Greenhouse Gas Management Institute, Verra

Agriculture Guidance

Guidance for assessing the greenhouse gas impacts of agriculture policies

May 2018

How to quantify the GHG impacts

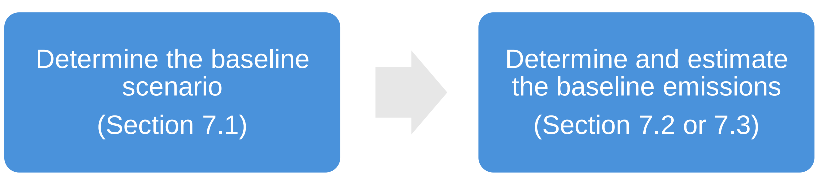
---

7. Estimating the Baseline Scenario and Emissions

When using the estimates approach, estimating the GHG impacts of a policy requires a reference case, or baseline scenario, against which impacts are estimated. The baseline scenario represents what would have happened in the absence of the policy intervention. Baseline emissions and removals are estimated according to the most likely baseline scenario that includes credible assumptions on land use, land-use changes, livestock and soil management practices, and the associated GHG emissions and removals that would have occurred, without the implementation of the policy.

The guidance in this chapter can be used for determining the baseline scenario and estimating emissions ex-ante or ex-post. Estimating baseline emissions is optional; users can calculate the GHG impacts of the policy directly, without explicitly determining separate baseline and policy scenarios using the activity data approach. In such cases, users can skip to Chapter 8.

Figure 7.1: Overview of the steps in the chapter



Checklist of key recommendations

For enteric fermentation:

- Determine livestock categories and feed characterisation
- Estimate the baseline average annual population for the species mix
- Choose or derive emission factors
- Calculate the cumulative GHG emissions for the baseline scenario over the assessment period

For soil carbon sequestration:

- Stratify land by IPCC land-use category and soil management practices
- Estimate the area of land in each stratum
- Determine the soil carbon stock for each stratum
- Calculate the net change in soil carbon stock over the assessment period
- Calculate the cumulative GHG emissions and removals for the baseline scenario over the assessment period

7.1 Determine the baseline scenario

The most likely baseline scenario is determined by drivers that affect emissions and carbon stocks. This step requires identifying parameters for these drivers and making reasonable assumptions about their most likely values in the absence of the policy.

When determining the baseline scenario, consider how the sector would have developed without the policy. For example:

- What mitigation practices or technologies would be implemented in the absence of the policy?
- Are there existing or planned policies, other than the policy being assessed that would likely have an impact on GHG emissions for the agriculture sector?
- Are there non-policy drivers (e.g., market trends or non-anthropogenic processes) or other sectoral trends that should be reflected in the baseline scenario? For example:
    - Trends in the increase or decrease of livestock populations
    - Improvements in livestock management
    - Exploitation of organic soils
    - Tillage practices

To the extent possible, identify a single baseline scenario that is considered to be the most likely. In certain cases, multiple baseline options may seem equally plausible. Users can develop multiple baselines, each based on different sets of assumptions, rather than just one set. This approach produces a range of possible emission reductions scenarios. Users can then conduct a sensitivity analysis to see how the results vary depending on the selection of baseline scenario. More guidance about conducting a sensitivity analysis is provided in Chapter 12 of the *Policy and Action Standard*.

Users that are assessing the sustainable development, transformational or other GHG impacts of the policy should use the same underlying assumptions about macroeconomic conditions, demographics and other non-policy drivers. For example, if GDP is a macro-economic condition needed for assessing both the job impacts and economic development impacts of an agriculture policy, users should use the same assumed value for GDP over time for both assessments.

7.1.1 Approaches to determining the baseline scenario

This section describes the various approaches to determining the most likely baseline scenario. There are multiple ways to project the baseline scenario, ranging from simple to complex. Depending on the availability and quality of historical and forecasting data, any of the following of approaches can be used for determining the baseline scenario. Figure 7.2 illustrates the different baseline approaches. More detailed step-wise guidance for determining the baseline scenario and estimating emissions for enteric fermentation and soil carbon sequestration are provided in the Sections 7.2 and 7.3, respectively.

Constant baseline

This approach assumes there will be no change in agricultural practices, the use of technology, or land use during the baseline period with respect to the situation prior to policy implementation. It represents the simplest approach as only historical data is required. Either the most recent available data, or an average of the data from at least three years prior to the start of the policy implementation, can be used to quantify the baseline parameters. This approach then assumes the parameters are held constant for the assessment period and the baseline is the continuation of the current or historical situation. For example, land will remain degraded under the baseline scenario. This baseline approach is the easiest to estimate, however assessments based on a constant baseline may be less accurate.

