Annex 23 Greenhouse Gas Accounting for the Community-Based Agriculture Support Programme + (CASP+)

A. Methodology

1.1. Ex-Ante Carbon-balance Tool (EX-ACT)

1. The Ex-Ante Carbon-balance Tool (EX-ACT) has been developed by the Food and Agriculture Organization of the United Nations (FAO) to evaluate impacts of the interventions in the Agriculture, Forestry and Other Land Use (AFOLU) sector on greenhouse gas (GHG) emissions. EX-ACT provides estimates of the mitigation potential of public or private investment projects, policies and national level programs. It helps the decision makers to understand whether the planned agricultural interventions contribute to meeting climate change mitigation objectives. The EX-ACT appraisals, initially designed for ex-ante analysis, can be also conducted during the project implementation as well as ex-post for comprehensive monitoring and evaluation, both at a project and at a country level. EX-ACT calculations are based on land use data.

2. The version of EX-ACT used in this analysis is primarily based on *the 2006 Guidelines for National Greenhouse Gas Inventories* (IPCC 2006) and *IPCC 2013, 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands* (IPCC 2014), complemented by other scientific research. GHG emissions for farm operations, inputs, transport and irrigation systems implementation are based on Lal (2004). Emissions factors for the fishery sector are derived from Parker & Tyedmers (2014), Winther et al. (2009) and Irribaren et al. (2010 & 2011). These references provide EX-ACT with recognized default values for emission factors and carbon values, the so-called Tier 1 level of precision.

3. The tool consists of seven topic modules that allow to analyse a range of agricultural and forestry activities including crop production, land rehabilitation, forest management, livestock and pasture management among others. The tool calculates changes in carbon stocks and GHG emissions including carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), which once converted to CO_2 equivalent are used to derive the carbon balance that indicates the impact of the project: positive carbon balance indicates that the project leads to greater emissions, while negative carbon balance indicates that project contributes to emissions reduction.

4. The evaluation assesses how the impacts of an intervention compared to the business as usual (BAU) scenario. The calculator requires data for 3 specific points in time: initial situation, with project scenario, without project or BAU. In preparing this data a lot of work is required up front to determine the adequate modelling of activities/interventions in the tool. This takes into consideration technical specificities, conversations with national staff, literature reviews to assess availability of Tier 2 coefficients to improve the accuracy of the assessment. Once all this information is gathered, a plan based on technical expertise is generated on how to best model the intervention in the tool along with the assumptions made. This is a crucial step as this is what really determines the measurement of the impact. All these aspects are discussed below to ensure a clear and transparent understanding of the assessment done for this project.

1.2 GLEAM-*i*

5. The Global Livestock Environmental Assessment Model-*interactive* (GLEAM-*i*), developed by FAO[1], was used to carry out this GHG accounting. It allowed to estimate emission reductions for cattle, sheep

[1] See http://gleami.apps.fao.org/

and goats. GLEAM-*i* is a publicly available and free tool specific to estimating the GHG emissions from different livestock species and production systems from all countries in the world. The livestock species covered in GLEAM-*i* are four ruminant species (cattle, buffalo, sheep and goat); and two monogastric species (chicken and pigs). The production systems embedded in the tool are grassland-based and mixed for ruminants; backyard, broiler and layers for chicken; and backyard, intermediate and industrial for pigs (FAO, 2017; MacLeod et al., 2017). The details regarding the background calculations in GLEAM-*i* can be found in the GLEAM manual[2] (FAO, 2017).

6. GLEAM-*i* has an embedded herd dynamic model that estimates animal numbers in different categories based on demographic parameters such as age at first parturition, fertility and mortality rates and replacement rates. In addition, GLEAM-*i* estimates feed requirements for each animal species, system and cohort based on their weights, activity, reproduction status and level of production. Direct emissions resulting from the consumption of these feed resources (enteric methane and emissions from manure) are based on their digestibility and nitrogen content. Indirect emissions coming from the production of these feed resources depend on their origin and nature (e.g. pastures, crop residues, grains and their by-products, produced domestically or imported).

B. Project Description and data sources

7. The Community-based Support Agriculture Programme 'plus' – Phase II (CASP+) has the following development objective: ***strengthen public sector capacity for transformative climate-resilient governance of natural resources, strengthen community capacity for planning and implementation for climate adaptation and diversify livelihoods for enhanced resilience through market-based approaches.*** The key outcomes include:

- Improved management of land and forest areas to reduce emissions,
- strengthen institutional and regulatory systems for climate responsive planning and development,
- strengthened adaptive capacity,
- strengthened awareness of climate threats and risk reduction processes and reduced exposure to climate risks.

8. CASP+ will be implemented over a period of **7 years** and directly benefit **100,000 rural HHs**. The **total project cost is estimated to be USD 84.8 million**. The project has three components with several activities. The component 2 and 3 concentrate those activities accounted for the GHG emissions in EX-ACT(*) and GLEAM-*i*(**):

- ***Component 1:*** *Strengthening public sector capacity for transformative climate-resilient management of natural resources (not relevant for carbon accounting)*.

