Africa, Asia, and Latin America. Those initiatives are addressing SDG 13 targets directly (13.1, 13.2, 13.a, 13.b) and indirectly through other SDGs (SDG 2 and SDG 15 targets).

91. The first group of 52 percent of projects/initiatives are undertaking adaptation activities to climate change and improvement of the resilience of livestock producers' livelihoods (13.1) followed by the group of 38 percent focusing on mitigation activities (reduction of GHG emissions from livestock or sequestrating CO_2 in the soil through restoration of degraded pasturelands, tree planting for regenerating the vegetation cover and biodiversity improvement (13.2 and 15.3). The third group of initiatives represents 10 percent of the portfolio of projects focusing on strengthening national capacities at all levels to tackle climate change and aims to improve education, awareness-raising, human and institutional capacity on climate change mitigation, adaptation, and early warning systems. The strengthening of institutional capacity at horizontal level through all sectors is contributing to the mainstreaming of climate development strategies and programmes to tackle climate change.

92. At the global level, capacity building of national institutions to be able to contribute to global negotiations and to meet national commitments for the preparation of reports and submissions within UNFCCC and Paris Agreement, requires the production of inventories of GHG emissions and mitigation measures and adaptation strategies or tools to access green climate finding. During the implementation of the above initiatives, FAO provided countries support with new technologies, tools, best practices for adaptation and mitigation, awareness raising, and knowledge sharing to meet SDG target 13.3.

93. The structure and repartition of FAO projects according to SDG13 targets for the assessed CSL projects is reflecting the three pillars of Climate smart livestock approach.

a. Increase productivity and improve producers' incomes.

b. Reduce GHG emissions from livestock.

c. Increase the adaptation of livestock production systems to climate change by building institutional capacity to incorporate the CSL approach into national and local policies to achieve the Global Agenda for Sustainable Livestock (GASL).

94. The achievement of the above initiatives and the output obtained in each group related to climate actions (mitigation and adaptation) are indirectly supported by other SDG activities and related targets (13.2 and 15.3). For example, the activities recommended to increase productivity of livestock production systems to reduce intensity of enteric methane emission (GHG emissions) will improve productivity of livestock.

95. The implementation of 13.1 and 13.2 can benefit also from the implementation of targets 2.1 and 2.4 regarding the component (a) and (c) above of the CSL approach to increase agricultural productivity and improve incomes of small-scale food producers, particularly women, indigenous peoples, family farmers, pastoralists (2.3) and most vulnerable groups to climate change.

96. The implementation of resilient agricultural practices can increase productivity and production for food security that helps to maintain ecosystem services and strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disaster risks, and that progressively improves land and soil quality.

97. The implementation of the CSL approach to reduce GHG emissions from livestock (13.2) (b above) is also supported by the implementation of SDG 15 (life on land) through its target 15.3 to restore degraded land and soil, including land affected by desertification due to livestock overgrazing of pasture and range lands and drought and floods. Target 15.3 strives to achieve a land degradation-neutral (LDN) world through carbon sequestration to improve soil quality and enrich its organic matter content using different techniques, including: reforestation, zero tillage of soil, and using manure as fertilizer instead of chemical fertilizers.

98. In its first phase, the project 'Reducing enteric methane for improving food security and livelihoods' (Table 1 Appendix 1) objective was to develop and disseminate innovative, evidence-based interventions and options to improve ruminant system productivity, and improve food security while reducing the GHG emissions intensity of livestock species. Project activities were implemented in three regions in Africa, Asia and Latin America and involved 13 FAO Members (Argentina, Bangladesh, Benin, Burkina Faso, Ethiopia, Kenya, Mali, Niger, Senegal, Sri Lanka, United Republic of Tanzania, Uganda and Uruguay) to measure the potential of reducing enteric methane emissions from livestock and its supply chains.

99. The project delivered detailed baseline estimates of enteric methane emissions from livestock production systems in the participating countries estimated using the GLEAM and comprehensive locally obtained data. The project identified the potential mitigation packages developed with the support of FAO experts. Mitigation options were assessed for both their ability to reduce GHG emissions and their cost effectiveness. Further, it improved knowledge and awareness of mitigation potential among local stakeholders and farmers. In various countries, the outcomes of the project were:

    i. During the implementation of CSL projects, FAO built an innovative partnership with the research sector to use a technical package of mitigation techniques related to livestock production systems and regions showed positive results to reduce GHG emissions variable from 14 to 41 percent[3] compared to baseline scenario. The support of the

[3] FAO. n.d. *Climate change* [web page]. In: *FAO* [online]. www.fao.org/climate-change

research sector in this regard is considered is considered as key indicator of the validity of the technologies and options proposed to farmers to improve livestock productivity while reducing methane emissions from livestock.

ii. The project laid a foundation for mitigation policy action with Nationally Appropriate Mitigation Actions (NAMAs) in each country, and providing a framework for measurement, reporting, and verification (MRV) to meet national obligations within UNFCCC and the Paris Agreement (NDCs) where FAO laid its support to participating countries.

iii. Promoting sustainable production systems for crops, livestock, forestry, fisheries and aquaculture that are climate-resilient and address climate change adaptation and mitigation, and thereby promoting the implementation of the 2030 Agenda and the Paris Agreement.

100. FAO CSL projects and initiatives are relevant and contribute to SDG 13 and other related SDGs by promoting sustainable production systems which are climate resilient and efficiently mitigate GHG emissions from livestock, responding to FAO's Climate Change Strategy planned action to undertake under SP2 to "promote sustainable production systems for crops, livestock, forestry, fisheries and aquaculture that are climate-resilient " contributing to the implementation of the 2030 Agenda for Sustainable Development and the Paris Agreement.

Finding 2. By launching a multi-stakeholders partnership, the Livestock Environmental Assessment and Performance Partnership (LEAP), FAO made relevant and effective contributions to globally agreed climate action targets through supporting countries to build inventories of GHG emissions from different livestock production systems in more than 25 countries. FAO identified potential mitigation packages, improved the knowledge base and increased awareness for mitigation potential from livestock production systems, allowing countries to meet their obligation within UNFCCC and the Paris Agreement through NDCs and NAPs.

101. The lack of accurate data and estimates of GHG emissions from livestock, in countries with an absence of capacities and tools to carry out comprehensive and consistent analysis, motivated FAO to develop and improve the GLEAM modeling framework through LEAP to support countries to build national GHG emissions inventories to meet their obligations within UNFCCC and the Paris Agreement through their NDCs, NAMAs and NAPs strategic documents. The work was carried out by countries and supported technically by FAO through the implementation of livestock projects, using improved practices to reduce GHG emissions from livestock (various options) and in various production systems. The FAO LEAP partnership improved the design and performance of the GLEAM tool to assess GHG emissions from livestock and its supply chains.

102. GLEAM tool was used by 25 countries (FAO, 2019c), a simplified open-access, web-based version, GLEAM-i, focusing specifically on emissions from livestock systems is available for use by countries and other FAO partners such as the World Bank, International Livestock Research Institute (ILRI), and IPCC.

103. GLEAM tool was used by countries in the development of NAMAs by defining a baseline scenario, identifying and setting priorities for the livestock sector and defining sustainable

development benefits e.g., productivity gain while adopting low carbon pathways for livestock production systems.

104. As it was mentioned during interviews, GLEAM tool is used by FAO and the World Bank, to prepare large scale investment projects on resilience to climate change in the dry lands of sub-Saharan Africa. In this region livestock is the main user of land and a key support for livelihoods to earn income, food, and nutrition. GLEAM is used for modeling the development of livestock under climate constraints, to assess feed balances and to analyze the potential of livestock in dry lands to meet the projected growth in demand of animal source food in the region.

105. Using the improved GLEAM tool and recent statistics on livestock population and production systems, with the support of LEAP stakeholders worldwide taking into account the whole supply chain of livestock production systems, FAO produced a global assessment and more detailed figures regarding livestock supply chains contribution to global GHG emissions detailed by region, countries, species and production systems (see Figure 3 above).

106. Results of the global assessment of GHG emissions from livestock are documented and published in *Tackling climate change through livestock* by FAO (Gerber *et al*, 2013) and accessible on FAO website.

107. The initiative led by FAO on reducing methane emission from livestock was relevant for the participating countries to build GHG emissions inventories, investigate options to adopt the low carbon development of livestock production systems, and to integrate this approach in their national strategies for adaptation and mitigation of climate change. The following country cases are given as examples:

i. In Argentina and Uruguay, FAO gave support to countries to test several management options to reduce CH_4 emissions and improve livestock productivity using GLEAM (FAO & New Zealand Agricultural Greenhouse Gas Research Centre, 2017) for assessment of technical options and scenarios. The large beef cattle population in Argentina and Uruguay provides one of the most cost-effective opportunities to reduce enteric CH_4 emissions while meeting other development goals such as food security, and improvement of producers' income through the export of beef cattle and integration of beef producers to markets.

ii. In Argentina, beef exports accounted for 16 percent of the total value of exports and 22 percent value of agricultural exports respectively.

iii. In Uruguay, beef exports reached 70 percent of its total beef production.

iv. Pursuing low-carbon development of their beef sectors, Argentina and Uruguay are more likely to benefit from strategic and competitive advantages, such as increased access to existing and emerging global markets for their low carbon beef products.

v. In sub-Saharan Africa, dairy offers sizable reduction opportunities. For example, in East Africa, between 70-80 percent of smallholders are engaged in dairy production and 70-98 percent of all milk is produced by smallholders. Livestock is one of the main economic activities, accounting for about 26 percent of the regional agriculture GDP.

vi. In South Asia, Sri Lanka and Bangladesh are heavily reliant on milk imports; only 30 and 48 percent of the national milk requirement is met through local production.