Simple trend baseline

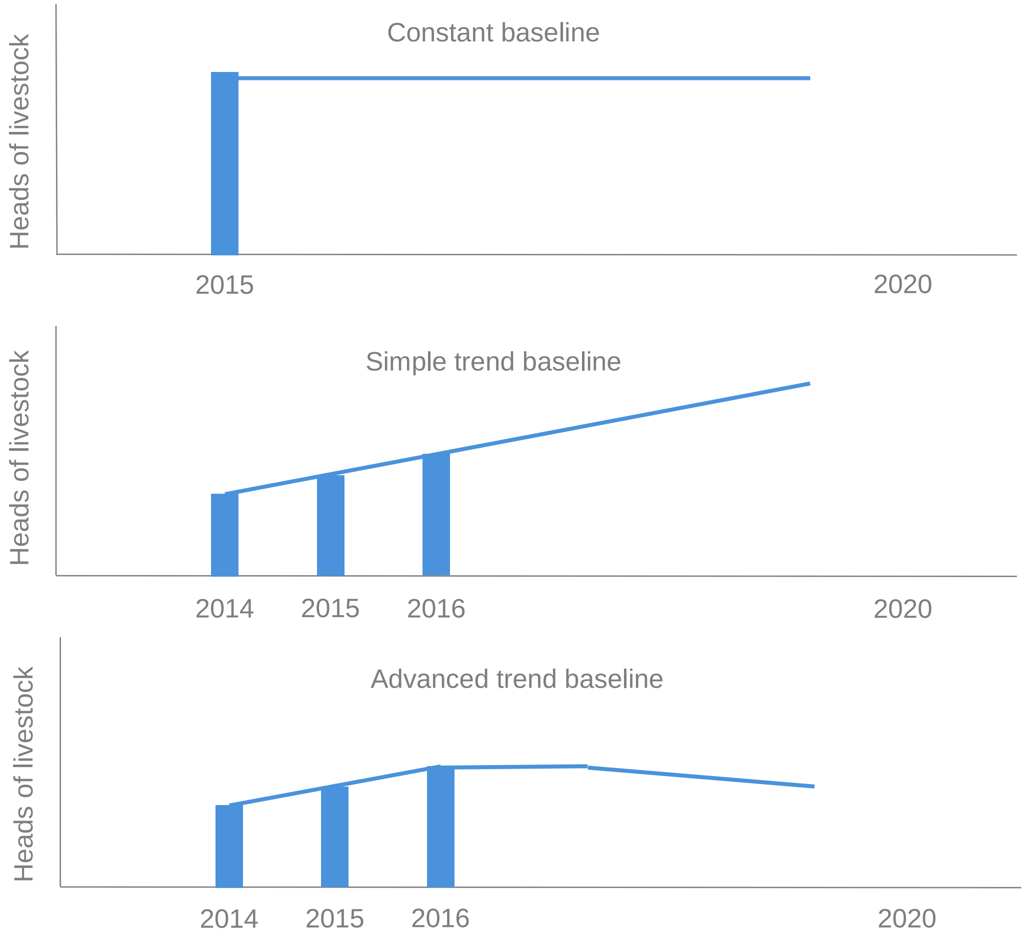
This baseline scenario approach assumes that agricultural practices, the use of technology, and land use will evolve in the same way as they have in the past. This approach typically uses a linear or exponential extrapolation of the historical trend for each baseline parameter. Users can employ a statistical regression analysis to estimate trends. This approach can be easy to implement but it does not include any assumptions about future policy measures or future mitigation actions. This approach should use historical data from 5 to 10 years prior to the implementation of the policy. More data points will strengthen the regression analysis. For example, livestock population in the future can be estimated by assuming that the same annual rate of livestock population change prior to policy implementation continues in the baseline. Land-use change can also be extrapolated this way using the historical trends.

Advanced trend baseline

This approach models the impact of many interacting elements, including trends in macroeconomic conditions, demographics and other non-policy drivers. A modelled baseline can be top-down or bottom-up:

- **Top-down model**: This models how the economy (e.g., macroeconomic and demographic conditions) will impact the agriculture sector. For example, the approach may model how GDP will impact livestock populations or changes in land-use management and then uses GDP forecasts to predict baseline livestock populations.
- **Bottom-up model**: This approach models the interaction of key factors on specific mitigation practices, use of technologies, and land use. It can offer a more detailed projection of specific GHG sources and carbon pools. This approach will likely require detailed data such as livestock census data, including the average daily feed intake per species, or specific land management practices. It is suitable for policies that target a specific livestock category (e.g., dairy cows or buffalo for milk production) or a specific land type (e.g., grasslands or croplands).

Figure 7.2: Examples of constant, simple trend and advanced trend baselines



7.1.2 Data sources

Multiple types of data can be used to develop baseline scenarios, including top-down and bottom-up:

- **Top-down data:** Macro-level data or statistics collected at the jurisdictional or sectoral level. Examples include economic data on milk or meat consumption, land-use maps, population and GDP. In some cases, top-down data are aggregated from bottom-up data sources.
- **Bottom-up data:** Data that are measured, monitored or collected at the facility, entity or project level. Examples include agricultural or livestock census data on current and/or historical livestock population, species, feed intake or land-use categories classified by climate region, soil type and management.

Historical data from national GHG inventories, National Communications and Biennial Update Reports, which are prepared following IPCC guidelines, can be used for determining the baseline scenario and estimating baseline emissions and removals.

7.1.3 Choosing the approach to determine the baseline scenario

The choice of approach to determine the baseline scenario depends on users' resources, capacity, access to data, availability of models and methodologies, and the parameters that are expected to change. A constant baseline is the simplest option and may be appropriate when parameters are considered likely to remain stable over time. A simple trend baseline is most appropriate if the change in baseline parameter values is expected to remain stable over time.

Advanced trend baseline approaches may yield more credible results than other approaches, since they take into account various drivers that affect conditions over time. However, more complex baselines will only be more accurate if the underlying data and methods used to model the impacts of drivers are robust. Users should use methods and data that yield the most accurate results within a given context, based on the resources and data available.

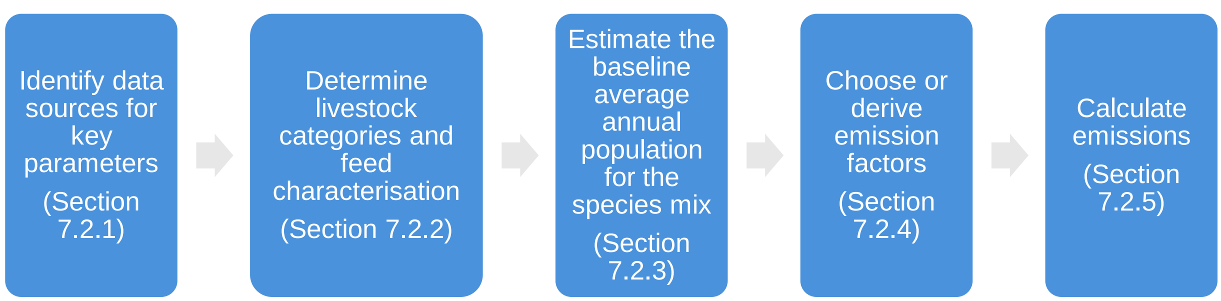
7.2 Estimate baseline emissions from enteric fermentation

This section provides guidance on estimating baseline emissions for enteric fermentation. It provides suggestions for identifying data sources and methods for projecting key baseline scenario parameters. Figure 7.3 outlines the steps in this section.