- ***Component 2:*** *Investments in community capacity for adaption and resilience to climate change;*
    - Activity 2.2.1: Implement Climate sensitive community action plans*

- ***Component 3:*** *Strengthening livelihoods for enhanced resilience through market-based approaches*
    - Activity 3.1.1. Improving the genetic potential of smallholder farmers' livestock**
    - Activity 3.1.2. Support to delivery of private animal health services**.
    - Activity 3.1.3: Support adoption of climate resilient innovative technologies*
    - Activity 3.2.1 Identification of market and business opportunities*

[2] User Guide for GLEAM-i available at: http://www.fao.org/fileadmin/user_upload/gleam/docs/GLEAM-i_User_guide_2_Revision_3.pdf

- Activity 3.3.1. Strengthening of CIGs capacity*
- Activity 3.3.2. Management of the CIG matching grant program*

9. Detailed information on activities from each component were used to inform the GHG analysis, providing some basic data needed to shape the EX-ACT analysis. The assumptions and data used are presented in the consecutive sections.

Table 1: Project activities considered under GHG accounting analysis.

Activity description	Reference	Ex-ACT Module
1) CsCAPs executed by local institutions Pasture Management Plan • 180,000 ha of pasture under Pasture Management Plan	Project Design Report_10/06/2021 & Data collected together with the project preparation team	Grassland
Community Forestry Investments* • 5,801 ha of land under JFM contracts • 1,350 ha of land reforested directly (in Laskhoz or other lands) • 179 ha managed in buffer zones		LUC Management Cropland
Agriculture equipment/ machinery investments • 220 tractors 80 HP • 24 tractors 90 - 100 HP • 15 combine harvesters 155 HP		Inputs
2) Support adoption of climate resilient innovative technologies • Demo plots • Farmers accessing to demonstration plots on climate resilient technologies • Farmers enrolled in FFS		Cropland
3) Management of the CIGs matching grant program • 1,020 groups of smallholders under window 1 receiving access to matching grants • 110 groups of smallholders under window 2 receiving access to matching grants		Inputs Cropland
4) Market and business opportunities • Establishment of 8 milk collection centers		Inputs
5) Smallholder livestock farmers receive AI, animal health or training services to increase productivity of their livestock	Data collected together with the project preparation team & Sate Enterprise "Project Management Unit – Livestock and Pasture Development"	GLEAM-*i*

* Budgeted area (7,330 ha) see table 6 and 7 for further detail

10. The estimation of emissions for this project considers the sequestration, reduction and or avoidance that result from the implementation of the activities summarized in Table 1. EX-ACT differentiates between two time periods: project implementation phase and capitalization phase. The implementation phase is the period during which the project activities are carried out. Yet, the period covered by the analysis does not necessarily end with the termination of the active project intervention. Further changes may occur as the result of the interventions (project activities) such as changes soil carbon content or biomass. This period defines the capitalization phase. IPCC recommends a finite timeframe between transition states of natural systems and the period necessary to reach a new equilibrium for carbon stocks and suggest applying a 20 year long time frame. In this analysis, it was considered a longer time period of capitalization to be aligned with other assessments within the project. The physical implementation of the project consists of 7 years, the benefits generated by the project will continue

to capitalize for 20 more years to reach 27-year period. The analysis further assumes the dynamics of change (from without (BAU) to "with project") to be linear over the duration of the project.

11.The EX-ACT v.8 is configured to avoid an infinite growth of the Soil Organic Carbon (SOC) stock changes. This avoids overestimation on SOC with a longer capitalization phase. On the other hand, the tool does not have biomass growth threshold. If the capitalization phase is too long, it may lead to an overestimation by assuming an infinite biomass growth. However, this analysis includes Tier 2 values in afforestation module which are lower than the reference values and fall under the maximum upper bound avoiding an overestimation. In the case of input activities (energy use & fertilizers) also continues unabated for the entire duration of the capitalization period.

12. Once the project finalizes, the risk of external factors and sequestration reversal is latent. However, the project has a number of elements that reinforce the sustainability of its investment, including in the production of benefits in the carbon sequestration. This are based on three main pillars related to (a) reinforcing national institutions monitoring capacity (under component 1), which include also dedicated trainings to use carbon accounting tools, in turn producing benefits that go beyond the specific project intervention areas; (b) reinforcing the 400 village-based institutions in the target areas, with improved capacities for monitoring and managing natural resources – including specifically on management and surveillance of pasture land and forests use (under component 2.1); and (c) with the support to community investment as well as improved to managerial and commercial capacities (under component 2.2 and component 3) which in turn provide the financial incentives to maintain the practices and in turn to mitigate the risk of reversals and diversify from unsustainable practices.

C. Results of the EX-ACT & GLEAM-*i* analysis

12. This annex presents the estimation of the GHG emissions sequestered or avoided by the implantation of the different activities envisioned in the CASP+ programme by the utilization of EX-ACT and GLEAM-*i.* The table 2 below presents the carbon sequestration/ avoidance through the various climate investments.

Table 2: Carbon balance and climate investments in CASP+ Project activities considered under GHG accounting analysis. Over a 27 year time period

EX-ACT Module	Activities	Area (ha) and other units	C balance (tCO_2-eq)	C Balance (tCO_2-eq.yr^{-1})
		Results	Over 27 years	
Afforestation (under LUC)	*Afforestation*	1,612	-463,262	-17,158
Agriculture (under LUC/ Crop Production)	*Perennial crops Demonstration plots (FFS)*	5,341	-657,693	-24,359
Grassland	*Improved management of pastures*	180,000	-4,361,119	-161,523
Livestock (GLEAM-*i*)	*Improved livestock's practices*	1,027,252 heads	-1,317,171	-48,784

Forest degradation and management	*Improved management of degraded forest lands*	3,105	-91,684	-3,396
Investments	*Fertilizers under Greenhouses, mechanization & technology under matching grant scheme*	227 tonnes 55 m^3 diesel 198 MWh/year	36,106	1,337
	Net Carbon Balance		**-6,854,822**	**-253,882**

13. The detailed results obtained with EX-ACT can be disaggregated by components each reflecting a different activity. The set of activities with major impact, are those under the *Climate-sensitive Community Action Plans (CsCAP.* The *Pasture Management Plan* appears in *Grassland* module in EX-ACT. Given the computation of data (detailed in Computation of data in EX-ACT), the total carbon balance over 27 years of this activity is equal to -4,361,119 tCO_2-eq.