Pursuing low carbon development of their dairy sectors can help reduce the drain on the country's foreign exchange resources, improve food and nutrition security, support employment and family incomes in the rural areas.

vii. The impact of GLEAM tool is well established by providing the above countries with appropriates and safe options to mitigate GHG emissions from livestock allowing farmers to reduce emissions from their sector by offering them cost effective options to promote sustainable livestock systems to improve livestock productivity.

viii. Our analysis confirms the relevance and effectiveness of FAO LEAP support to countries in using GLEAM tool along with the bulk of knowledge that has been produced related to GHG emissions reduction from livestock. The tool is responding to the need to take urgent action to mitigate GHG emissions from all sectors including livestock as explicitly requested in the Paris Agreement.

Finding 3. FAO projects and initiatives in the livestock sector have been supporting countries to develop capacity in climate financing, for example by accessing GCF and GEF contributions, to catalyse financial support for the development of low carbon livestock production systems (SDG 13.A.1)

108. FAO, through CSL initiatives, has been supporting countries to develop capacity in climate financing to have better access to funding from specialized donors like GEF.

109. As shown in Figure 6 above, the majority of financial support for livestock projects of the portfolio came from GEF for 91 percent of the total investment costs.

110. During interview meetings with external stakeholders regarding resource mobilization for the implementation for CSL projects, respondents expressed the need to address other climate funds, such as the GCF, to secure more financial support and the consistent investment required for the mitigation and adaptation of the livestock sector to climate change.

111. The implementation by FAO in 2015 of the initiative of 'Reducing methane' helped countries to attract new financial resources to address the incremental costs of low carbon development systems through technology and provided an opportunity for countries to access climate finance through international mechanisms such as GEF and GCF, but also bilateral and multilateral funding mechanisms, as well as national financing and partnership with private sector (FAO, 2019e).

112. Examples:

i. In Ethiopia, Bangladesh, Uruguay and Kenya, the above initiative has helped to create an enabling environment and to catalyze additional financing for methane mitigation through GCF, GEF and also bilateral and multilateral funding mechanisms, as well as national financing.

ii. In Ecuador, the FAO/GEF project on CSL contributed to strengthening national and local institutions (through capacity development processes at a national level and provincial level). An arrangement with BanEcuador (the national bank) to strengthen technical capacities in the analysis and design of green financial products was implemented.

iii. In Uruguay, FAO's comparative advantage with its technical expertise supported the design of local projects, the creation of capacities, FAO has been the coach for Uruguay to access GEF funding sources.

113. As it was noted during the interview with external stakeholders, FAO supported the preparation of the CSL project in Uruguay, thanks to its technical knowledge on resource mobilization. The CSL project was funded by GEF and the Ministry of Livestock in Uruguay. With support of FAO, Uruguay started diversifying its financial support from other agencies, including GCF financing its investment program for low carbon development of beef production system at large scale.

114. FAO support was effective to support Uruguay to diversify its financial partners to mobilize green financing resources.

Finding 4. Through FAO initiatives/projects implemented in the livestock sector to mitigate GHG emissions from livestock and to improve resilience of livelihoods, FAO made relevant contributions to promoting the CSL approach, UNFCCC and the Paris Agreement.

115. In December 2015, the Paris Agreement was adopted by the UN Conference of the Parties (COP) of the UNFCCC at its 21st session (COP21). Over 97 percent of NDCs submitted by countries to the conference identified crops and livestock as an area to launch mitigation and adaptation to achieve SDG 13 and to meet their commitments to UNFCCC and the Paris Agreement.

116. In several CSL initiatives and projects, FAO supported countries using the GLEAM tool which allowed national governments to undertake regular monitoring of GHG emissions to facilitate easy reporting to UNFCCC. The results of GLEAM tool estimates are useful for country reporting on NDCs within UNFCCC and the Paris Agreement, and also for NAPs and NAMAs for mitigation and adaptation to climate change.

117. The FAO LEAP partnership was active through its input to the climate agenda and its Koronivia Joint Work on Agriculture (KJWA). More specifically, LEAP contributed to the FAO submissions to the UNFCCC and the keynote speech of the UN Climate Change Conference (COP25) side event: 'How governments can use LEAP guidelines in the context of the Paris Agreement'.

118. During the last five years, FAO also contributed to global fora including the 10th Global Forum for Food and Agriculture (GFFA) in Berlin (2018), where FAO presented the document *Shaping the future of livestock sustainably, responsibly, efficiently* (FAO, 2018b), published to help guide discussions during the forum on how the global livestock sector must manage four important roles: food and nutrition security; livelihoods and growth; health and animal welfare; and climate and natural resource use.

119. Also FAO participated in UNFCCC processes and organized thematic events on GHG emissions reduction and adaption of livestock to climate change,.

120. FAO made relevant contributions for the adoption of the Koronivia decision by the COP of UNFCCC on Joint Work on Agriculture.

121. FAO also organized several side events during UNFCCC COPs and provided support to developing country negotiators.

Finding 5. The CSL approach promoted by FAO through field livestock projects strengthened country capacities in designing, implementing, and reporting on climate change mitigation and adaptation actions undertaken in the livestock sector, in compliance with UNFCCC directives and the Paris Agreement. FAO's knowledge products included best practice packages, publications and knowledge sharing platforms targeting various stakeholders and meeting their information needs.

122. Results of the FAO global initiative on 'Reducing methane to improve food security of livelihoods' are being used to demonstrate the range of mitigation options and cost of mitigation operations. Catalyzing climate finance for mitigation and adaptation activities in the livestock sector required robust GHG accounting, identification and prioritization of mitigation options, and cost-benefit analyses to support decision-making in developing investment programmes.

123. As a result of the low-carbon growth pathways studies in 13 pilot countries, FAO support was effective to assist countries to design investment programmes that can leverage allocations from international financial mechanisms, such as GCF, GEF, and multilateral development banks, such as the World Bank, to advance mitigation planning activities in the livestock sector.

124. In Kenya, FAO project results on reducing emissions from livestock have been used in the design of the dairy NAMA 'Low-carbon and Climate Resilient Dairy Development in Kenya' submitted to GCF for funding. The main objective of this NAMA is to trigger low-carbon development in the dairy sector through the introduction of CSL practices. The NAMA programme aims to provide effective support to 267 000 dairy farmers, double milk production from 450 million litres to 915 million litres, increase household dairy enterprise net income by at least 50 percent and provide additional benefits in the form of reduced labor and health burden of fuel wood collection, especially for women.

125. In Ethiopia, results of FAO projects were used to inform the design of the 'Livestock and Fisheries Sector Development Project'. Under the World Bank supported investment project, financial resources have been allocated towards institutional capacity building on GHG quantification and methane mitigation and towards data collection to support development of improved GHG inventory on livestock emissions.

126. In Bangladesh, under the World Bank supported investment project 'Bangladesh Livestock Development-based Dairy Revolution and Meat Production Project' financial resources have been allocated towards institutional capacity building on GHG quantification and methane mitigation and towards data collection to support development of improved GHG inventory on livestock emissions.

127. in Zambia and Malawi, FAO is working to identify, assess and upscale climate- smart agriculture options. GLEAM was used for the assessment of technical interventions in the livestock sector looking at feed quality, herd and manure management. The model also supported the assessment of climate change impact on feed balances in both countries.

128. In Ecuador, the CSL project (Sangoluisa, P. *et al*, 2019) is funded by GEF, the project is based on natural resource use efficiency and carbon sequestration. GLEAM provides the analysis of emission profiles in livestock supply chains and the assessment of options to increase system resilience and productivity.

129. Since 2016, Ecuador, through the Ministry of Agriculture and Livestock and the Ministry of the Environment, with technical support from FAO and financing from GEF, has implemented the CSL approach. This approach seeks to sustainably increase livestock productivity and the income of producers, improve the resilience of livestock systems to climate change, reduce GHG emissions and increase carbon sequestration in pasture lands.

130. The preliminary results of the initiative showed an increase of the income of the participating families of livestock producers to the project, the efficiency of livestock production, reduction of intensity in GHG emissions per unit of product (milk and meat), was observed. As part of this valuable process, the FAO Country Office in Ecuador has taken the important step of mobilizing private sector participation.