The guidance can also be used to estimate policy scenario emissions for enteric fermentation. To estimate policy scenario emissions, use the same method that was used to estimate baseline emissions with new parameter values derived following the guidance in Sections 8.2 – 8.5 and, if relevant, new emission factors that represent conditions under the policy scenario. The policy scenario can be estimated ex-ante or ex-post with these methods.

Note that potential CH_4 and N_2O emissions from animal manure are not included in this guidance. Refer to the guidance in Section 6.2 to determine whether this GHG source should be included in the GHG assessment boundary. For some policies, it may be conservative to assume that the animal manure management systems in the baseline and policy scenarios are the same.

Figure 7.3: Steps for estimating the baseline emissions for enteric fermentation



7.2.1 Identify data sources for key parameters

Methane production from ruminant livestock is dependent on a number of factors, including population, animal characteristics and feed characteristics. To estimate enteric fermentation emissions for the baseline scenario, the key parameters are:

- **Livestock population data**: The annual average livestock population data, over the duration of the assessment period, for the livestock species and categories targeted by the policy
- **Methane emission factors**: A factor that represents the methane emissions per head of livestock per year, based on feed properties and animal attributes

For livestock population data, evaluate available, existing data that can be used to create a baseline. There are three possible sources of data for livestock populations. These include:

- **Agricultural or livestock census data**: Primary data on current and/or historical livestock population and species. The Food and Agriculture Organization (FAO) operates the World Programme on Agricultural Census and provides methodological guidance for carrying out agricultural censuses.[1] Users can follow this guidance. Where available, agricultural or livestock census data that is available from the national GHG inventory can be used for this assessment; conversely any data gathered as part of an agricultural census can be used to inform the national GHG inventory.
- **Population estimates**: Secondary data on the current estimation of livestock population and species (e.g., extrapolation of livestock population from sample surveys).
- **Economic data**: Secondary data on the output of milk and/or meat production from which estimates of livestock population and species can be derived.

Identify the type of emission factors to be used. There are three options for selecting emission factors. The choice of option depends on availability of data and the source of emission reductions. Further guidance on identifying or deriving emission factors is provided in Section 7.2.4.

Where the policy aims to reduce the population of livestock, Tier 1 factors can be used. Where the policy aims to improve the efficiency of livestock production, Tier 2 factors should be used to capture changes in management and feeding and improvements in productivity. Higher tier methods require more data, but can yield a more accurate GHG impacts assessment. Users should consider the objectives of the policy when selecting which emission factor method to use.

The emission factor options include:

- **Tier 1 IPCC default emission factors**: IPCC 2006 GL, Volume 4, Chapter 10 provides emission factors for dairy and non-dairy cattle for geographic regions in Table 10.11. Table 10.10 provides emission factors for non-cattle livestock types.
- **Published Tier 2 emission factors**: These emission factors can found in published research studies or in the national GHG inventory. These factors are based on feed and diet characteristic data and are country- or region-specific.
- **Derived Tier 2 emission factors**: These factors are developed by the user to represent the baseline scenario and are used for estimating the impact of the policy. They are based on feed and diet characteristic data. Users may develop a full Tier 2 emission factor if all relevant data and information are available. Alternatively, users may derive a preliminary Tier 2 emission factor by using country- or region-specific data (where it is available) or by relying on expert judgment (described in Section 4.2.4), and using default data where information is not available. The method to derive Tier 2 or preliminary Tier 2 emission factors is explained in Section 7.2.4.

[1] Available at: http://www.fao.org/world-census-agriculture/en/

Further resources

Obtaining the data needed for estimating emissions can be challenging. Comprehensive guidance on gathering and analysing data for estimating emissions from livestock can be found in numerous resources, including:

- IPCC 2003 Good Practice Guidelines for Land Use, Land-Use Change and Forestry[2]
- IPCC 2006 GL for AFOLU, Volume 4[3]
- Global Research Alliance (GRA) Livestock Research Group[4]
- Standard Assessment Of Agricultural Mitigation Potential And Livelihoods (SAMPLES) Tool[5]
- Winrock International Grazing Land and Livestock Management methodology, A MICROSCALE excel tool for estimating emission factors[6]

7.2.2 Determine the livestock categories and feed characterisation

It is a *key recommendation* to determine the livestock categories and feed characterisation. Use the following steps to determine the livestock species categories, sub-categories and typical feed input (i.e., diet) for each livestock subcategory.[7]

Livestock categories

Users should determine which livestock species to include in the assessment, focusing on livestock categories or subcategories that are affected by the policy. It may also be sufficient to focus on the highest emitting livestock species (such as dairy and non-dairy cattle). Where other types of livestock do not contribute significantly to overall enteric emissions, they can be excluded.

Of all possible types of livestock, dairy cattle tend to have the highest enteric fermentation emissions ranging from 46 - 128 kg CH_4/head/year. Non-dairy cattle groups, such as beef cattle, have enteric fermentation emissions ranging from 27 – 60 kg CH_4/head/year. After cattle, the next highest emitters, in rank order, are buffalo, sheep, goats, swine, horses, camels, mules/asses and poultry (IPCC 2006).

Livestock characterisation

To accurately estimate baseline emissions, users should characterise each livestock species. A characterisation is a list of livestock sub-categories. In the next step (Section 7.2.3), the average annual population for each category will be derived.