14. The set of activities under *Joint Forest Management (JFM), direct reforested areas in Leskhoz, and reforested buffer zones* in EX-ACT modules *Land Use Change,* and *Management*, the total carbon balance over 27 years of these activities is equal to -1,038,397 tCO_2-eq. Additionaly, the project considers the *Management of the Common Interest Groups (CIGs) matching grant programme.* This component foresees the distribution of matching grants under two Windows of investments, Window 1 focus on the livelihood diversification for vulnerable households, and Window 2 focus on commercialization and agribusiness development. The grants could be used for different types of small investments: the current analysis foresee the following potential activities: small-scale processing equipment, inputs and service provision, drip irrigation, solar drying facilities, greenhouses, nurseries. Most of these activities follow simple technologies adapted to local knowledge and investment capacities. Yet the utilization of energy generates positive emissions, with a total carbon balance over 27 years limited to about 36,106 tCO_2-eq.

15. Overall EX-ACT results show a positive environmental impact due to the implementation of the project's activities, quantified **at a total carbon balance of - -5,537,652 tCO_2-eq over 27 years**, or -205,098 tCO_2-eq per year. Knowing the total area under focus, this would amount to a carbon balance of -1.1 tCO_2-eq per hectare and per year, see figure 1, below.

Figure 1: EX-ACT results

Project Name	CASP+	Climate	Warm Temperate (Dry)	Duration of the Project (Years)	27
Continent	Asia (Continent)	Dominant Regional Soil Type	HAC Soils	Total area (ha)	190058.14

Components of the project	Gross fluxes Without	With	Balance	Share per GHG of the Balance All GHG in tCO2eq CO_2 Biomass	Soil	Other	N_2O	CH_4	Result per year Without	With	Balance
	All GHG in tCO2eq Positive = source / negative = sink										
Land use changes											
Deforestation	0	0	0	0	0		0	0	0	0	0
Afforestation	0	-463,262	-463,262	-312,776	-150,486		0	0	0	-17,158	-17,158
Other LUC	0	-215,133	-215,133	-1,440	-213,700		6	0	0	-7,968	-7,968
Agriculture											
Annual	4,309	-7,916	-12,225	0	-12,225		0	0	160	-293	-453
Perennial	0	-430,335	-430,335	-404,100	-26,235		0	0	0	-15,938	-15,938
Rice	0	0	0	0	0		0	0	0	0	0
Grassland & Livestocks											
Grassland	0	-4,361,119	-4,361,119	0	-4,361,119		0	0	0	-161,523	-161,523
Livestocks	0	0	0				0	0	0	0	0
Degradation & Management											
Forest degradation	40,064	-51,620	-91,684	-70,051	-21,633		0	0	1,484	-1,912	-3,396
Peat extraction	0	0	0		0		0	0	0	0	0
Drainage organic soil	0	0	0		0		0	0	0	0	0
Rewetting organic soil	0	0	0		0		0	0	0	0	0
Fire organic soil	0	0	0	0				0	0	0	0
Coastal wetlands	0	0	0	0	0		0	0	0	0	0
Inputs & Investments	0	36,106	36,106			22,318	13,787	0	0	1,337	1,337
Fishery & Aquaculture	0	0	0			0	0	0	0	0	0
Total	44,373	-5,493,279	-5,537,652	-788,367	-4,785,397	22,318	13,794	0	1,643	-203,455	-205,098
Per hectare	0.2	-28.9	-29.1	-4.0	-25.2	0.1	0.1	0.0			
Per hectare per year	0.0	-1.1	-1.1	-0.1	-0.9	0.0	0.0	0.0	0.0	-1.1	-1.1

16. In *GLEAM-i* the project implementation phase is 7 years of actual implementation and the capitalization phase is assumed to be 20 years, for a total project lifespan of 27 years. The animal numbers were projected for year 7 (project duration), year 14, and year 27.

The scenario WP represents the impact of a package of measures comprising of improved breeding through artificial insemination (AI) (for cattle) and distribution of improved bulls and rams, improved animal health through improved access to private veterinary services and vaccination (e.g. *Brucellosis* for sheep and goats), treatment for internal and external parasites, improved animal husbandry through hands on training of farmers, pasture management including rotation and restoration, and improved availability and quality of feed. In the without project scenario (i.e. baseline). It was assumed that the parameters still improve by time but at a lower level than the scenario with project.

The carbon balance is estimated as the cumulative net incremental difference in CO_2-eq, which is the difference in emissions between the situation with project and the situation without project, over 20 years. Trends were assumed to be linear over the 27 years. The ex-ante analysis shows a net cumulative incremental **carbon balance of -1,317,171 million tCO_2eq over the 27 years**[3] of the project compared to a situation without project. and produce an incremental 4,824 t protein assuming a linear increase between WP and WOP. The breakdown of emissions is presented in table 3.

