Climate-smart initiatives for climate change adaptation and sustainability in prioritized agricultural production systems in Colombia (CISCAP)

Review 16/11/2021

Annex 22-2. GHG Emissions reduction estimates

This document briefly explains how Annex 22 was prepared to estimate GHG emission reductions. The Excel document in Annex 22 contains:

1. A spreadsheet with a matrix showing the areas that will be directly intervened by the project which consider full investments, differentiated by crop and year.
2. A spreadsheet that includes areas with implementation of technologies by producers who received training and technical assistance from the project, differentiated by crop and year.
3. A spreadsheet with a matrix with the areas that will indirectly benefit from the project, differentiated by crop and year.
4. A fourth spreadsheet contains a matrix with baseline emission reference values and emission values for the new technologies proposed, as well as information on the difference in emission reduction differentiated by crop and hectare per year.

After, we show four spreadsheets result from multiplying the direct full investment, training and total direct GHG emissions reductions, and indirect areas by the technologies' emission reduction values. The information contained in each spreadsheet is explained in more detail below.

1a. Direct area - Full invest (ha): The crops are presented horizontally (columns) and the years vertically (rows). This spreadsheet only considers the project's five-year duration and the areas that will directly benefit from the project's intervention and investments. The aggregated values correspond to the same values in column 3 "Area (hectares)" of table D.1.2 in the FP, but the difference is that it presents annual figures. It is expected that the areas that directly benefit will start from 2024 onwards, as in previous years, GHG is measured directly using controls and technologies to generate emission factors for these technologies that will be used for MRV implementation. The first phase of these interventions will also serve to adjust technologies and/or crop management to optimize emissions reduction or carbon capture. The annual values presented in this worksheet also correspond to planned financial investments presented in "Annex 3 - Economic and Financial Analysis" in relation to technology transfer and escalation in 3.5 "producer associations". Finally, please note that for coffee and sugar cane, they do not have project interventions under mitigation, thus the areas are zero.

1b. Direct area - Training (ha): This area represents the areas that will be intervened by producers themselves as a result of the training and technical assistance received from the project. This assume that there will be a 20% adoption rate of the technologies disseminated by the project, which has been estimated based on the impact evaluation of previous/similar interventions and will be included in the MRV process of the project.

2. Indirect area (ha): The crops are presented horizontally (columns) and the years vertically (rows). Table 2.1 presents the project's five-year execution period and an additional 20 years that correspond to the project's useful life. For each crop, the annual values of the indirect areas are taken from "Annex 24 - Other references beneficiaries direct indirect estimation", which are presented in the second table below. The

values at the top of each column present the percentage of indirect hectares related to mitigation[1] for each crop. The values in Table 2.1 corresponds to the multiplication of indirect area (Table 2.2) by the area share of mitigation activities in Table 2.1. Please note, that the calculations in Table 2.1 consider the difference between semi-annual and perennial crops (e.g., livestock pastures), as hectares in perennial crops are cumulative.

3.1. Emission Factors (EF): Table 3.1 presents the average hectare-year emission values generated with conventional technologies versus new technologies, and the average annual difference between the with and without project scenarios. Table 3.2 presents the annual emissions reduction factors (ton CO2 eq./ha/year) for each value chain. It is necessary to note that since livestock is a long-cycle production system where technology generates changes in carbon capture over the years, the values change. The reference emission values used in this spreadsheet were used as a reference for the studies presented in the "Emission (FE) references" sheet. The idea is that once direct measurement values are available, they will be used for the project's MRV system. Finally, please also note that as coffee and sugar cane do not have project interventions under mitigation, their values are zero.

3.2 Emission Factors (EF) – Calculations: The baseline emission values (without project scenario) for each crop correspond to the quantification of the GHG emissions balance in one hectare in a period of one year, in accordance with the IPCC guidelines for emissions inventories in agricultural systems. These values were obtained by totaling emissions from, fossil fuel use, energy, fertilizers use and residues management. The activity data were collected from official sources of production of each crop, taking into account a representative production system at the country level (agricultural census, national or regional authorities, reports and technical documents) and the specific emission factors, which were obtained from secondary information sources (scientific publications, IPCC and Ecoinvent).