Choose a basic or enhanced livestock characterisation. A basic characterisation uses the livestock subcategories for which there is a default emission factor (e.g., dairy cattle, non-dairy cattle, buffalo,

---

[2] Available at: http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf.html

[3] Available at: http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol4.html

[4] Available at: https://globalresearchalliance.org/research/livestock/

[5] Available at: http://samples.ccafs.cgiar.org/

[6] Available at: https://americancarbonregistry.org/carbon-accounting/standards-methodologies/grazing-land-and-livestock-management-gllm-ghg-methodology

[7] This section is adapted from IPCC 2006.

sheep, goats, swine, horses, camels, mules/asses and poultry). An enhanced livestock characterisation is necessary when more detailed Tier 2 emission factors are used. For an enhanced livestock characterisation, subdivide the livestock categories further. Livestock subcategories should be defined as relatively homogenous sub-groupings of animals accounting for variations in age structure and animal performance. Table 10.1 in the IPCC 2006 GL provides representative livestock subcategories and Chapter 10 provides guidance on defining country-specific livestock subcategories.

Feed intake

With Tier 2 emission factor methods, users should estimate the feed intake for a representative animal in each livestock subcategory. The representative feed intake is used to derive each subcategory's emission factor. Guidance for estimating feed intake is provided in Chapter 10 of the IPCC 2006 GL. Feed intake is typically measured in terms of gross energy (e.g., MJ per day) or dry matter (e.g., kg per day). The assumed feed intake should represent animal feeding practices under the baseline scenario. Feed intake is in many cases a key parameter that is changed in the policy scenario.

7.2.3 Estimate the baseline average annual population for the species mix

It is a *key recommendation* to estimate the baseline average annual population for the species mix. Where livestock census or population data are available, use one of the baseline approaches described in Section 7.2.3 to estimate the average annual livestock population numbers and species mix (i.e., population numbers in each livestock subcategory) for the baseline assessment period. See Equation 10.1 in the IPCC 2006 GL for how to calculate average annual population numbers for livestock.

Where livestock census or population data are not available, economic data can be used to infer livestock population numbers. When using economic data (e.g., an output or yield), an advanced trend baseline approach is appropriate for projecting the baseline scenario. The following steps should be followed to estimate livestock population:

- Step 1: Estimate future milk and/or meat demand
- Step 2: Estimate the livestock population needed to meet the demand

Step 1: Estimate future milk and/or meat demand

Start by developing an understanding of how demand for milk and/or meat are expected to change over time. This approach assumes that demand will be met by supply. That is, as demand increases, supply will increase; or as demand decreases, supply will decrease. Therefore, trends in demand are used as a proxy for the expected output of milk and/or meat (e.g., kg of milk meat produced per year) production in the baseline scenario. Users can choose between the following three methods to estimate the future demand for milk and/or meat:

1. Where forecasts for milk and/or meat demand or production are available for the country or region, it is preferable to use those forecasts. Ministry of agriculture, national agricultural research institutes, ministry of finance and international agencies (e.g., FAO) are potential sources of demand forecast data. Where possible, employ national data sources that are widely accepted among policymakers and endorsed by the government.

2. Where forecasts for milk and/or meat demand or production are not available for the country or region, estimate future demand using one of the approaches for determining the baseline described in Section 7.1.1. Users can forecast demand by extrapolating historical data on milk and/or meat demand using a linear trend that aligns with the historical trend (i.e., simple trend baseline).

   Alternatively, users can link milk and/or meat demand or production to trends in population and GDP growth. Users can use future trends in GDP, population or other proxy factors, to estimate how current demand for milk and/or meat will evolve in the future (advanced trend baseline). Bear in mind that future changes in eating patterns could make such correlations poor predictors of future demand.

3. Where neither of the above data sources is available, user can obtain estimates of future milk and/or meat demand or production from sector experts. Users can consult national experts for estimates of growth, to provide the compound annual growth rate for demand for milk and/or meat output as an indicator.

Step 2: Estimate the livestock population needed to meet the demand

The forecasts for milk and/or meat demand or production can be used to estimate the species mix in the baseline scenario (e.g., livestock population in each livestock category or subcategory). Users can choose one of the following approaches to achieve this, or adapt one of the approaches below:

1. **Constant baseline**: Use the constant baseline approach and assume that the percentage of livestock in each category remains the same in the baseline scenario as it is in the current situation, or the situation prior to policy implementation. Users estimate how many of each type of livestock is needed to meet the forecasted milk and/or meat demand. This is the best default assumption where there data about the future species composition is limited.
2. **Simple trend baseline**: Use the simple trend baseline approach and assume that the historical trend for milk and/or meat demand evolve the same way in the future. Based on this, estimate the population of livestock in each category needed to meet the demand as described by the future demand scenario. This approach can lead to unreasonable results for longer timeframes where certain livestock categories experienced high growth rates in the past but are unlikely to continue at the same rate in the future. It may be necessary to adjust to livestock categories to account for this.
3. **Advanced trend baseline**: Use the advanced trend approach and assume that certain livestock categories decrease more or less than others to meet forecasted demand for milk and/or meat. This approach is appropriate where there is evidence that a certain livestock category will have greater dominance in the future food system. For example, a national study may predict replacement of buffalo milk with cow milk.

7.2.4 Choose or derive emission factors

It is a *key recommendation* to choose or derive emission factors. For each livestock category, users should apply the emission factor to estimate the emission level. The following approaches can be used to choose or derive emission factors:

1. **Tier 1**: Use IPCC default emissions factors for livestock by geographic region (in kg CH_4 per head per year) in Table 10.10 and 10.11 of the IPCC 2006 GL, Volume 4, Chapter 10. Users should also refer to tables in IPCC Annex 10A.1 to ensure that the underlying animal characteristics (e.g., weight, growth rate and milk production) used to develop the emission factors for cattle and buffalo are similar to the conditions in the baseline scenario. Select the emission factor from Annex 10A.1 that best matches the characteristics of the cattle and buffalo populations in the baseline scenario, even if that means choosing an emission factor for a region that is different from where the policy is being implemented. For dairy cattle, average annual milk production data should be used to select an emission factor. If necessary, interpolate between dairy cow emission factors in the table using assumed baseline scenario average annual milk production per head.