131. In early 2019, FAO established a strategic alliance with El Ordeño, a major Ecuadorian food company. FAO worked with the company on a pilot project to adapt and validate participatory diagnostic tools, in order to identify good practices and measure GHG emissions in the field. The mitigation results show that enteric fermentation is the main source of direct emissions, thus it is recommended to continue implementing practices aimed to improve the feed basket of livestock.

132. Despite the fact that direct emissions have been quantified, it is advised to account for carbon sequestration activities that take place at farm level in order to better understand the mitigation potential of the livestock sector. Collecting and processing information regarding livestock management and farm data remains a challenge to evaluate mitigation and adaptation practices in Ecuador.

Findings 6. No evidence base was found on addressing trade-offs in a systematic way in livestock production projects and climate change-related work, but examples of potential synergies and trade-offs exist between SDG 13 and other SDGs.

133. Trade-offs between intensive livestock production systems and climate action exist when livestock projects do not implement mitigation and adaptation practices, in line with the SDG 13.

134. As FAO CSL livestock projects aim to support Members to improve food security (SDG 2) and farmers livelihoods, this will contribute to increased GHG emissions from livestock by increasing livestock pressure (stocking rate) on pasture/rangelands (overgrazing), increased area of cultivated fodder (more energy for pumping water for irrigation), and all these activities will increase GHG emissions, causing trade-offs between the SDG 13 and food security objectives (SDG 2).

135. Trade-offs between SDG1 3 and SDG 2 in CSL implemented projects were managed by FAO using appropriate technical options for mitigation, including appropriate improved management practices for livestock, such as balanced feed practice which will reduce methane emissions (SDG 13) and increased animal productivity (i.e. growth or milk) to meet food security objectives (SDG 2) while reducing GHG emissions and increased productivity by using less resources per unit of production.

136. There are synergies and trade-offs between SDG 13 and other SDGs. The identification of mitigation options in the FAO CSL projects portfolio was modelled using the GLEAM tool to maximise synergies between SDGs and improve resource use. The CSL approach functions as tool to implement SDG 13 to reduce GHG emissions, improve food security,

improve income and reduce poverty, and improve soils, creating synergies between SDG 13, SDG 1, SDG 2 and SDG 15. This was the case many projects in Ecuador, Mongolia and Uruguay, where livestock grazing systems present an opportunity to create synergies.

137. FAO did not systematically address trade-offs between SDG 13 and other SDGs, such as SDG 2, meanwhile FAO in livestock interventions is optimizing synergies. This was confirmed by consulted project documents and two case studies from Ecuador and Uruguay,

4.1.2 Is climate change mainstreamed across FAO's portfolio of programmes and projects to ensure enhanced relevance and coherence with FAO's mission on climate action, SDG 13, the Paris Agreement and the evolving international climate agenda?

Finding 7. FAO, using the CSL approach, supported country members for the mainstreaming of climate change to mitigate GHG emissions from livestock and application of best practices through its support provided to countries in NDCs and NAPs.

138. FAO, as a leading international organisation in the livestock sector, published strategic documents to demonstrate how to transform the livestock sector through the SDGs. Moreover, the publication *World Livestock: Transforming the livestock sector through the Sustainable Development Goals* (FAO, 2018c) examines the sector's interaction with each SDG, as well as the potential synergies, trade-offs and complex inter-linkages involved (FAO, 2020a).

139. To achieve CSL initiatives, FAO supported by a multi-stakeholder partnership such as LEAP and the GASL, started approaching the sustainability of livestock production systems from different angles.

140. Main concerns of climate change mainstreaming in livestock sector production systems were addressed through FAO CSL projects and initiatives during the last five years and addressed climate change issues at different levels, from producers to decision makers, with the aim of sensitizing them to move to sustainable practices in the livestock sector to achieve the 2030 Agenda.

141. Based on its Climate Change Strategy and strategic programme of work to integrate climate change in food production systems, FAO took these relevant steps to integrate CSA, including CSL practices, to adopt low carbon livestock production systems:

i. Related the role of livestock in adaptation practices to the management of organic matter and nutrients, and the diversification of incomes.

ii. Demonstrated mitigation option opportunities along the entire livestock supply chain. These are mostly associated with feed production, enteric fermentation, and manure management.

iii. Implemented several CSA practices by farmers, these practices include grassland restoration and management (e.g. silvopastoral systems), manure management (e.g. recycling and bio digestion) and crop-livestock integration.

Removed barriers to the adoption of CSL approaches related to a lack of information, limited access to technology and insufficient capital. Overcoming these barriers

requires specific policy interventions, as well as extension services and financing mechanisms, such as schemes for improving livestock producers' access to credit and payment for environmental services.

142. A CSA approach that considers the entire food supply chain is particularly important for the livestock sector, given the sector's strong interrelationship with crop production.

143. Tackling one or more of the above criteria to achieve CSL production systems, FAO projects and initiatives contributed the following to the mainstreaming of climate-smart approaches to strengthen capacity at political, institutional and individual levels, for planning and application of best practices in the livestock sector:

i. Increased participation of beneficiaries during conception and implementation of CSL initiatives and working with indigenous peoples are crucial aspects to improve resilience of livestock producers to climate change.

ii. FAO global project on 'Reducing enteric methane for improving food security and livelihoods', making inventories of GHG emissions from livestock production systems under various management systems in different countries and regions, produced detailed estimates of enteric methane emissions from livestock production systems (FAO, 2019e).

iii. Comprehensive locally-obtained data developed potential mitigation packages and assessed them for both their ability to reduce GHG emissions and their cost effectiveness, as well as improved knowledge and awareness on mitigation potential among local stakeholders and helped to meet national obligations within UNFCCC[4] and the Paris Agreement (submissions and monitoring of national GHG emissions within NDCs).

iv. In Ecuador, through the Ministry of Agriculture and Livestock, with the technical support of FAO and financing from GEF, the Government of Ecuador has focused since 2016 on the implementation of the CSL approach, aiming to adopt a low carbon beef production system. The project has been implemented in seven provinces of the country (Guayas, Manabí, Santa Elena, Imbabura, Loja, Napo and Morona-Santiago) and the preliminary results confirm the need for actions that improve the efficiency of production systems and reduce GHG emissions.

144. Based on above evidence base, FAO projects made relevant contributions to demonstrate the efficiency and feasibility of CSL production systems to achieve the transformation of livestock production systems beyond SDG 13, with more sustainable food production along livestock supply chains.

Finding 8. Through its portfolio of programmes and CSL projects, FAO made relevant contributions for the adoption of CSL practices at national levels with preliminary positive environmental and socioeconomic impacts.

145. The adoption of CSL practices at national and local levels is considered as a positive response from countries and communities where livestock production systems are a major component of the national economy which contributes significantly to GDP, generating income (sales and exports) and a source of employment for the local population.

146. CSL initiatives and projects were implemented by FAO in alignment with its Country Programming Framework (CPF) priorities and Climate Change Strategy, as embedded in SP2, which is focusing on sustainably increasing production and productivity and addressing climate change and environmental degradation in agriculture.

147. During the implementation of CSL projects, FAO contributed to building national capacities at the local and national levels to facilitate intersectoral dialogue on climate action and create synergies at country level. FAO produces guidelines and manuals to improve the development of livestock value chains, health, and husbandry practices. FAO is building capacity at local level to promote best practices and facilitate sharing of these practices through the initiative of farmer field schools (FFS).

148. Since 2016, FAO has been implementing the project 'Promotion of climate-smart livestock management integrating reversion of land degradation and reduction of desertification risks in vulnerable provinces' (GCP/ECU/085/GFF). The project was implemented in seven provinces in Ecuador (three in the coastal region, two in the Andean region and two in the Amazon region). Its aims reflect the three pillars of CSA practices in increasing productivity and improve producers' incomes, reduce GHG emissions, and increase the adaptation of productive systems to climate change by building institutional capacity to incorporate the CSL production approach into national and local policy. Results of the initiative are very encouraging and the income of the participating families of livestock producers has increased by 10.7 percent, and the efficiency of livestock production, measured in GHG emissions per unit of product (milk and meat), has increased by 17.7 percent. As part of this valuable process, the FAO Country Office in Ecuador has taken the important step of mobilizing private sector participation. In early 2019, FAO established a strategic alliance with El Ordeño, a major Ecuadorian food company. In the first stage, FAO worked with the company on a pilot project to adapt and validate participatory diagnostic tools in order to identify good practices and measure of GHG emissions in the field. The second stage, which will start soon with the participation of about 2 400 family livestock producers, will focus on the application and monitoring of technical solutions to improve the quality and sustainability of dairy farming. This collaboration forms part of a *win-win* logic since, for El Ordeño, the adoption of the CSL approach is one of the factors that has helped to strengthen its certification as a B Corporation that has generated a triple positive impact – economic, social and environmental – and allowed it to enter the market with a new generation of sustainable foods.