17. **Production of protein (milk+meat) is expected to be 2% higher in the cumulative 27 years** in the project scenario (WP) (12,038 t/year) than in the without project scenario (WOP) (11,780 t/year) despite the higher magnitude of increases in the animal numbers in the scenario WOP than in the WP.

18. **Total feed intake is expected to be 6% lower** compared to the scenario WOP, but about 43% higher than that of baseline.

Table 3. Breakdown of emissions with (WP) and without (WOP) project at year 7, 14, and 27.

Emission sources	Baseline	WPY7	WOPY7	WPY14	WOPY14	WPY27	WOPY27
CH_4 from enteric fermentation	588,677	664,953	682,195	739,709	782,776	837,454	898,667
CH_4 from manure management	30,828	34,611	35,762	38,600	41,019	43,834	47,184
N_2O from manure management	34,244	40,614	39,890	45,833	46,669	52,455	54,320
CO_2 from feed	455,160	517,327	527,762	577,328	611,811	653,436	702,707
CO_2 from energy use	10,301	13,249	12,403	16,180	15,494	19,491	18,665

Emission sources	Baseline	WPY7	WOPY7	WPY14	WOPY14	WPY27	WOPY27
CH_4 from enteric fermentation	588,677	664,953	682,195	739,709	782,776	837,454	898,667
CH_4 from manure management	30,828	34,611	35,762	38,600	41,019	43,834	47,184
N_2O from manure management	34,244	40,614	39,890	45,833	46,669	52,455	54,320
CO_2 from feed	455,160	517,327	527,762	577,328	611,811	653,436	702,707
CO_2 from energy use	10,301	13,249	12,403	16,180	15,494	19,491	18,665

D. Computation of data in EX-ACT:

4.1 Activity 2.2.1: Implement Adaptation Investments

- Pasture Management Plan – Module Grassland in EX-ACT

[3] As herd dynamics are usually not linear, the estimate of carbon co-benefits provided here can be considered conservative.

19. Pasture Management Plan investments identified through the form of PUU - PUUs are the core of the mechanism established in the country in the last decade to delegate management of pasture to local communities and arrest pasture degradation. The pasture plans could include pasture restoration, rotation, pasture protection through fencing, reseeding, fertilization, in compliance with the project environmental safeguards. It has been targeted 180,000 hectares, 450 for each PUU. Through remote-sensing tools, the targeted area of 400 villages was monitored. This information helped to determine the level of degradation over a span time period and used to establish the share of area under the different grassland degradation levels as the table below presents.

Table 4: Pasture areas under level of degradation, according to EX-ACT and IPCC, 2019.

Initial level of degradation according to EX-ACT classification	Percentage of area	Area (ha)	Final level of degradation according to EX-ACT classification
Severely degraded: Implies major long-term loss of productivity and vegetation cover, due to severe mechanical damage to the vegetation and/or severe soil erosion.	77%	139,648	**Moderately degraded** Represents high intensity grazing systems (or cutting and removal of vegetation) with shifts in vegetation composition and possibly productivity but is not severely degraded[4]
Moderately degraded Represents high intensity grazing systems (or cutting and removal of vegetation) with shifts in vegetation composition and possibly productivity but is not severely degraded	3.14%	34,707	**Non-degraded** Represents low or medium intensity grazing regimes, in addition to periodic cutting and removal of above-ground vegetation, without significant management improvements
Non-degraded Represents low or medium intensity grazing regimes, in addition to periodic cutting and removal of above-ground vegetation, without significant management improvements	3.14%	5,644	**Improved without inputs** Represents grassland which is sustainably managed with moderate grazing pressure and that receive at least one improvement (e.g., fertilization, species improvement, irrigation).

Source: IPCC, 2019

Use of Tier 2 – in Grasslands

20. The coefficients for the emission factor were corrected from Tier 1 to more *ad hoc* ones of Tier 2. The IPCC methodology on grasslands is based on soil organic carbon (SOC) stock changes between a nominal state and an improved or degraded state (IPCC 2019 Volume 4 chapter 6), according to a management factor. The reference SOC is 31.7 tC/ha, retrieved from Earth Map in the project location. Using this refence SOC ($SOC_{initial}$) was derived the expected SOC stock (SOC_{final}) from grassland managed. Following IPCC's equation:

$$\text{Equation (1)} \qquad SOC_{final} = SOC_{initial} \bullet FMG \bullet Fi$$

21. where the relative stock change factor (management factor, FMG) is 1.14 for improved grassland, and the management factor for improvement with input (Fi) is 1.11, according to IPCC, 2006. For SOC stock for severely degraded grassland and moderately grassland a 70% and 95%, respectively of the SOC of $SOC_{initial}$ is considered.

22. Taking in consideration the above information, in EX-ACT this was represented with the following emission factors.

Non degraded	Default tC/ha	Tier 2 tC/ha	
Non-degraded	38	31.8	Reference SOC of the area
Severly Degraded	26.6	22.2	70%
Moderately Degraded	36.1	30.2	95%
Improved without inputs managament	43.3	36.2	FMG
Improved with inputs improvement	48.1	40.2	FMG*Fi

Table 5: Tier 2 emission factors Grassland module

Level of degradation	Default tC/ha Tier 1	Calculated Tier 2 tC/ha	Equation
Non-degraded	38	31.8	$SOC_{initial}$
Severely Degraded	26.6	22.2	70%
Moderately Degraded	36.1	30.2	95%
Improved without inputs management	43.3	3.2	FMG (1.14)
Improved with inputs improvement	48.1	40.2	FMG*Fi (1.14*1.1)

- Agriculture equipment/ machinery investments – Module Inputs in EX-ACT

23. It foresee the purchase of agricultural equipment that will be shared, maintained and owned by the community. Tractors (220 at 80 HP, 24 between 90 and 100 HP), and combine harvesters (15 at 155 HP).