- Use the same emission factor for all years in the baseline assessment period (i.e., assume there are no changes in underlying animal characteristics).

2. **Published Tier 2**: Where Tier 2 country-specific emission factors for livestock categories are available in the national GHG inventory report, those emission factors can be used. It is important to know the underlying species mix and feed intake characteristics associated with the emission factors so that these parameters can be adjusted in the policy scenario. If information on these underlying characteristics is not available, even though the emission factors are country-specific, it may be preferable to use one of the other two emission factor options.

- Using the same emission factor for all years into the future assumes there are no changes in underlying animal characteristics. This assumption is not appropriate for all scenarios. If underlying animal characteristics (including reproductive rates, milk yield or weight gain) change over time, then a derived Tier 2 emission factor may be more appropriate.

3. **Derived Tier 2**: Calculate species-specific emission factors that represent that baseline scenario following the method provided in the IPCC 2006 GL, Volume 4, Chapter 10. The Tier 2 emission factor requires an enhanced livestock characterisation, specifically data on the gross energy intake and methane conversion factor for each livestock category. If data for all of the parameters needed to estimate Tier 2 emission factor are unavailable and a Tier 1 emission factor is not sufficient for assessment objectives, a preliminary Tier 2 emission factor may be estimated. The Compendium of Tier 2 Approaches for Livestock Emission Factors may be a useful resource that provides examples how different countries have obtained preliminary Tier 2 emission factors.[8] The most important country-specific data needed to estimate preliminary Tier 2 emission factors are live-weight, milk production and/or slaughter-weight (i.e., parameters that will be affected by productivity improvements). Further guidance on developing a preliminary Tier 2 emission factor is provided in the steps below.

   To derive Tier 2 emission factors, follow these steps:

   - Step 1: Derive gross energy for each livestock sub-population, Users may follow the methods provided in the IPCC 2006 GL. This requires data on: live-weight, weight gain and average daily milk production (and fat content of milk for dairy cows only), average number of hours worked per day (for draft animals), feeding situation (e.g., stall, pasture,

[8] (GRA, forthcoming)

grazing lands), percentage of females giving birth and number of offspring produced each year, and average feed composition and digestibility.

If country-specific data for all of these parameters are not available, derive a preliminary Tier 2 emission factor. To do this, focus on collecting data for live-weight, weight gain and milk production parameters, or collect data on aspects that are expected to change as a result of the mitigation policy (e.g., if the focus is on improving fertility rate of animals, collect data on this expected change). Default factors can be used for the other parameters to derive gross energy if country-specific data are not available.

- Step 2: Derive a methane emission factor (EF) from the gross energy intake for each livestock sub-population using the following equation for estimating a Tier 2 emission factor:

$$EF = \frac{GE \times \frac{Y_m}{100} \times 365}{55.65}$$

Where:

EF = methane emission factor, kg CH_4 /head /yr

GE = gross energy intake, MJ /head /day

Y_m = methane conversion factor, %

55.65 = the energy content of methane, MJ /kg CH_4

Users can assume that the emission factor remains constant over the baseline assessment period (static baseline emission factor), or that the emission factor changes over time (e.g., dynamic baseline emission factors). A static baseline emission factor indicates that there is no change in the agricultural practice during the baseline period. A dynamic baseline emission factor can be appropriate if the productivity of livestock systems (e.g., through breeding, improved livestock husbandry, pasture management, or feed quantity or quality) are expected to change significantly over the baseline period.

Box 7.1: Choosing a static or dynamic baseline emission factor

A static baseline emission factor implies that without the policy, the productivity of livestock systems (e.g., live-weight gain, milk yield, reproductive performance) does not change at all over time. In some situations, this assumption may be correct or can be justified because any changes in livestock systems are likely to be small.

However, the productivity of livestock systems has changed significantly in many regions over the past few decades, owing to general rural development programmes, including the use of new or cross-bred species, improved pasture management, livestock husbandry practices and use of new feed resources. Such improvements are likely to continue, and will result in changes to emissions per animal. Where this is the case, a dynamic baseline emission factor will be necessary to accurately capture changes in livestock emissions likely to occur in the absence of policy, and to avoid systematically over- or underestimating the change in emissions that can be attributed to the policy. Such trends are especially important over extended time horizons of 10 years or more into the future.

While a dynamic baseline emission factor is always desirable because it more accurately reflects any changes likely to occur in the baseline, judgment will be required to determine whether it is indeed necessary. An uncertainty assessment (see Chapter 12 of the *Policy and Action Standard*) can be used to compare the magnitude of the ex-ante emission reductions resulting from the policy with the potential changes in emissions resulting from improvements in livestock systems in the baseline. Where baseline changes constitute a significant fraction of the change achieved by the policy (e.g., greater than 10%), a dynamic baseline emission factor should be developed.

Uncertainty assessments can be made even in the absence of complete data, using preliminary Tier 2 emission factors for the baseline and the policy scenario, and using expert judgment and defaults to fill data gaps. If this preliminary uncertainty assessment indicates that a dynamic baseline emission factor is indeed required, users can decide to invest appropriate resources to obtain better activity data and fill data gaps.

7.2.5 Calculate GHG emissions

It is a *key recommendation* to calculate the cumulative GHG emissions for the baseline scenario over the assessment period. This is done by applying the species-specific emission factors to each species in the forecasted livestock population to derive the baseline emissions over the assessment period.