149. In Senegal, FAO implemented the project 'Integration of climate resilience in agro-pastoral production for food security in vulnerable rural areas through the farmer field school approach' (GCP/SEN/065/LDF) which has significantly contributed to building the capacities of stakeholders for the mainstreaming of climate change into development policies and programs:

i. In collaboration with other partners (Direction de l'Environnement et des Etablissements Classés [DEEC] in Senegal, German Agency for International Cooperation [GIZ] and the Innovations Environnement Dévéloppement [IED]) and other actors, FAO organized capacity building workshops on mainstreaming climate change into public policies and mobilizing financial resources, for the benefit of national and local elected officials, civil society organizations, farmers organizations and journalists.

ii. At the local level, FAO in partnership with DEEC, enabled the capacity building of regional committees for climate change. The regional committees are playing an important role in the information, awareness-raising, training and facilitation in the design, financing, implementation, validation and M&E of national projects and programs, both sub-regional and regional, related to adaptation, resilience and mitigation to climate change of vulnerable sectors including livestock production systems.

iii. FAO, in partnership with the Senegalese Agency for Reforestation and for the Great Green Wall (ASRGMV) and the Centre de Suivi Ecologique (CSE) in Senegal, implemented the project 'Action Contre la Désertificationenappui à l'initiative de la mise enœuvre de la Grande Muraille Verte et à la Coopération Sud-Sud dans les pays d'Afrique des Caraïbes et du Pacifique' (GCP/INT/157/EC), where climate change mitigation and adaptation were addressed through the establishment of natural reserves (mitigation) and strengthening national capacities with the following results:

- Establishment of natural reserve (1000 ha) existing on the route of the great green wall initiative; and development management plans for the Koyli Alpha community natural reserve and the large Widou plot, with an area of 1000 ha and 2300 ha, respectively.
- Strengthened the capacities of ASRGMV experts in the field of M&E and data collection using FAO Collect Earth tool.

iv. In the area of strengthening the adaptation and resilience of local communities to climate change, FAO has developed a participatory and inclusive approach for better involvement of local communities, and has supported the development of income-generating activities for local communities and women and actions to restore degraded pastures to secure pastoral livestock needs.

v. In the United Republic of Tanzania, FAO implemented the project 'Support Livelihood Restoration to the Disaster Affected Communities in Kagera Region of Tanzania' (TCP/URT/3606) to support communities at local level to improve their resilience to climate change risks.

4.1.3 What type of initiatives have been, or are likely to be, most effective to achieve significant and sustainable, results, and why? (policy advisory, governance and institutional development; data, information and knowledge management; direct assistance to stakeholders, SSTC; farmer organizations, traders, schools, mobilization of resources, etc.).

Finding 9. FAO initiatives and projects promoted GHG emissions reduction methods, strengthened national capacity, and enabled environment for partnership for mobilizing resources.

150. The majority of projects and initiatives implemented by FAO using the CSL approach during the last five years aim to support countries exploring the adoption of low carbon livestock production through the reduction of GHG emissions of livestock (SDG target 13.2.1) and increasing resilience and productivity of livestock production systems using best practices to improve efficiency of resource use (water, pasture lands, animal feed).

151. To provide effective support to countries for the reduction of enteric methane emissions from livestock, FAO in partnership with the NZAGRC countries were able to identify

system-specific technologies and interventions to increase livestock productivity, food security and reduce enteric methane emissions per unit of product (meat and milk).

152. The project provided guidance to decision-makers engaged in the policy discourse on mechanisms, recommendations on incentives and institutional framework necessary to incentivize the adoption of productivity-enhancing technologies and practices.

153. The main achievements the project on enteric methane emissions, with the involvement of 13 countries, were obtained in capacity building, awareness raising, financing and partnership development:

i. Capacity building and knowledge sharing with over 150 stakeholders: The project has developed a knowledge base that increased awareness and knowledge of the potential role of methane in climate change and food security. The knowledge base is used by countries for methane mitigation. The project supported countries to update their inventories of respective estimates of GHG emissions from livestock and supply chains. This stimulated in-country ownership and provided two valuable outputs:

- a successful process for establishing low carbon pathways (Ecuador and Uruguay); and
- useful knowledge and data set that can be used to support countries address methane emissions.

ii. Increased awareness and policy advocacy: Knowledge generated used to enhance awareness and commitment across governments and other stakeholders to address methane emissions from livestock. For example in Uruguay, this collaborative effort supported the country by improving the quality of its emissions inventory, better defining its reduction targets in terms of emissions intensity, and improving the understanding of the impacts of measures to improve productivity, and production efficiency.

iii. Catalyzed funding for methane mitigation: Through its activities within 13 countries, the project generated a wealth of knowledge which can be used to develop low carbon pathways, identify GHG reduction investments in these countries and make use of growing sources of carbon finance and methane mitigation from GEF and LDF.

iv. Strengthening partnerships with the research for GHG mitigation: The partnership of the Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants (CCAC), the NZAGRC, and FAO, showed that working together is a much more efficient way to achieve better results.

Finding 10. FAO developed guidelines, tools, methodologies, and protocols to assess the environmental impacts of livestock systems and identify best practices relevant to promote CSL initiatives for sustainable livestock production systems.

154. FAO supports countries to address climate change by generating applications and dissemination of knowledge in order to strengthen the capacity of its Members in addressing issues related to livestock and climate change among other support for the transformation of livestock through the 2030 Agenda.

155. For example, FAO develops tools to guide decision-making on adaptation and mitigation, for modeling and to design protocols for monitoring and collection of data. The GLEAM

tool provides a valuable evidence base to define priorities and design technical and policy responses to climate change adaptation and mitigation. The tool is relevant to achieve GHG emissions inventories from livestock, it also helps countries to update NDCs and prepare national reports regarding emissions within UNFCCC and Paris Agreement processes.

156. Tools, such as the guidelines produced by the LEAP Partnership, helped to generate consensus on data and methods for livestock mitigation and adaptation actions among a wide range of stakeholders.

157. Country responses to climate change through practice and policy changes were implemented with the support of FAO projects and programmes.

158. FAO helped countries to identify livestock breed diversity through a dedicated intergovernmental working group and describe the characteristics of local genotypes and their adaptation to climate, which allows for evolution in step with environmental changes. FAO is supporting regional and global gene banks to provide for the maintenance of backup collections of genetic material that can be drawn upon to support climate change adaptation measures in the future.

159. Enhancing the evidence base for mitigation, many developing countries need support to collect the data needed to calculate GHG emissions and carbon sinks in the agriculture sectors. The Global Livestock Environmental Assessment Model (GLEAM) and the free on-line version GLEAM-i is an appropriate tool which FAO produced to be used by governments, scientists and the private sector to calculate emissions from livestock and assess the impacts of project interventions on production and emission levels. It is a helpful tool to design mitigation options based on data generated using the model.

160. FAO GLEAM outputs are used by the IPCC to inform the development of guidelines relevant to livestock emissions through FAO multi-stakeholder LEAP Partnership, which provides methodologies for monitoring the environmental performance of livestock agri-food systems.

161. FAO, by developing tools and guidelines and ensuring dissemination in assisted countries to analyze the impacts of climate change, is planning appropriate responses to these impacts and meeting their reporting cycles of NDCs.

162. During the last five years, FAO has been very active in assessing the impact of climate change on livestock production (FAO, 2019c), especially through high-level participation and contributions to UNFCCC pre-COP, COP24 and COP25, with focus on studying the effect of climate change on livestock and identified climate actions to be undertaken through good practices in livestock and supply chains for mitigation, adaptation and increasing resilience of livestock production systems synthesized and disseminated through publications and during side events.

4.2 Is FAO fit for purpose to significantly contribute to globally agreed climate action targets?

4.2.1 To what extent are FAO's overall strategic objectives, results framework and strategies (current and under development) aligned with global policies and strategies such as the 2030 Agenda and the Paris Agreement?

Finding 11. FAO's Climate Change Strategy is a cross-cutting theme in FAO's reviewed strategic framework (2017b) to address climate change impacts in agriculture sectors through SDG 13.

163. Climate change is threatening food security and nutrition but agriculture is also contributing to exacerbating climate change through GHG emissions, mainly from livestock. FAO's Climate Change Strategy intends to promote an ecosystem-based approach to increase resilience to climate change, through technical packages of adaptation strategies and mitigation (both adaptation and mitigation are the main targets of SDG 13.1 and SDG 13.2). FAO's Climate Change Strategy under SP2 considers "promoting sustainable production systems for crops, livestock, forestry, fisheries and aquaculture that are climate-resilient and addresses climate change adaptation and mitigation, and thereby promoting the Implementation of the 2030 Agenda for Sustainable Development and the Paris Agreement."

164. FAO is committed to SDG 13 implementation, integrating climate change adaptation and mitigation (CCAM) considerations into its programming and project cycle. This approach is used in mitigation of GHG emissions from livestock and was designed and started by FAO in collaboration with 13 countries in three regions (Africa, Asia and Latin America) through the initiative 'Reducing enteric methane for food security and livelihoods'. The project was achieved in collaboration with countries in partnership with the research institutions for the transfer of technology.

165. FAO used its approach of CSL, which is mainly based on improving feeding system to improve digestibility, to reduce GHG emissions from livestock. Despite the technical feasibility and benefits for farmers by improving livestock productivity, the approach is not yet integrated into strategy at the global and country level.