The GHG emission per each crop were estimated multiplying the activity data with the crop specific emission factor

$$Crop\ Emissions_{GHG} = Activity\ data\ _{\frac{inputs}{outputs}} * Crop\ Emission\ factor_{CO2\ eq.}$$

Where,

Activity data is the quantitative measure of activity that results in a GHG emission or removal; and
Crop emission factor is the factor relating activity data to GHG emissions (CO_2 eq.).

The ex-ante emission values of the CSICAP interventions (with project scenario) were obtained by generating mitigation scenarios with the incorporation of mitigation practices. The mitigation practices consider: in rice cultivation 33% of N_2O emissions due to efficient use of fertilizers; in corn cultivation, a 20% reduction in N_2O emissions due to the implementation of conservation agriculture; in panela cultivation, the reduction of 40% of CO_2 emissions due to the implementation of efficient stoves and 20% of N_2O emissions due to the efficient use of fertilizers; in potato cultivation, a 20% reduction in N_2O emissions by adopting conservation practices and efficient use of fertilizers; in livestock, the reduction of 29% of emissions due to the management of manure and urine due to the inclusion of new diets, additionally the removal of CO_2 due to the implementation of silvopastoral arrangements; in plantain and bananas, a 50% reduction in N_2O emissions due to efficient use of fertilizers and application of bio-inputs,

[1] It is important to clarify that Result 2.2 is the only component that considers mitigation actions that contribute to reducing emissions, but part of the actions considered in Result 2.2 also point to efficient water use and hence support Adaptation. Results 1.1, 1.2, and 2.1 are clearly focused on adaptation, although they may bring mitigation co-benefits that are not estimated given their uncertainty.

and a 10% reduction in CO_2 emissions due to a reduction in fuel use due to the optimization of irrigation systems.

Table 1. Mitigation of GHG emissions by crop (percentage)

Crop	N_2O (% reduction)	CO_2 (% reduction)
Rice	33%	
Corn	20%	
Panela	20%	40%
Potato	20%	
Livestock	29%	
Bananas	50%	10%

3.2. Emission Factors (EF) – Assumptions: This contains the emissions factors and assumptions for all coefficients used in the calculations of the baseline emission factors (without project) and the emission factors under the project interventions (with project).

4a. Direct GHG reductions full invest: Table 4a.1 presents the aggregate emission reductions as a result of the activities in the areas that directly benefit from project interventions during the three years of the project (2024, 2025, and 2026) where these interventions take place. These emission reductions results from the multiplication of the directly benefit from the project's intervention and investments (worksheet "Direct area - Full invest (ha)") with the average emission reduction factor for each crop (worksheet "Emissions (FE)"). Table 4a.2A presents the results of direct emissions reduction in the project's direct intervention areas in the year 2024. Table 4a.2B presents the calculation for direct interventions in the year 2025, while Table 4a.2C presents the emission reductions as a result of project interventions during the year 2026.

4b. Direct GHG reductions training: This spreadsheet is the result of multiplying the areas that will be directly intervened by the producers as a result of the training and technical assistance received by the project and the changes in emission values resulting from implementing the new technologies. Please note that this estimation assumes the 20% adoption rate of these technologies by the farmers that have been trained and received the technical assistance, incorporated into the area estimation (worksheet "Direct area - training (ha)"). Tables 4b.2A presents the annual emissions associated with the activities in year 2024. Tables 4b.2B to 2J present the annual emission reductions for livestock only, as the calculations consider the cumulative nature of perennial crops (pastures).

4. Total Direct - Full & Training: This worksheet presents the sum of the direct investment and training emission reductions.

5. Indirect GHG reductions: This spreadsheet shows the project's reduction of indirect emissions. Table 5.1 contains the aggregate emission reduction for all value chains per year. These are estimated by multiplying the indirect areas by the emission factors, as presented in Tables 5.2A to 5.2J. Table 5.2A presents the emission reductions as a result of the hectares that will be impacted annually, multiplied by the hectare-year emissions reduced by the technologies implemented in the project. Since livestock is perennial, it is necessary to consider that the hectares are multiplied by the annual emission reductions and that is why calculations are made up until 2033, which corresponds to the tables 5.2B to 5.2J.