Annual enteric fermentation emissions from a livestock category are calculated as follows:

$$Total\ annual\ CH_4\ Emissions\ = \sum_t^i EF_t \times N_t$$

Where:

Total annual CH_4 Emissions = total methane emissions from enteric fermentation, kg CH_4 /yr

EF_t = emission factor for the defined livestock population, kg CH_4 /head /yr

N_t = the number of head of livestock per category t in the country, head

t = livestock category or subcategory

i = the number of livestock categories in the characterisation

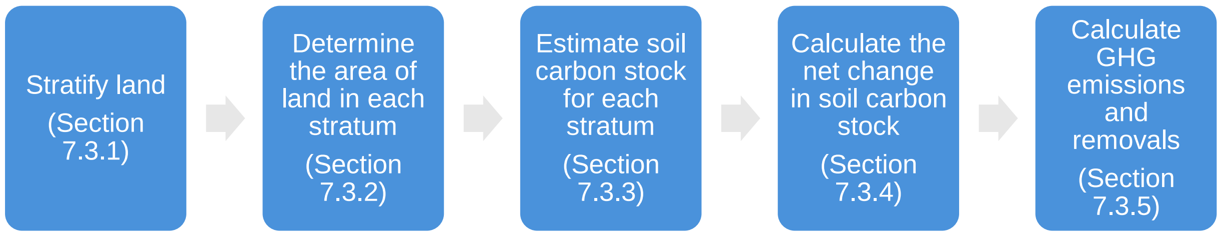
Convert CH_4 to CO_2 equivalent (CO_2e) based on the 100-year global warming potential (GWP) of CH_4 and multiply by 0.001 to convert kg to tonnes. Sum the annual emissions over all years in the assessment period to yield total cumulative emissions.

7.3 Estimate baseline soil carbon sequestration

This section provides guidance on estimating the GHG emissions and/or removals from soil carbon for the baseline scenario. The baseline scenario can be estimated ex-ante or ex-post. Figure 7.4 outlines the steps in this section.

The guidance can also be used to estimate GHG emissions and/or removals from soil carbon for the policy scenario. To estimate policy scenario emissions and/or removals, use the same method that was used to estimate baseline emissions and/or removals with new parameter values (land-use strata and land area in each strata) derived following the guidance in Sections 8.2 – 8.5 and, if relevant, new emission factors that represent conditions under the policy scenario. The policy scenario can be estimated ex-ante or ex-post with these methods.

Figure 7.4: Steps for estimating the baseline emissions for soil carbon



Changes in land use can lead to a decrease or increase in soil carbon, and thereby to GHG emissions or GHG removals, respectively. For example, conversion of grassland to cropland usually results in a net loss of carbon from soils. However, cropland established on previously sparsely vegetated or highly disturbed lands (e.g., degraded lands) can result in a net gain in soil carbon and biomass (the latter if there is perennial woody vegetation in the cropland system).

Where land use remains the same in the baseline and policy scenarios (e.g., cropland remaining cropland or grassland remaining grassland), changes in management (e.g., switching from conventional tillage to no till practices or from intensive grazing to rotational grazing practices) can result in net increases or decreases in soil carbon.

The impact of changes in land use and management lasts for approximately 20 years, or until a new change occurs. Where no changes in land use or management have occurred in the past 20 years, carbon stocks in the soil can be assumed to remain constant (i.e., at equilibrium with no net emission or removal of CO_2).

The key parameters for estimating baseline emission reductions and removals are:

- **Areas of land in land categories**: Hectares of land in land categories such as forestland, cropland, grassland, wetlands, settlements or other land divided into subcategories for climate zone, soil type, and management practices.
- **Representative soil carbon stocks**: A factor that represents the average soil carbon stock for a particular land category.

The IPCC Tier 1 and Tier 2 methods are the basis for the guidance below. The Tier 1 and 2 methods assume a constant annual change in soil carbon stocks over a 20-year default time period, based on a constant soil carbon stock change factor, which is derived from land use and land management trends. Therefore, Tier 1 and Tier 2 methods represent land-use and management impacts on soil carbon stock as a linear shift from one equilibrium state to another.

The Tier 1 method can be readily adapted to a Tier 2 method by using country-specific data in place of Tier 1 defaults and therefore is expected to provide more accurate results; however, Tier 2 still employs the same linear assumptions as Tier 1.

Tier 3 methods may also be used to estimate baseline and policy scenario changes in soil carbon stocks. Tier 3 methods involve advanced measuring, monitoring, and estimation systems that will capture year-to-year variability in soil carbon fluxes. Tier 3 methods are able to address non-linear relationships, represent soil carbon dynamics at shorter time scales than 20-years and are capable of capturing longer-term legacy effects (i.e., effects from longer than 20-years in the past) of land use and management.

7.3.1 Stratify land

It is a *key recommendation* to stratify land by IPCC land-use category and soil management practices. Following guidance in Section 6.1.1, Step 3, users should have identified the affected land categories where soil carbon management impacts are expected to occur under the policy scenario. For each affected land category in the GHG assessment boundary, identify the climate regions, soil types and management categories that occur on those lands in the baseline scenario.

A list of example climate region, soil type and management categories are provided in Table 3.1 of the IPCC 2006 GL, Volume 4, Chapter 3. The definitions of the categories are explained in Annex 3A.5. Additional management categories for cropland and grassland are provided in the Tables 5.5 and 6.2 of the IPCC 2006 GL. Where using the Tier 1 estimation methods described in Section 7.3.3, management categories should correspond to relative stock change factors developed by the IPCC.

Stratify land following the guidance on land stratification provided in the IPCC 2006 GL, Volume 4, Chapter 3. The approaches for land stratification range from simple (Approach 1) to complex, requiring spatially explicit data sets derived from remote sensing (Approach 3). Where users are relying on datasets prepared for other purposes (such as forest and agriculture census data or land cover maps showing one point in time) Approach 1 for land stratification may be the best option.

Where relying on Approach 1, the land categories are simplified to cropland, grassland and forest land at a given point in time (without regard to prior land use). Users need data on the area of land in each strata. Where data on conversions between land categories (i.e., land remaining in a land-use category and land converted to a new land-use category) is not available, it is still possible to assess impacts with an Approach 1 stratification following the methods in Section 7.3.2.