4.2 Activity 2.2.2: Implement Community Forest Investments

- Community Forestry Investments – Modules LUC & Management in EX-ACT

24. The project will include in the village plans scope for the inclusion of agroforestry, afforestation and forestry investment via Joint Forest Management, directly by Leskhoz or as part of Village Development Plans. The potential set of investments would reach 8,641 hectares divided by budgeted area (7,330 hectares) and open area for each site (1,311 hectares). The budgeted area corresponds to: 5,801 ha under JFM, 1,350 directly from Leskhoz, and 179 hectares of land in buffer zones. It could include riparian forest for fuelwood and wood for construction, planting of orchards, pistachio forests, Juniper forests, Natural regeneration of Juniper for fuelwood, Saxaul for fodder and erosion control and poplar planting / agroforestry – fuelwood/construction and fodder. Under EX-ACT it is necessary to account for a pre-existing 30% of tree coverage. The targeted area, 8,641 hectares, is adjusted for the 30% pre-canopy existence, as table 6 shows.

Table 6. Unadjusted and adjusted areas for forestry

	Unadjusted	Adjusted for 30% cover
Cropland	5,400	3,924
Afforestation	1,930	1,612
Subtotal	7,330	5,536
Improved management (Open & Guard)	1,311	1,311
Improved management of 30% pre-existence canopy cover		1794

	Total	**8,641**	**8,641**

The table below shows the breakdown of hectares under JFM and directly for Leskhoz that are used in EX-ACT to account for the 30% tree cover.

Table 7: Forest areas under forestry component in EX-ACT

EX-ACT Module		JFM	Leskhoz	Adjusted 30%	Total
LUC	Sum of Buckthorn	601.02	96.4	257.6	955.00
	Sum of Fruit	393.10	63.0	168.5	624.62
	Sum of Rosehip	586.46	94.1	251.3	931.87
	Sum of Walnut	134.01	21.5	57.4	212.93
	Sum of Pistachio	1626.32	205.0	697.0	2528.31
Afforestation	Riparian forest	393.85	0.0	168.8	562.64
	Juniper forest	220.69	50.0	94.6	365.27
	Natural regeneration of Juniper	0.00	750.0		750.00
	Saxaul	84.88	0.0	36.4	121.26
	Poplar	20.37	70.0	8.7	99.10
Management	Open and Guarded	424.0	13.08		437.08
		424.0	13.08		437.08
		424.0	13.08		437.08
LUC	Buffer: Fruit and nut	52.9		22.7	75.58
	Buffer: Pistachio forest	50.2		21.5	71.69
Afforestation	Buffer: Riparian forest	12.2		5.2	17.36
	Buffer: Juniper forest	6.8		2.9	9.73
	Buffer: Saxaul	2.6		1.1	3.74
	Buffer: Poplar agroforestry	0.6		0.3	0.90
W/O&G - Buffer Zones		5458.00	1389.2	1794.0	**8641.25**
WO/O&G - Buffer Zones		4060.70	1350.0	1740.3	7151.00
W/Buffer Zones WO/O&G		4186.00	1350.00	1794.0	**7330.00**

Use of Tier 2 – in Forest and Perennial

25. A Tier 2 value was applied for forestry areas. Values from orchard where retrieved from IPCC 2019, as a refinement compared to 2006 Guidelines. The rest of the coefficients were derived based on previous validated EX-ACT analysis with similar characteristic project. This will present a more realistic value compared to Tier 1 values.

Table 8: Aboveground and belowground biomass growth rate, soil carbon content and carbon fraction

Species	Growth rates ABG up to 20 years (t d.m./ha /yr)	Growth rates ABG after 20 years (t d.m./ha /yr)	Growth rates BGB up to 20 years (t d.m./ha /yr)	Growth rates BGB after 20 years (t d.m./ha/ yr)	Ratio of roots to the stem	Soil carbon (t C/ha)	Carbon Fraction (t C/t d.m.)
Orchard	0.43	-	0	-	-	24	0.46

Species	Growth rates ABG up to 20 years (t d.m./ha /yr)	Growth rates ABG after 20 years (t d.m./ha /yr)	Growth rates BGB up to 20 years (t d.m./ha /yr)	Growth rates BGB after 20 years (t d.m./ha/ yr)	Ratio of roots to the stem	Soil carbon (t C/ha)	Carbon Fraction (t C/t d.m.)
Júglans régia (walnut)	0.59	1.61	0.83	0.48	0.3	38	0.46
Pisacia vera	1.32	3.6	1.65	1.08	0.3	38	0.46
Juníperus (wooden juniperus)	0.09	0.45	0.02	0.2	0.45	38	0.48
Pópulus	1.01	2.19	3.43	0.54	0.25	38	0.46

Source: EX-ACT CS FOR – Kyrgyzstan, 2019, IPCC, 2019

4.3 Activity 3.1.3 Support adoption of climate resilient innovative technologies

- Promotion of technical climate smart innovations through demonstrations and establishment of FFS – Cropland

26. The project will implement and roll out Farmers Field School (FFS), a total of 80 FFS will be established in villages. It aims to establish 21 demo plots (1/ District) and reach access to demonstration plots to 40,000 smallholders. For the purpose of this analysis, it was assumed that half of those who had access to the demonstration plots will carry out good agronomic practices (Improved agronomic, and nutrient management). Additionaly, the project will set a Farmers Field Schools and provide trainings services to 2,000 smallholders. It is expected a high engagement enabling 90% of beneficiaries continuing the good agronomic practices. The FFS will prioritize new crops and varieties of drought and heat resistant fodder, fodder management, among other activities. The table below summarize the activity data use in EX-ACT.

