Annex 22a – Assumptions used for calculation of GHG emissions

1. Assumptions used in EX-ACT (AFOLU)

Baseline assumptions	Areas (expressed in ha) WITHOUT PROJECT	Areas (expressed in ha) WITH PROJECT	Notes
Total Cultivated Land (TCL)	32,890	28,600	avoided deforestation and land clearing - without project the land under cultivation would increase by 15% over 6 years - it would all be perennials monoculture
45% of TCL area is cultivated with perennials		12870	The project seeks to introduce intercropping practices of fruit trees to existing coffee and tea plantations, and shift away from monocultures.
50% of perennials is cultivated with tea as monoculture	6435	3861	Without project: Residues are burnt and there is no irrigation practices and no manure application - all improved management techniques recommended (irrigation, manure, improved management and agroforestry), with adoption rate of 60%
Half of perennials cultivated with coffee as monoculture	6435	3861	Residues are burnt and there is no irrigation practices and no manure application - all improved management techniques recommended, with adoption rate of 60%

50% of TCL is cultivated with mixed systems annuals-perennials		14300	Residues are burnt, no practices of irrigation, use of pesticides and fertilizers isn't conventional, deep tillage, insignificant application of manure
60% of Annuals is African Leafy Vegetables and fruit tree	8580	5148	Residues are burnt and there is no irrigation practices and no manure application - all improved management techniques recommended, with adoption rate of 60%
Area under irrigation is 40% of total cultivated land	6435	12870	Without project access to irrigation islow (30%). With project access to irrigation is 60%

2. Assumptions used in GLEAM (Livestock value chains)

BASELINE AND PROJECTIONS

- Projections for domestic production of animal commodities in Kenya were downloaded from the FAO Global Perspective Studies (GPS) dataset, which presents projected data from 2012 to 2050. Specifically, data were downloaded from the "Commodity balances, volume" domain, in 5 years steps and from the "Business-As-Usual" scenario, for the following animal products: Raw milk, Beef and veal, Eggs and Poultry meat. These data were used to estimate the relative increase in domestic production for each product and time step, using 2020 as the base year. The GPS dataset is available at the following link: https://www.fao.org/global-perspectives-studies/food-agriculture-projections-to-2050/en
- The volume of domestic production, for the base year 2020, was downloaded from FAOSTAT (https://www.fao.org/faostat/en/#data), for the following items: Bovine meat, Raw milk of Cattle, Eggs and Poultry meat. These data were combined with the relative increase in projected production calculated from GPS for each 5 yeas time step, to rebase projections to the FOASTAT data for 2020.
- The projected production of each commodity was converted in volumes of proteins, based on the protein contents of beef, cattle milk, eggs and chicken meat used in the Global Livestock Environmental Assessment Model (GLEAM, https://www.fao.org/gleam/en/). The volumes of proteins produced as beef and cattle milk were combined to estimate the total protein production from cattle, while those for eggs and poultry meat were combined for poultry production. Moreover, GLEAM was used to calculate the proportion of cattle proteins produced in Kenya only by the dairy sector, to adjust projections for cattle accordingly.
- The total protein yield per stock head in the country was calculated from GLEAM for both dairy cattle and chickens. For each year, a 1% increase in the protein yield was assumed, to simulate expected increases in genetics and technologies. The protein production of each time step was then divided by the respective protein yield to estimate the number of animals required to sustain it. For poultry, separate estimates were done for extensive and intensive systems, using data from GLEAM about the proportion of protein produced by each and their respective protein yields in the country.
- The estimated number of animals were then multiplied by the total emissions per head calculated from GLEAM, to estimate total emissions per time step (in million tonnes of CO_2-eq). Separate emission factors were used for dairy cattle, extensive and intensive chickens. For the baseline projections, it is assumed that the emission factors per head are constant in time.
- GLEAM was also used to estimate the share of total emissions from different sources along each supply chain. Separate emission profiles were estimated for dairy cattle, extensive and intensive chickens, and used to correct the total emission factors per head for some of the simulated interventions.
- A downscale of the model was calculated to determine the project-specific emissions reductions. Overall proportions were maintained as above, but calculated on the basis of the number of cattle and poultry heads in the project. These were estimated on the basis of the

distribution of project beneficiaries per value chain, which was collected during the Cooperative Census. Details of the calculations are included in the excel file attached.

INTERVENTIONS

All species

- **Reduction of production losses:** losses by animal commodity (milk and eggs) for 2020 were downloaded from the Food Balances domain of FAOSTAT (https://www.fao.org/faostat/en/#data/FBS). These data were used in combination with production data and the respective protein contents to estimate projected losses of protein production. A scenario of losses reduction was simulated assuming a potential linear reduction in protein losses from 0% in 2020 to 50% by 2050. Avoided losses were subtracted from the projected production to estimate emissions accordingly.
- **Mitigation of land-use change:** for each supply chain, a linear reduction of land-use change emissions from 0% in 2020 to 100% in 2050 was assumed and applied to the respective share of emissions, to reduce the emission factor per stock head accordingly. This reduction in emissions simulates changes in diet composition, feed production and trade to avoid process of land-use change. The emission factor per head and the share of land-use change emissions were calculated using GLEAM.

Dairy cattle

- **Improved herd management:** a linear reduction of total emissions from 0% in 2020 to 7% in 2050 was assumed and applied to simulate the effect of improved herd management for dairy cattle. Such improvements includes health measures and improved reproduction management. The average 7% potential reduction is based on figures estimated for dairy production in East Africa by Mottet et al. (2017, https://link.springer.com/article/10.1007/s10113-016-0986-3).
- **Reduction of enteric fermentation:** a linear reduction of enteric methane emissions from 0% in 2020 to 20% in 2050 was assumed and applied to the respective share of emissions, to reduce the emission factor per stock head accordingly. This reduction in emissions simulates changes in diet composition and quality. The emission factor per head and the share of enteric methane emissions were calculated using GLEAM. The average 20% potential reduction is based on interventions simulated for Kenya with GLEAM and presented in a report from FAO and the New Zealand Agricultural Greenhouse Gas Research Centre (2017, https://www.fao.org/3/i7669e/i7669e.pdf).

Poultry

- **Intensification of production:** a linear increase in the share of poultry protein production from intensive systems was simulated from a baseline of 58% in 2020 to an assumed 100% in 2050, to estimate the effect on projected emissions. The baseline share of production from intensive systems was calculated from GLEAM, as well as the protein yield and emission factors for extensive and intensive chicken production.
- **Reduction of emissions from energy consumption:** a linear reduction of emissions from energy consumption from 0% in 2020 to 50% in 2050 was assumed and applied to the respective share of emissions, to reduce the emission factor per stock head accordingly. Energy consumption is associated with feed production, on-farm processes and equipment and post-farm processing,

and transport of animal products. Reduction in these emissions simulates improvements in energy use efficiency and changes in the energy mix used.