7.3.2 Estimate the area of land in each stratum

It is a *key recommendation* to estimate the area of land in each stratum. To determine the soil carbon stock of each stratum for the baseline scenario, it is important to understand how the land-use and management practices are expected to evolve in the absence of the policy.

Estimates for the hectares of land in a land stratum should be derived from national data sources that are widely accepted among policymakers and endorsed by the government. Potential data sources include ministry of agriculture or forests, national agricultural or forest research institutes, and international agencies (e.g., FAO). Relevant land area data compiled for the national GHG inventory is also useful. These data sources will typically provide information on historical and current land area.

Where historical and current data are available, they can be used to estimate the hectares of land in each stratum for the baseline scenario following any one of the approaches for determining the baseline scenario in Section 7.1.1. Further guidance on using the baseline approaches to estimate area of land in each stratum is provided below:

- **Constant baseline**: Assume that the current percentage of land in each stratum remains unchanged over the period of the baseline scenario. This assumption is suitable where future land use is unknown.

- **Simple trend baseline:** Recognising that land can transition between use and management categories, the baseline scenario can be estimated by continuing historical trends. Users can assume that the historical trend for the change in land area between strata evolves in the same way into the future.

  An example for how to do a simple trend extrapolation using an Approach 1 land stratification follows. Estimate the hectares of land in each stratum for at least two points in time in the past. For each stratum, calculate the change in area over time and divide by the number of years in the time period to give the historical average annual rate of change in area for that stratum (ha/year). Use the simple trend to estimate future land area in each strata (see Table 7.1 and Table 7.2 for examples of how to do this). Datasets from multiple sources may need to be combined to cover all of the strata in the land classification developed following Section 7.3.1.

  Table 7.1 shows land area data (hypothetical), according to an Approach 1 land stratification for two past points in time that are 20 years apart. From these data, one can calculate the annual average rate of change in area of a given strata (see the last column).

  Table 7.2 shows how historical land area change rates are used to extrapolate the amount of land in each category into the future. Note that if the total land area changes in the extrapolation, there is an inconsistency in the data or error in the projection.

Table 7.1: Example area estimates at two points in time in the past

Strata	Area at time $T_{(0-20)}$ (million ha)	Area at time $T_{(0)}$ (million ha)	Average annual change over 20 yrs (million ha/yr)
Grassland (moderately degraded)	10	7	-0.15
Grassland (improved)	2	5	0.15
Cropland (intensive till)	5	10	0.25
Forest	20	15	-0.25
TOTAL	37	37	0

Table 7.2: Future extrapolation of land areas for next 1 to 20 years (million hectares)

Strata	$T_{(1)}$ (million ha)	$T_{(20)}$ (million ha)
Grassland (moderately degraded)	6.85	4.0
Grassland (improved)	5.15	8.0
Cropland (intensive till)	10.25	15.0
Forest	14.75	10.0
TOTAL	37	37

- **Advanced trend baseline**: Assume that certain land-use strata decrease more or less than others. This assumption is appropriate when a simple forward extrapolation of historical land data results in changes deemed unrealistic, such as a complete loss of forests. In this approach, users can adjust annual average changes in particular categories based on expert judgment.

7.3.3 Determine soil carbon stock for each land stratum

It is a *key recommendation* to determine the soil carbon stock for each land stratum. Determine a representative soil carbon stock value (tC/ha) for each land stratum using either a Tier 1 or Tier 2 approach. The two approaches are further described below:

- **Tier 1**: The representative soil carbon stock (tC/ha) for each stratum is calculated by multiplying a reference soil carbon stock with stock change factors. The reference soil carbon stock represents the average soil carbon stock that would occur on unmanaged soils in a given climate zone for a given soil type. The stock change factors adjust the reference soil carbon stock up or down based soil management practices. There are three types of stock change factors: stock change factor for land-use systems or sub-systems (F_{LU}); stock change factor for management regime (F_{MG}); and stock change factor for inputs of organic matter (F_I).

  IPCC default reference soil carbon stock values are available in Table 2.3 of the IPCC 2006 GL, Volume 4, Chapter 2. These are based on climate region and soil type. Relative stock change factors are provided in Table 5.5 for cropland and Table 6.2 for grassland in the IPCC 2006 GL, Volume 4, Chapters 5 and 6. Where there is not a default IPCC stock change factor that is suitable for the conditions in the country use a factor of "1".

  Table 7.3 provides an example for how to prepare a Tier 1 estimation of representative soil carbon stocks for the strata in the example above. This simple example assumes the entire GHG assessment boundary is in a tropical moist climate zone with high activity clay (HAC) soils.

  Table 7.3: How to estimate representative soil carbon stocks using IPCC Tier 1

Land-use category	**Reference soil carbon stock**	**Stock change factors**			**Representative soil carbon stock**
	***SOCref* (tC/ha)**	F_{LU}	F_{MG}	F_I	***SOC* (tC/ha)**
Grassland (moderately degraded)	65	1	0.97	1	63.05
Grassland (improved)	65	1	1.17	1	76.05
Cropland (intensive till)	65	1	1	1	65.00
Forest	65	1	1	1	65.00

- **Tier 2**: Where country-specific representative soil carbon stock values are available (e.g., from a national GHG inventory or scientific research studies occurring within the geographic region of the country), they can be used. Tier 2 approaches can combine some Tier 1 defaults with country-specific factors. For example, if data are available to derive country-specific reference soil carbon stocks, these can be used with the IPCC default stock change factors for a Tier 2 estimate. Generally, Tier 2 representative soil carbon stocks are more accurate than Tier 1 representative soil carbon stocks.

7.3.4 Calculate the net change in soil carbon stock

It is a *key recommendation* to calculate the net change in soil carbon stock over the assessment period. Two approaches are described below for calculating the net change in soil carbon stock.

Where the baseline scenario is a constant baseline, then land area in each land stratum stays the same for the duration of the assessment period. In this case, carbon stocks are in a steady state and there is zero net change in soil carbon stocks over the assessment period for the baseline.