Table 9: Activity data for climate smart innovations through demonstrations and FFS

Activity	Beneficiaries	Adoption Rate	Av. ha	Total (ha)
Demo plots	21 (1 per District)	100%	0.5	10.5
Access to demonstration plots	40,000	50%	0.02	800
Farmers enrolled in Farmers Field Schools	2,000	90%	0.05	100

- Identification of market and business opportunities – Inputs

27. The project will facilitate business partnerships between groups of smallholder farmers and private sector actors (e.g. aggregators, processors). One example is the establishment of 8 milk collection centers (including mobile ones) under Productive Alliance arrangement. This will imply the use of energy, and it is estimated an average of 25 kWh/day (73,000 kWh/year for the 8 milk collection centers). It is assumed, that the milk collection centers will do use of transport. The emissions related to transportation of milk were accounted too by the use of 22 m^3/year of diesel.

Activity 3.3.1. Strengthening of CIGs capacity

- Management of the CIGs matching grant program – LUC, Cropland, and Inputs

28. Two types of Common Interest Groups (CIGs) to access support services to identify, analyse and adopt climate resilient production practices. The first group (Window 1) of 1,020 CIGs will focus on

strengthening their capacity to adapt their production systems to become more resilient to changing climate conditions and in some cases identify opportunities to link to local markets. A second group Window 2) of 110 CIGs will be supported to engage in prioritized value chains through targeted capacity building.

29. This support will increase access for CIGs to productive assets and services to increase agricultural productivity and diversification. The grants could be used for different types of small investments: the current analysis foresee the following potential activities: small-scale processing equipment, hydroponic fodder, inputs and service provision, drip irrigation, solar drying facilities, greenhouses, nurseries. The table below, it is important to mention that groups in window 1 can access to similar type of investments, however those were not accounted in EX-ACT due to it is not consider the use of energy or fuels.

Table 10: Matching grants Windows of potential types of investments analysed in EX-ACT.

Investment type	% Groups	Value	Units	Groups
Nurseries	10%*	51	ha	Window 1
Greenhouse**	10%	3.4	ha	Window 1 & 2
Dripping irrigation	20%*	408	ha	Window 1
Hydroponic fodder	3%	4,171.20	kWh/year	Window 2
Solar drying facilities**	10%	1,100	m^2	Window 2
Mini milk diary processing	3%	120,450	kWh/year	Window 2
Fruit & nut orchards	10%*	44	ha	Window 2
Oil production	5%*	7,700	kWh/year	Window 2

* Percentage of beneficiaries
** The use of greenhouses supposes the use of fertilizers, under the safeguards established by the project, and a preference of organic fertilizers is established.
*** Construction of concrete surface

4.4 Activity 3.1.1. Improving the genetic potential of smallholder farmers' livestock

30. The project foresees the provision of breeding services to improve productivity of cattle and support transition towards more intensive production systems involving a reduced number of animals. The sources of emissions covered by the tool are listed in Table 11.

Table 11: Sources of emissions covered in GLEAM-i

Sources of emissions		Description
Feed CO_2[1]	field operations	CO_2 emissions arising from the use of fossil fuels during field operations
	fertilizer production	CO_2 emissions from the manufacture and transport of synthetic nitrogenous, phosphate and potash fertilizers
	pesticide production	CO_2 emissions from the manufacture, transport and application of pesticides
	processing and transport	CO_2 generated during the processing of crops for feed and the transport by land and/or sea
	blending and pelleting	CO_2 arising from the blending of concentrate feed
Feed LUC[2] CO_2	soybean cultivation	CO_2 emission due to LUC associated with the expansion of soybean
	palm kernel cake	CO_2 emission due to LUC associated with the expansion of palm oil plantations
	pasture expansion	CO_2 emission due to LUC associated with the expansion of pastures
Feed N_2O[3]	applied and deposited manure	Direct and indirect N_2O emissions from manure deposited on the fields and used as organic fertilizer
	fertilizer and crop residues	Direct and indirect N_2O emissions from applied synthetic nitrogenous fertilizer and crop residues decomposition

Sources of emissions		Description
Feed CH_4[4]	Rice production	CH_4 emissions arising from the cultivation of rice used as feed
Enteric fermentation CH_4		CH_4 emissions caused by enteric fermentation
Manure management CH_4		CH_4 emissions caused by manure management
Manure management N_2O		N_2O emissions arising from manure storage and management
Direct energy use CO_2		CO_2 emissions arising from energy use on-farm for ventilation, heating, etc.
Embedded energy use CO_2		CO_2 emissions arising from energy use during the construction of farm buildings and equipment