Finding 12. FAO's senior management pays attention to livestock due to its multiple facets as a source of animal foods, employment and income. However,there is no sufficient mainstreaming of mitigation and adaptation practices into the existing livestock programmes and projects along with training and awareness raising to farmers on livestock feed and management.Investigating information gaps could reduce the negative impacts of livestock raising.

166. Existing cost-effective methods to reduce GHG emissions from livestock are not mainstreamed within the organization.

4.2.2 Does FAO have clear and articulated institutional strategies and plans to support climate action?

Finding 13. FAO's Climate Change Strategy and strategic objectives referred to global policies and explicitly to both the 2030 Agenda and Paris Agreement. FAO livestock projects for mitigation and resilience to climate changes threats are aligned with FAO's Climate Change Strategy and the reviewed strategic framework (2017b).

167. In 2015–2016 important global developments occurred, in particular the adoption of the 2030 Agenda for Sustainable Development with the adoption of the 17 SDGs, and entry into force of the Paris Agreement on climate change. These changes provide the broad context in which FAO operated and adapted to improve delivery and impact to achieve sustainable development at global, regional and national level.

168. To cope with new development challenges and provide support to country members, FAO revised its strategic framework (2017b) which provides the overall strategic direction for the Organization, identifies main challenges and implications to be addressed at global and national levels through the implementation of FAO's Climate Change Strategy and its work plan (2016a).

169. During the interviews of FAO staff from headquarters and country offices, FAO's Climate Change Strategy was seen as a guidance of activities for technical divisions to support countries in climate change requests (to make GHG emissions inventories, prepare projects, get financing and address green climate funding sources).

170. Some of the respondents implicated in the preparation and implementation of FAO projects and initiatives claimed that the CSL initiatives and projects are aligned with both CPF priorities and with FAO's Climate Change Strategy as embedded in SP2, which is focusing on sustainably increasing production and productivity, and addressing climate change and environmental degradation in agriculture.

Finding 14. Some FAO CSL projects made a clear focus on women's participation in climate change mitigation and adaptation projects with a limited number of initiatives dedicated specifically to women.

171. An analysis of women's participation in FAO CSL initiatives shows that not all projects include a gender-sensitive approach at design stage. There are still some examples that show explicit attention to women and gender. For example:

i. In Uruguay the Climate Smart Livestock Production project has included an expert in gender and has recently presented its gender strategy for the project to improve the participation of women in the implementation of the project activities both at local and national levelsIn Senegal, FAO is implementing the project 'Integration of climate resilience in agro-pastoral production for food security in vulnerable rural areas through the farmer field school approach' (GCP/SEN/065/LDF). The participation of women and youth in this programme to collect and use agroclimatic information and the adoption of practices should increase the adaptation of agro-silvopastoral producers, including women and youth, within affected agroecological zones of Senegal.

Finding 15. FAO activities to implement CSL initiatives, aligned with FAO strategic objectives and CPFs, contribute to globally agreed climate action targets at national, regional and global levels.

172. During interviews with FAO staff, respondents recognized that FAO's Climate Change Strategy is a useful tool. It was used by FAO staff at headquarters for work on climate change in their respective fields and disciplines, the strategy was useful to formulate CSL projects at country level and to target climate financing from GEF and GCF.

173. Climate smart livestock (CSL) approach is well described by FAO in its sourcebook as a relevant strategy to mitigate and adapt to climate change, it gives clear guidance on GHG mitigation and best practices for improved production systems (implementation modalities).

174. For mitigation of GHG emissions from livestock, FAO is supporting initiatives at country and regional levels and developed specific tools such as GLEAM tool model for estimation

the intensities of GHG emissions and options of reducing the intensity of emissions of livestock sector.

175. FAO has already applied CSL initiatives at regional level with positive results obtained by countries in Latin America, (Ecuador and Uruguay and Argentina) where livestock is economically important. FAO support is needed for the scaling up of investments in the sector with the financial support of GEF and GCF.

176. FAO supported the Regional Agricultural Policy of the Economic Community of West African States (ECOWAS) recognizing the importance of climate change and variability for the region (FA0, 2019g). It promotes an approach to increase productivity while strengthening adaptation to climate change and reducing GHG emissions. In five countries in the region, livestock was mentioned in their NDCs under the Paris Agreement. For Benin, Mali and Niger, specific measures target livestock production within both the mitigation and adaptation components. The GLEAM tool was used to quantify GHG emissions from livestock and to identify mitigation options.

177. During the last two years, FAO has been very active in assessing the impact of climate change on sustainable livestock production, especially through high-level participation and contributions to UNFCCC COPs (COP24 and COP25,) with focus on analysis of the effect of climate change on livestock productivity and the effect on food security. FAO identified climate actions to be undertaken through good practices in livestock and supply chains for mitigation, adaptation and increasing resilience of livestock production systems synthesized in the document *Five practical actions towards low carbon* (FAO, 2019c).

4.2.3 How is FAO's mission on climate action reflected and included in the institution's governance and operative structure?

Finding 16. Under FAO's overall strategic framework, the Committee on Agriculture (COAG) and the CGRFA discuss proposals and take decisions addressing various emerging issues and priorities in the livestock sector, with a particular focus on the theme 'sustainable livestock for achieving the SDGs'.

178. Several COAG agenda items discuss the major trends and challenges and provide substantive input towards the priority areas of work for the committee's considerations, such as assessing and improving the contribution of livestock to food security and nutrition and healthy diets, enhancing productivity of small-scale livestock keepers, developing knowledge and tools to guide countries' livestock policies and investments, developing solutions to reduce livestock's negative environmental impacts, and mainstreaming pastoralism and rangelands in FAO's work (COAG, 2020).

179. During its 17th Regular Session, the Commission on Genetic Resources for Food and Agriculture (CGRFA), held in February 2019, considered the Report of the Tenth Session of the Intergovernmental Technical Working Group on Animal Genetic Resources for Food and Agriculture, welcomed the document *Review of implementation of the Global Plan of Action for Animal Genetic Resources* and took note of other relevant documents. The commission also endorsed the *Guidelines on Developing Sustainable Value Chains for Small-scale Livestock Producers* and requested FAO to publish and distribute them widely.

4.2.4 How relevant and adequate are FAO's delivery mechanisms, human and financial resources and monitoring systems to address country/regional level needs and to plan, budget, monitor and communicate FAO's support in achieving the targets posed by SDG 13 and by the Paris Agreement?

Finding 17. At global and country level, FAO has good team of livestock and climate change experts working together to provide support from headquarters to country level, to deliver tangible results in supporting countries in achieving mitigation of GHG emissions from livestock and improving livestock productivity increasing resilience of farmers, however most of them including key positions are project-funded positions which increased the risk of the turnover of expertise and lack of continuity.

180. During interviews withFAO staff, respondents noted the limited number of permanent livestock senior positions staff on regular programs due to financial constraints. FAO is using extrabudgetary resources to hire consultants to fill these positions temporarily with lower professional positions to respond to counties demands. This approach may not be appropriate in the long term to strengthen FAO structures to deliver high quality assistance to countries and deliver sound normative products and policies in climate action at regional and national level. An effective integration of climate change in national development strategies requires an experienced and multidisciplinary team to coach the integration processes.

181. Survey respondents in Uruguay, including both FAO technical staff and representatives of the Ministry of Agriculture and Livestock, stated that the current CSL project team is well integrated within the Ministry of Agriculture and Livestock which facilitated the project activities.

182. In Ecuador, the mid-term review carried during 2019 for the CSL project indicated that the projected delivery was effective and efficient. Among project results, it was found that project staff and authorities at the Ministry of Agriculture and Livestock were trained in the methodologies and tools for incorporating the CSL approach in the field, with clear and significant progress towards the integration of the CSL mitigation approach in the design of strategies, instruments and public policies for mitigation and adaptation to climate change as prioritized in Ecuador's NDC to be reported to UNFCCC.

4.3 Does FAO optimally engage in partnerships that leverage the effect of its work on climate action towards impact generation?

4.3.1 Is FAO's collaboration with its main (public and private) development partners (UN and others) effectively building on FAO's comparative strengths and weaknesses on climate change-related areas? (What partnerships? Do they build on added value?)

Finding 18. The comparative advantage of FAO lies in its role as the world's agricultural knowledge agency, including the livestock sector, and having a well experienced pool of experts to assess and analyze the environmental impact of livestock as part of the implementation of its Climate Change Strategy. FAO has successfully engaged relevant partnerships at global, national and local levels to reduce GHG emissions of livestock and

improve adaptation and resilience of livestock production systems to achieve the GASL, however partnership with private sector has remained low.

183. From 2015 to 2020, FAO launched 18 projects identified as CSL production initiatives (analyzed projects) to promote sustainable livestock production systems based on improved management practices of livestock to reduce GHG emissions from livestock, improve productivity and livelihoods of livestock keepers.