[1] Carbon dioxide [2] Land use change [3] Nitrous oxide [4] Methane

31. The following assumptions were used to conduct the GLEAM-*i* analysis:
    - Increases in herd sizes in cattle by 7% with project and 14% without project from baseline to year 7, with project 7% and 8% without project from year 8 to 14, and increase of 10% for both scenarios from year 15 to 27. For sheep and goats by 8% with project and 16% without project from baseline to year 7, with project 8% and 9% without project from year 8 to 14, and increase of 12% for both scenarios. Changes in animal numbers in the assessments apply to the herd size, therefore, number of adult females was calculated using the expected herd size and herd parameters. Calculation of the number of adult males is based on a male to female ratio of 1:10 in all species. Aimed herd size reflects the % changes applied to each scenario. The reason for not reducing number of males to reflect the impact of AI is because farmers usually do not keep bulls for breeding purposes and cows are mated with young bulls kept for meat purposes, therefore, it was foreseen that the AI would not change the number of adult males in the scenario WP.
    - Weight at different life stages was increased by 8% in cattle (impact of crossbreeding) and by 3% in sheep and goats (impact of improved health and feeding). It was foreseen that the weights of animals may be lower in the AI database than they would be during the entire year because of the Eid al-Adha (i.e. Festival of the Sacrifice). Each year, the Eid moves earlier by 10-11 days due to the lunar year consisting of 354 days. This means that unless the lambing/kidding time is synchronized, the animals will be lighter every year during this time – until the Eid happens in winter again.
    - Mortality rate was reduced by 20% in all species for the first 7 years. For the consecutive years is in the range of 15%, reflecting the improvements expected through vaccination and good animal husbandry.
    - Fertility rate was increased by 5% in all species to reflect the impact of heat synchronization in AI campaigns (cattle) and the reduction in early abortions as a result of the *Brucellosis* vaccination (sheep and goats).
    - Litter size remained unchanged in both scenarios.

Detailed list of parameters for the livestock assessment are detailed in table 12.

Table 12. Herd, feed and manure parameters used in CASP+ assessment. Project targets, if different, in WP are in red.

Parameters		**Year 0**			**Year 7**			**Year 14**			**Year 27**		
HERD	**Unit**	**Cattle**	**Sheep**	**Goats**	**Cattle**	**Sheep**	**Goats**	**Cattle**	**Sheep**	**Goats**	**Cattle**	**Sheep**	**Goats**
Age at first parturition	months	27.6	16	15	27.6 27.6	16 16	15 15	27.6 27.6	16 16	15 15	27.6 27.6	16 16	15 15
Death rate of adult animals	%	6	10	9.3	5.7 4.8	9.6 8	9.2 7.4	4.8 4.2	8.2 7	7.4 6.8	3 3.8	7.4 6.5	7.2 6.5
Death rate of young animals	%	12	15	15	11.5 9.6	14.8 12	14.8 12	9.5 8.3	11.7 10	11.7 10	8.5 7.6	10.6 9	10.3 9
Fertility rate of adult females	%	12	74.5	83.9	11.5 9.6	75 78.2	84 88.1	9.5 8.3	78.5 81	87 90	8.5 7.6	82.3 83	89 91
Litter size	number	70	1.2	1.1	71.2 73.5	1.2 1.3	1.1 1.2	73 75	1.2 1.4	1.1 1.3	74.5 76	1.2 1.5	1.1 1.4
Live weight of adult females	kg	350	58.8	38	355 385	59 60.6	38.1 39.1	385 400	60.8 62	39.2 40	400 410	61.5 63	40 40.5
Live weight of adult males	kg	450	98.1	58.6	460 495	98.7 101	58.9 60.4	500 520	102 103	60.4 61	520 535	102.8 104	60.8 61.5
Live weight of meat females at slaughter	kg	350	50	35	355 385	50.5 51.5	35.4 36.1	385 400	51.8 52.5	36.2 36.6	400 410	52.7 53	36.7 36.8
Live weight of meat males at slaughter	kg	350	85	50	355 385	85.9 87.6	50.5 51.5	385 400	88 89	51.8 52.5	400 410	89.3 90	52.7 53
Milk fat	%	4.1	-	-	4.1 4.1	-	-	4.1 4.1	-	-	4.1 4.1	-	-
Milk protein	%	3.5	-	-	3.5 3.5	-	-	3.5 3.5	-	-	3.5 3.5	-	-
Milk yield	kg/year	600	-	-	660 780	-	-	820 960	-	-	920 1100	-	-
Parturition interval	days	-	365	287	-	365 365	287 287	-	365 365	287 287	-	365 365	287 287
Replacement rate of adult females	%	25	14.9	21.3	25 25	14.9 14.9	21.3 21.3	25 25	14.9 14.9	21.3 21.3	25 25	14.9 14.9	21.3 21.3
Weight at birth	kg	25	5.3	3	25.8 27.5	5.4 5.5	3.0 3.1	28 29	5.5 5.6	3.1 3.2	29.3 30	5.6 5.7	3.2 3.2
FEED													
By-products from cottonseed	%	3	0	0	3 5	0 2	0 2	3 5	0 2	0 2	3 5	0 2	0 2
Crop residues from wheat	%	25	25	25	24 20	24 20	24 20	20 17	21 17	20 17	18 15	19 15	16 15
Fodder beet	%	4	3	3	4 5	3 3	3 3	4 5	3 3	3 3	4 5	3 3	3 3