184. At the technical level, FAO has the experience, knowledge and tools from previous initiatives like such as CSA and REDD to deal with GHG emissions reduction from agriculture including livestock. In regards to this, FAO has a dedicated multidisciplinary team of livestock and climate change specialists working at global, regional, national and local levels to assess GHG emissions from different livestock production systems.

185. FAO succeeded in designing protocols to measure GHG emissions and carried out tests to measure the impacts of using appropriate technology and practices to improve productivity and efficiency of resource use at farm level. FAO also identified development options and assisted countries with mitigation of livestock GHG emissions and adaptation of the livestock sector to climate change.

186. FAO adopted a participative, bottom-up approach with farmers, technicians and governments.

187. FAO used its expertise to strengthen stakeholders capacities at all levels (farmers, technicians and decision makers) of government in implementing the approach to use technical packages of the best practices to implement CSL initiatives and supported countries to mobilize resources for implementation of projects.

188. FAO's CSL approach was effective to reduce emissions from livestock, to improve productivity and to generate income for livestock producers.

189. GLEAM is an effective tool for estimating GHG emissions from livestock and its supply chain, it identifies cost effective technical options for the reduction of emission intensity per livestock product unit. The use of the tool by international development and financial agencies (World Bank) and research institutions (IPCC and ILRI) is an evidence base of the effectiveness of GLEAM.

Finding 19. Focusing on livestock development to promote CSL production systems worldwide with better response to country needs in adopting CSL approach, and to foster the integration of the sustainability concept across the livestock sector, FAO adopted a multi-stakeholder partnership approach to support countries to move to CSL production systems targeting a low carbon livestock development system, fostering dialogue on livestock sustainability and mobilizing financial resources.

190. Implementation of livestock projects is associated with significant use of natural resources and contributes to GHG emissions and climate change. FAO, through the LEAP Partnership, developed specific tools (GLEAM model) for the assessment of the environmental impacts of livestock interventions (GHG emission measurements) and elaborated detailed guidelines and methods for assessment (FAO, 2019a). In 2014, the technical advisory group was formed to develop comprehensive guidelines for the assessment of GHG emissions from ruminants livestock supply chains. The technical advisory group of experts from all

regions of the world developed the guidelines, which strive for alignment with international standards such as ISO 14040/44 and IPCC guidelines. The guidelines were presented and then communicated by FAO to policy makers at country level to be used for GHG emissions assessments.

191. The FAO LEAP partnership, which prepared the above guidelines involving leading experts from different scientific communities and all continents, has resulted in high quality, sound, consensual LEAP products. The open, transparent, inclusive, stepwise development process has also ensured that LEAP products are credible.

192. In this respect, the FAO LEAP partnership assisted and strengthened national capacities of 13 countries to achieve GHG emissions reduction (methane emission from livestock) while improving productivity of livestock and providing income for livestock producers (as shown in country cases studies). Countries were supported to produce GHG emissions estimates and inventories from livestock, which can be used to elaborate and actualize NDCs within UNFCCC and Paris Agreement. The FAO LEAP partnership was effective and its actions can be considered as transformational contribution of FAO towards achieving the GASL.

193. **Global Agenda for Sustainable Livestock (GASL) partnership:** Launched by FAO in 2011, GASL is a recognized platform for sharing good practices and policies and promotes the sustainability of the global livestock sector (GASL, 2019).

i. GASL is working through thematic networks which encompass the main factors affecting livestock sustainability such as social, economic, and environmental issues. Technical solutions for sustainable livestock globally, regionally, and nationally, such as a resource-use efficiency matrix, silvopastoral techniques, a multi-criteria grasslands value model are explored by GASL.

ii. In 2018, the annual meeting of GASL took place in Mongolia with participation representatives of 30 countries. Research institutes, the private sector, social movements, NGOs and other stakeholders discussed the future of GASL and nomadic livestock keepers and how to link them to markets for environmental services (in the case of Mongolia).

iii. The last meeting of GASL in 2019, held in the United States of America, focused on discussions on fostering low-carbon livestock production.

iv. FAO GASL partnership recognized nine SDGs with particular importance for the livestock sector: SDG 1, 2, 3, 5, 8, 12, 13, 15 and 17.

194. **FAO's partnership with the Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants (CCAC) and the NZAGRC** is a specialized partnership for methane mitigation, focusing on the GHG methane emissions coming from ruminants which contribute up to 95 percent of GHG emissions from livestock. The partnership has played an important role in framing and positioning the methane mitigation potential to reduce emissions from livestock in the process of developing low carbon livestock production systems (Donald, E.J. and Gerald, M.W., 1996).

195. **FAO's partnership with the World Organisation for Animal Health (OIE) and the World Health Organization (WHO) within the Global Early Warning System for Major Animal Diseases Including Zoonosis (GLEWS)** is positioning FAO as key player in animal diseases, reduction of the risk of zoonosis and emerging diseases.

196. FAO established governance and structures in animal health through its Animal Production and Health Division (NSA), to support countries to reduce the impact of animal diseases on livestock and human health through the establishment of two early warning systems: GLEWS and the Emergency Prevention System for Animal Health (EMPRES-AH).

197. With better coordination between this partnership through the pooling of expertise, data, and functional global networks and systems, the three organizations can have a more significant impact on both animal and human health. The improvement of global animal health will improve productive performances of livestock, reduce the intensity of GHG emissions from livestock, and contribute to achieving climate action (mitigation of GHG emissions).

Finding 20. The work delivered by FAO partnerships is relevant to mitigate climate change and make FAO stronger within the climate change arena to achieve the GASL by 2030, however FAO partnership with the private sector remains limited.

198. During interviews with internal and external stakeholders, FAO's strategic partnerships were recognized as useful tools to exchange and communicate on best practices for mitigation and adaptation of the livestock sector to climate change. Capacity building through using farmer field schools (FFS) is an example of strengthening livestock farmers capacity in climate change adaptation and mitigation.

199. In Ecuador, FAO collaboration with the Ministry of Agriculture and Livestock and the Ministry of Environment has been achieved through the CSL project financed by GEF. FAO is involved in the preparation of the country's NDC inventory, NAMAs and CSL strategy.

200. FAO, in partnership with the Chinese Academy of Agriculture Science, the World Agroforestry Center and the Northwest Institute of Plateau Biology, developed The *Methodology for Sustainable Grassland Management* which benefits herders worldwide and provides a strong incentive for better grassland management by leveraging carbon finance and unlocking low-carbon private sector investments.

201. Examples of FAO's collaboration with the private sector to implement CSL projects was limited, however, during the implementation of the CSL project in Ecuador, a formal partnership agreement with COFIDES and a financial contribution agreement with Ordeño and BanEcuador was established to strengthen local farmers' capacities and productive development of small and medium-sized dairy farms through green microcredit in pilot areas (FAO, 2019b). These achievements can be rated as relevant contributions towards achieving the 2030 Agenda.

4.3.2 To what degree has FAO's collaboration with state partners or development/multi-lateral partners been effective in leveraging climate action at the country and global level? And why not?

Finding 21. FAO has engaged in partnerships with state and development partners to promote CSL at the national level and advance the GASL Agenda at the global level.

202. FAO's partnership with GASL provided innovative multi-stakeholder conditions and a worldwide platform for the interaction of more than 100 partners, enhancing their motivation, capacity and financial resources to produce and share effectively a variety of

technical solutions for sustainable livestock globally, regionally and nationally. The contribution of GASL included: a resource-use efficiency matrix, pastoral techniques, a multi-criteria grasslands value model, the positioning of dairy products as a source of nutrition and employment in Asia, livestock environmental and performance guidelines, solid evidence on the positive relationship between dairy and poverty reduction, livestock sustainable investment guidelines, and productivity-boosting good practices related to animal welfare and mitigation.

203. During the implementation of CSL projects, almost all financed by GEF, to adopt low carbon production systems (for example, beef production projects in Argentina, Ecuador and Uruguay), while restoring degraded grassland and improving resilience of small livestock producers, FAO partnerships with countries played a significant role in capacity building and the mainstreaming of CSL within national development programmes and strategic frameworks.

204. To enhance climate action, FAO opted to partner with international and regional institutions in the livestock sector to respond to urgent needs in the drylands of sub-Saharan Africa. FAO, in collaboration with the World Bank, International Cooperation Centre of Agricultural Research for Development (CIRAD), International Food Policy Research Institute (IFPRI) and Action Against Hunger, assessed livestock production under climatic constraints and proposed interventions to increase productivity and reduce the impact of climate variability on livestock outputs, providing evidence that livestock are a tool for mitigation and adaptation to climate change.

205. During the implementation of CSL projects, FAO partnered with the research sector (the Global Research Alliance on Agricultural Greenhouse Gases [GRA]) on agricultural GHG emissions and collaborated with Members to investigate enteric methane emissions from livestock. FAO coordinated this programme and provided tools for the assessment of production systems in countries, identifying options looking at feed, animal health or manure management, and quantifying the potential to increase productivity and reduce emission intensity. Based the results of this research, FAO started the upscaling phase by identifying investment opportunities with countries and targeting climate green financing from GCF and GEF (for example in Ecuador, Kenya and Uruguay).

4.3.3 Are new, innovative partnerships in support of SDG 13 (for example in financing, know-how and technologies, research, advocacy) being forged or adhered to by FAO and are these showing concrete results?

Finding 22. Within the implementation of the CSL approach for sustainable livestock production systems, FAO partnered with Members to reduce enteric methane from livestock to achieve SDG 13 targets, while also exploring ways to identify technical solutions and mobilizing resources to promote the CSL approach through partnerships following a project approach, rather than a strategic/programmatic one.

206. Through partnering with the research sector, FAO produced more information regarding the technical packages which can be used at country level to reduce methane emissions from livestock and improve livestock productivity, as well as to sequestrate CO_2 in the soil through the planting of shrubs which can be used as forage for livestock.

207. The above initiative gave the idea for some countries to go further and adopt the approach through new projects with the support of FAO to mobilize resources from GEF, such as in Ecuador and Uruguay where governments decided to implement CSL projects to adopt a low carbon development production system using FAO methods and tools, developed during the first phase of the above partnership.

208. Capitalizing on the results of the partnership on reducing methane emissions, the FAO Country Office in Ecuador launched anew partnership with the private company El Ordeño (FAO, 2020d). This pilot phase was carried out in the Cayambe canton involving 49 farms of livestock producers linked to the company, with the aim to become a benchmark for key alliances for the promotion of good livestock practices through its expansion and replication in the different areas and provinces that El Ordeño operates. These strategic alliances between FAO, the private sector and the community, are an important step towards achieving the SDGs within the framework of the 2030 Agenda, mainly through climate action and the responsible management of natural resources.

209. By improving the capacities of small and medium-sized milk producers, production is optimized by implementing good livestock practices that reduce GHG emissions and improve the quality of the supply of healthy food for the Ecuadorian population. This initiative, which is part of FAO's work in Ecuador, has trained 15 technicians from El Ordeño through vulnerability-focused workshops on GHG emission potential, and data collection and analysis with the Mobile Data Collection (ONA) and Open Data Kit (ODK) platform.

210. With 30 producers from the company's areas of influence in Pichincha province in Ecuador, a workshop on participatory rural diagnostics and vulnerability analysis was held, identifying the training and productive promotion activities that must be implemented to establish efficient, cost-effective and climate-resilient production systems.

211. In addition to technical training, together with the El Ordeño team, FAO has conducted field information collection; interviewing more than 50 farmers on milk production, animal health, feeding and reproduction of the herd, handling of pastures and fodder, living fences, excreta management and available infrastructure.

212. FAO is currently developing a tool for estimating GHG emissions in dairy livestock systems. Through this application, farmers will have the ability to calculate emissions on their farms and implement good livestock practices to be applied through the CSL approach. The CSL approach seeks to transform and reorient agricultural systems to effectively support development and achieve food security in the context of climate change.

213. El Ordeño, aware of its role in promoting livestock activity in the country, joined this initiative to support CSL through the development of local capacities (both technicians and producers) which help small and medium-scale milk producers optimize their production as a result of the implementation of good practices, with approaches that are based on the three pillars of sustainable development: social-political, economic and environmental. Through having a technical team trained in the use of new technologies, El Ordeño can be considered as driver for change and engaged in rural development.

4.3.4 Is FAO using its internal implementation modalities to effectively achieve globally agreed climate action targets (in SDGs and the Paris Agreement) through sharing knowledge, best practices, and experiences as well as by adapting, replicating and scaling up climate change adaptation and mitigation technologies?

Finding 23. FAO's CSL approach was launched for the adoption of low carbon livestock development by providing options to farmers for the adaptation and resilience of livestock production systems to climate change (SDG 13). Strategic supportive and structural partnerships (GASL, LEAP and SSTC) contributed to enriching FAO knowledge packages to promote a low carbon development approach, foster dialogue on livestock sustainability, and increase awareness on best practices for sustainable livestock production systems.

214. **FAO LEAP partnership**: LEAP3 (2019 and on) aims to generate impact by sharing knowledge from the application of the FAO LEAP guidelines, collect feedback for the improvement of the technical documents and provide guidance for the adoption and use of LEAP guidelines at various scales.

215. In July 2019, a new communication strategy was implemented to ensure the broadest impact and highest level of dissemination of the LEAP guidelines and knowledge exchange. A specific web page was created to facilitate access to GLEAM, as well as knowledge sharing about the GLEAM model as a tool to measure GHG emissions from livestock, including supply chains.

216. **FAO Pastoralist Knowledge Hub** is an initiative bringing together pastoralists and the main actors in the livestock sector to work together and create synergies for dialogue and pastoral development by sharing their views, documents, studies and targeted information. This collaboration is done by jointly organizing events and by promoting pastoralist-friendly interventions and policies, including pastoralist knowledge and best practices for mitigation and adaptation to climate change using the web portal for knowledge and information sharing.

217. **FAO GASL partnership**: The last evaluation of the GASL partnership stated that the approach of this initiative has demonstrated encouraging progress towards a more consensual view on sustainable livestock as well as policy and practice change. The contributions and added value of GASL rest in its partnership building and knowledge sharing effects, which have been clearly appreciated by its members. Within the GASL partnership, FAO shared knowledge and developed a common vision of the contribution of the livestock sector to the SDGs, which was adopted during its 8th meeting of GASL as a specific theme.

218. **FAO partnerships and upscaling of best practices in the livestock sector**: FAO pilots and validates best practices to improve the efficiency of the sector and livestock environment interactions through projects and support to the scaling up of investments. FAO provides convening platforms for intergovernmental processes and multi-stakeholder partnerships for better integration of the environment, with broader sustainability and development objectives:

    i. The resilience of small-scale producers must be strengthened through the diversification of incomes, resources, adapted genetics and husbandry technics.

ii. Livestock policy must be developed considering the ecosystem services that livestock production systems utilize and provide.

iii. Improving productivity is key to reducing the negative environmental impact of the sector. Low carbon livestock development can be achieved with higher resource-use efficiency. Gains could reduce emissions from the sector by up to 30 percent (Gerber *et al*, 2013).

iv. Community-based programmes should be supported as an efficient approach to sustainably use and develop livestock breeds.

v. Promoting regenerative grazing practices and restoring degraded rangelands can help soil carbon sequestration and put carbon back in the ground, while also improving biodiversity and water quality, especially in extensive grazing systems. Improving manure management can avoid nutrient loss.

219. The scaling up of climate change adaptation and mitigation technologies at country level, to achieve transformational change towards low-carbon development, would require FAO to focus on mobilizing resources from green climate funds, the public sector and the private sector.

220. Within the **FAO South-South Cooperation partnership initiative,** experts have introduced and transferred Chinese development technologies to farmers in host countries through, for example, technology demonstration hubs. The programme supported livestock development activities in Kenya and Mongolia, among other countries.

5. Conclusions and recommendations

5.1 Conclusions

Conclusion 1. Through its CSL initiatives, FAO made relevant and effective contributions to SDG 13 targets through GHG emissions mitigation and adaptation of livestock production systems to climate change. FAO enhanced more than 25 countries capacities to attain GHG emissions inventories from different livestock production systems, including species (cattle, small ruminants, pigs and chicken) and commodities (meat, milk and eggs), allowing these countries to improve livestock productivity and income for producers, while reducing GHG emissions and meet reporting obligations within UNFCCC and the Paris Agreement through NDCs and NAPs.

Conclusion 2. FAO projects and initiatives in the livestock sector have been supporting countries in developing their capacity through integrating and mainstreaming climate change (mitigation and adaptation) in strategic planning and investment projects targeting green climate fund sources (GEF and GCF).

Conclusion 3. In piloting CSL initiatives, FAO strengthened national capacities to use methodologies, tools (GLEAM) and information products of technical and technological knowledge for mitigation and adaptation of the livestock sector. The approach of low carbon livestock production systems is being adopted by several countries where livestock production systems are a major component of the national economy, for example in Ecuador and Uruguay.

Conclusion 4. FAO applied improved livestock practices (improved feed, animal health, animal breeding and manure management) to reduce GHG emissions from livestock, however without systematically addressing trade-offs between SDG 13 and other development goals (e.g. SDG 2).

Conclusion 5. FAO initiatives and projects promoted GHG emissions methods and practices, strengthened national capacities, enabled environment for mobilizing resources and fostering collaboration among countries, developed tools and identified best practices relevant to promote CSL production systems.

Conclusion 6. FAO CSL projects are broadly aligned with FAO's Climate Change Strategy, revised strategic framework, CPFs and regional initiatives on climate change. However, few CSL projects address the specific needs of vulnerable groups including women, indigenous people and youth.

Conclusion 7. FAO CSL projects were adequately delivered by FAO, from global to national levels, however the lack of permanent positions due to shortages of funds obliged the Organization to operate through projects rather than in a programmatic approach to monitor CSL interventions.