Parameters		Year 0			Year 7			Year 14			Year 27		
HERD	**Unit**	**Cattle**	**Sheep**	**Goats**	**Cattle**	**Sheep**	**Goats**	**Cattle**	**Sheep**	**Goats**	**Cattle**	**Sheep**	**Goats**
Fresh grass	%	60	65	65	58 50	64 59	64 59	55 45	60 55	61 55	50 40	56 52	58 52
Fresh mixture of grass and legumes	%				0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2
Hay or silage from alfalfa	%	1	1	1	1 2	1 2	1 2	1 2	1 2	1 2	1 2	1 2	1 2
Hay or silage from grass and legumes	%	6	6	6	9 12	8 12	8 12	16 20	15 19	15 19	23 27	21 24	22 24
Silage from whole grain plants	%				0 1			0 1			0 1		
Silage from whole maize plant	%	1			1 3			1 3			1 3		
MANURE													
Burned for fuel	%	20	20	20	20	20	20	20	20	20	20	20	20
Pasture/Range/Paddock	%	40	40	40	40	40	40	40	40	40	40	40	40
Solid storage	%	40	40	40	40	40	40	40	40	40	40	40	40

Parameters		Year 0			Year 7			Year 14			Year 27		
HERD	**Unit**	**Cattle**	**Sheep**	**Goats**	**Cattle**	**Sheep**	**Goats**	**Cattle**	**Sheep**	**Goats**	**Cattle**	**Sheep**	**Goats**
Age at first parturition	months	27.6	16	15	27.6 27.6	16 16	15 15	27.6 27.6	16 16	15 15	27.6 27.6	16 16	15 15
Death rate of adult animals	%	6	10	9.3	5.7 4.8	9.6 8	9.2 7.4	4.8 4.2	8.2 7	7.4 6.8	3 3.8	7.4 6.5	7.2 6.5
Death rate of young animals	%	12	15	15	11.5 9.6	14.8 12	14.8 12	9.5 8.3	11.7 10	11.7 10	8.5 7.6	10.6 9	10.3 9
Fertility rate of adult females	%	12	74.5	83.9	11.5 9.6	75 78.2	84 88.1	9.5 8.3	78.5 81	87 90	8.5 7.6	82.3 83	89 91
Litter size	number	70	1.2	1.1	71.2 73.5	1.2 1.3	1.1 1.2	73 75	1.2 1.4	1.1 1.3	74.5 76	1.2 1.5	1.1 1.4
Live weight of adult females	kg	350	58.8	38	355 385	59 60.6	38.1 39.1	385 400	60.8 62	39.2 40	400 410	61.5 63	40 40.5
Live weight of adult males	kg	450	98.1	58.6	460 495	98.7 101	58.9 60.4	500 520	102 103	60.4 61	520 535	102.8 104	60.8 61.5
Live weight of meat females at slaughter	kg	350	50	35	355 385	50.5 51.5	35.4 36.1	385 400	51.8 52.5	36.2 36.6	400 410	52.7 53	36.7 36.8
Live weight of meat males at slaughter	kg	350	85	50	355 385	85.9 87.6	50.5 51.5	385 400	88 89	51.8 52.5	400 410	89.3 90	52.7 53
Milk fat	%	4.1	-	-	4.1	-	-	4.1	-	-	4.1	-	-

Parameters		Year 0			Year 7			Year 14			Year 27		
HERD	**Unit**	**Cattle**	**Sheep**	**Goats**	**Cattle**	**Sheep**	**Goats**	**Cattle**	**Sheep**	**Goats**	**Cattle**	**Sheep**	**Goats**
					4.1			4.1			4.1		
Milk protein	%	3.5	-	-	3.5 3.5	-	-	3.5 3.5	-	-	3.5 3.5	-	-
Milk yield	kg/year	600	-	-	660 780	-	-	820 960	-	-	920 1100	-	-
Parturition interval	days	-	365	287	-	365 365	287 287	-	365 365	287 287	-	365 365	287 287
Replacement rate of adult females	%	25	14.9	21.3	25 25	14.9 14.9	21.3 21.3	25 25	14.9 14.9	21.3 21.3	25 25	14.9 14.9	21.3 21.3
Weight at birth	kg	25	5.3	3	25.8 27.5	5.4 5.5	3.0 3.1	28 29	5.5 5.6	3.1 3.2	29.3 30	5.6 5.7	3.2 3.2
FEED													
By-products from cottonseed	%	3	0	0	3 5	0 2	0 2	3 5	0 2	0 2	3 5	0 2	0 2
Crop residues from wheat	%	25	25	25	24 20	24 20	24 20	20 17	21 17	20 17	18 15	19 15	16 15
Fodder beet	%	4	3	3	4 5	3 3	3 3	4 5	3 3	3 3	4 5	3 3	3 3
Fresh grass	%	60	65	65	58 50	64 59	64 59	55 45	60 55	61 55	50 40	56 52	58 52
Fresh mixture of grass and legumes	%				0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2
Hay or silage from alfalfa	%	1	1	1	1 2	1 2	1 2	1 2	1 2	1 2	1 2	1 2	1 2
Hay or silage from grass and legumes	%	6	6	6	9 12	8 12	8 12	16 20	15 19	15 19	23 27	21 24	22 24
Silage from whole grain plants	%				0 1			0 1			0 1		
Silage from whole maize plant	%	1			1 3			1 3			1 3		
MANURE													
Burned for fuel	%	20	20	20	20	20	20	20	20	20	20	20	20
Pasture/Range/Paddock	%	40	40	40	40	40	40	40	40	40	40	40	40
Solid storage	%	40	40	40	40	40	40	40	40	40	40	40	40

Refinement of the analysis: given the scope of the project as demand driven and community planning. The monitoring report and conclusion evaluation could refine those activities accomplished, and have detailed information on the types of investments under CIG (activity 3.3.1)

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