Conclusion 8. FAO has successfully engaged relevant partnerships at global, national and local levels to reduce GHG emissions from livestock and improve adaptation and resilience of livestock production systems to achieve the GASL. However, outputs from partnership with the private sector remain limited.

Conclusion 9. FAO CSL initiatives contributed to establishing national institutional structures for measuring emissions (for NDCs and NAPs) and developing best practices for adaptation and resilience of farmers with state partners, rather than with the private sector and civil society partnerships.

Conclusion 10. Through multi-stakeholder partnerships (LEAP and GASL), FAO enriched its knowledge products and tools to promote a low carbon development approach, increased advocacy for climate action and fostered dialogue on livestock sustainability. However, FAO does not have clear a strategy for the extension and capitalization of its relevant mitigation and adaptation technical packages at the country and regional levels.

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Appendix 1. People interviewed

N.	Surname	Name	Division	Position
1. FAO Headquarters				
1	Henning	Steinfeld	Animal Production and Health Division (NSA)/ Livestock Information, Sector Analysis and Policy Branch (NSAL)	Chief of NSAL
2	Timothy	Robinson	NSA/NSAL	Senior Livestock Policy Officer
3	Aimable	Uwizeye	NSA/NSAL	Livestock Policy Officer
4	Preetmoninder	Lidder	Plant Production and Protection Division (NSP)	Technical Officer
5	Dusunceli	Fazil	NSP	Agricultural Officer
6	Bicksler	Abram	NSP	Agricultural officer
7	Corsi	Sandra	NSP	Agricultural officer
8	Stefano	Mondovi	NSP	Agricultural officer
10	Mba	Chikelu	NSP	Agricultural officer
11	Muratebek	Koshoev	NCCA - Office of Climate Change, Biodiversity and Environment (OCB)	Environment Resources Policy Officer
12	VelascoGil	Gregorio	NSA Animal Production and Genetics Branch (NSAG)	Manager Pastoralism Knowledge Hub
13	Irene	Hoffman	Secretariat of the Commission on Genetic Resources for Food and Agriculture (OCBC)	Commission on Genetic Resources for Food and Agriculture (CGRFA)
14	Camillo	De Camillis	NSA/LEAP	Manager, LEAP Partnership
15	Eduardo	Arce Diaz	NSA/GASL	Manager, GASL
16	Giuliano	Cecchi	NSA Animal Health service (NSAH)	African Trypanosomosis Expert
17	Weining	Zhao	NSAH	Senior Animal Health Officer
18	Vallet	Julien	Sub-Saharan Africa Service of FAO Investment Centre (CFIA)	Agriculture Economist
19	Moens	Marc	CFIA	Senior Officer
20	Anne	Mottet	NSAG	Livestock development officer
21	Seyda	Ozkan	NSAG	livestock and climate change expert
22	Alessandro	Ferrara	OCB	Climate change consultant
23	Julia	Wolf	OCB	Natural Resources Officer - Climate Change, FAO
2. FAO Decentralized Offices				
24	Felipe	Garcia, Olaso	FAO Uruguay	Coordinador Componente 2 (co-innovación)
25	Philippe	Ankers	Subregional Office for North Africa (SNE)	FAO Representative for Tunisia and coordinator for SNE
26	Mohamed	Amrani	SNE	SDG focal point
27	Said	Helal	SNE	Field program support, evaluation focal point
3. External stakeholders				
28	Walter	Oyhantcabal,	Ministry of Livestock, Agriculture and Fisheries, Uruguay	Director of the Unit of Sustainability and Climate Change Ministry of Livestock, Agriculture and Fisheries
29	Rogerio	Mauricio	Universidade Sao Joao del Rei, Brazil	Lecturer, Member of GASL
30	Donald	Moore	Global Dairy Platform, USA	CEO of Global Dairy Platform, USA

Appendix 2. Main climate-smart livestock (CSL) initiatives launched by FAO at global, regional and national levels from 2015 to 2020

No	Projects	Period	SDG 13 targets	Other SDGs	Countries	Codes	Regions	Investment costs (USD)	Development Financial Institutions and mechanisms	Actions type
1	GCP/SEN/065/LDF «Intégration de la résilience climatique dans la production agro-pastorale pour la sécurité alimentaire dans les zones rurales vulnérables à travers l'approche des champs-écoles paysans»	2015–2020	SDG 13.1, 13.2 and 13.3	SDG 1.1, 1.2, 1.5; SDG 2.1, 2.2, 2.3, 2.4 and 2.5	Senegal	GCP/SEN/065/LDF	Africa	6 228 995	Local Development fund (LDF)	Adaptation
2	GCP/INT/157/EC «Action Contre la Désertification en appui à l'initiative de la mise en œuvre de la Grande Muraille Verte et à la Coopération Sud-Sud dans les pays d'Afrique des Caraïbes et du Pacifique»	2014–2016	SDG 13.1 and 13.3	SDG 1.1, 1.2 et 1.5 ; SDG 2.1, 2.2, 2.3, 2.4 et 2.5 ; SDG 10.2, SDG15.3	Senegal	GCP/INT/157/EC	Africa		European Commission (EC)	Adaptation restoration des terres agropastorales
3	Promotion of climate-smart livestock management integrating reversion of land degradation and reduction of desertification risks in vulnerable provinces (FSP) - SCCF Portion of Full-size Project	2016–2020	13.1	2.4	Ecuador	GCP/ECU/085/GFF	Latin America	2 393 977	Global Environment Facility (GEF)	Mitigation of GHG emissions from dairy cattle
4	Climate-smart livestock production and land restoration in the Uruguayan rangelands (PPG)	2016–2017	13.1	2.4	Uruguay	GCP/URU/035/GFF	Latin America	100 000	GEF	GHG livestock mitigation

										Pasturelands restoration
5	Support Livelihood restoration to the disaster affected communities in Kagera Region of Tanzania	2016–2017	13.1	2.4	United Republic of Tanzania	TCP/URT/3606	Africa	299 000	FAO	Resilience of communities Capacity building
6	Promoting climate-smart livestock management in the Dominican Republic (PPG)	2017–2019	13.2	2.4	Dominican Republic	GCP/DOM/020/GFF	Latin America	97 311 993	GEF	Mitigation +best practices
7	Piloting the Climate-Smart approach in the livestock production systems	2017–2019	13.3	2.3	Mongolia	TCP/MON/3703	Asia	250 000	FAO	Built resilience of livestock
8	Evaluation, gestion des données et utilisation efficiente des ressources nationales d?alimentation animale pour une gestion durable de la production des ruminants	2018–2020	13.3	2.1 2.4	Niger	TCP/NER/3603	Africa	249 000	FAO	Adaptation Best practices in animal feeding measurements
9	Strengthening capacity in Integrated agro-forestry and livestock production system	2018–2020	13.3	2.1	Tuvalu	TCP/TUV/3703	Asia	200 000	FAO	Capacity building
10	Promoting climate-smart livestock management in the Dominican Republic (MSP)	2018–2022	13.3	2.4	Dominican Republic	GCP/DOM/019/GFF	Latin America	1 540 585	GEF	Best practices
11	Low-emission livestock, a contribution to the sustainable development of the sector in South America	2018–2021	13.1	2.1	Argentina; Chile; Ecuador; Paraguay; SLS - Multidisciplinary Team for South America; Uruguay	TCP/RLA/3714	Latin America	150 000	FAO	Livestock best practices

12	Climate-smart livestock production and land restoration in the Uruguayan rangelands (FSP)	2019–2023	13.3	2.4, 15,3	Uruguay	GCP/URU/034/GFF	Latin America	2 091 781	GEF	Mitigation and adaptation
13	Strengthening capacity for climate change adaptation through support to Integrated Watershed Management Programme in Lesotho (FSP)	2015–2019	13.1	2.4	Lesotho	GCP/LES/049/GFF	Africa	12 089 694	GEF	Capacity building
14	Increase resilience of vulnerable communities to the effects of El Niño in Mozambique	#N/A	13.3	2.4	Mozambique	OSRO/MOZ/703/AUS	Africa	2 491 536	AUS	Build resilience of communities
15	Development of a livestock policy analysis and monitoring system in Vietnam	2017–2020	13.3	2.4	Viet Nam	TCP/VIE/3501	Asia	299 000	FAO	Capacity building for monitoring
16	Promotion of climate-smart livestock management integrating reversion of land degradation and reduction of desertification risks in vulnerable provinces (FSP) - SCCF Portion of Full-size Project	2016–2020	13,1	2.4/13.1	Ecuador	GCP /ECU/092/SCF	Latin America	1 462 083	South South Cooperation SCF	Mitigation and adaptation
17	Promoting climate-smart livestock management in the Dominican Republic (MSP)	2016–2020	13.1	2.4	Dominican Republic	GCP /DOM/019/GFF	Latin America	1 540 585	South South Cooperation	Mitigation and Adaptation
18	"Reducing enteric methane for improving food security and livelihoods	2018–2020	13.1,	2.4	13 countries	EP/GLO/652/UNEP	Global	756354	UNEP	Capacity building mitigation
Total investment costs USD								**129 454 583**		