Where the baseline scenario is a simple or advanced trend baseline for changes in land use and management, calculate the baseline change in soil carbon stock over the assessment period for each land stratum following the steps below. In this case, changes in soil carbon stocks occur over the assessment period because of shifts in land area between categories of land use and management over the assessment period. An example calculation of these steps is provided in Table 7.4.

1. Multiply the representative soil carbon stock (tC/ha) by the land area (ha) for each land stratum at year 0 ($T_{(0)}$); this yields the total soil carbon stock (tC) of that land stratum at the beginning of the assessment period or for the reference year of the policy.
2. Sum total soil carbon stocks across all the strata to yield a total soil carbon stocks in all land in the GHG assessment boundary at the beginning of the assessment period or for the reference year of the policy.
3. Repeat steps 1 and 2, for the end of the assessment period ($T_{(x)}$), to yield a total soil carbon stock for all land in the GHG assessment boundary at the end of the assessment period. The example in Table 7.4 is based on a 20-year assessment period ($T_{(x)} = T_{(20)}$).
4. Subtract the total soil carbon stock at the beginning of the assessment period from total soil carbon stock at the end of the assessment period (i.e., $SOC\ T_{(x)} – SOC\ T_{(0)}$); this yields the baseline net change in soil carbon stock over the entire assessment period. Positive values indicate net gain of carbon in soils over time and negative values indicate a net loss of carbon from soils over time.

Table 7.4: Example of calculating the total net change in soil carbon stock over time using IPCC Tier 1

Land-use category	Representative soil carbon stock (tC/ha)	Land Area (million ha)		Total soil carbon stock (million tC)		Net change in soil carbon stock (million tC)
		$T_{(0)}$	$T_{(20)}$	$T_{(0)}$	$T_{(20)}$	
Grassland (moderately degraded)	63.05	7	4	441.4	252.2	
Grassland (improved)	76.05	5	8	380.3	608.4	
Cropland (intensive till)	65.00	10	15	650.0	975.0	
Forest	65.00	15	10	975.0	650.0	
Total				2,446.6	2,485.6	39.0

In the example above, total soil carbon stock increases over time in the baseline scenario by 39 million tonnes of carbon. The net increase in soil carbon stock over time is most likely explained by management changes. Grasslands that were formerly moderately degraded appear to come under improved management by the end of the period because there are 3 million more hectares of improved grassland and 3 million less hectares of degraded grassland at the end of the period. In addition, the improved grasslands have a higher representative soil carbon stock than degraded grasslands. The data also suggests that land use changed from forest to intensively tilled cropland. But, because the representative soil carbon stocks values are the same for forests and intensively tilled croplands, this type of transition is not causing the total net change in soil carbon stock.

7.3.5 Calculate GHG emissions and removals

It is a *key recommendation* to calculate the cumulative GHG emissions and removals for the baseline scenario over the assessment period. This is done by converting the total net change in soil carbon stock to CO_2e emissions in tonnes by multiplying the total net change in soil carbon stock by 44/12 and by -1. This yields total cumulative CO_2e emissions (positive) or removals (negative) for the baseline, meaning the amount of CO_2e emissions and removals that occurred over the assessment period in the baseline.

Average annual emissions and removals can also be calculated by dividing the cumulative CO_2e emission or removals by the time interval of the assessment period (i.e., 20 years). In the example above, cumulative CO_2e removals are calculated as follows:

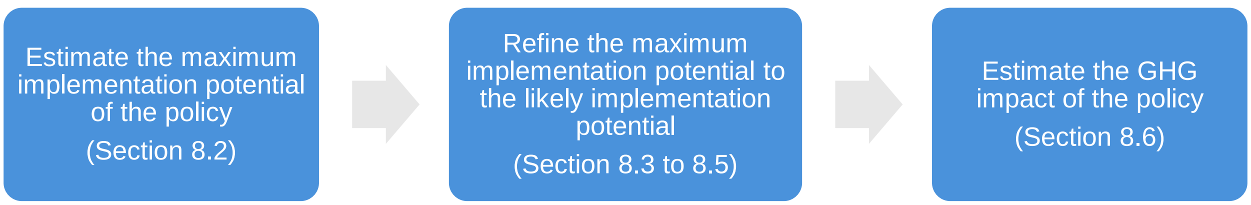
39.0 million tC x (44/12) x (-1) = -143 million tCO_2e

8. ESTIMATING GHG IMPACTS EX-ANTE

This chapter describes how to estimate the expected future GHG impacts of the policy (ex-ante assessment). Users estimate the maximum implementation potential of the policy based on the causal chain that was developed in Chapter 6. Then users evaluate how barriers to implementation and other factors may limit its overall effectiveness, and determine the likely implementation potential of the policy. The likely implementation potential represents the effects that are expected to occur as a result of the policy (most likely policy scenario). Implicitly, these effects are relative to the baseline scenario.

There are two ways that users can estimate the GHG impacts of the policy scenario based on the implementation potential of the policy. Using the emissions approach, the GHG impacts are estimated by subtracting the baseline emissions (as determined in Chapter 7) from policy scenario emissions (as determined in this chapter). Alternatively, users estimate the relative change in GHG emissions based on the likely implementation potential of the policy, using the activity data approach.

Figure 8.1: Overview of steps in the chapter



Checklist of key recommendations

- Determine the maximum implementation potential of the policy
- Analyse policy design characteristics and national circumstances that may reduce the effectiveness of the policy, and account for their effect on the maximum implementation potential
- Analyse the financial feasibility of the policy for each stakeholder group, and account for the effect on the implementation potential of the policy
- Analyse other barriers that could reduce the effectiveness of the policy and account for their effect on the implementation potential
- Estimate the GHG impacts of the policy

8.1 Introduction to estimating the implementation potential

The policy scenario represents the events or conditions mostly likely to occur in the presence of the policy being assessed. The guidance focuses first on estimating the *maximum implementation potential* of the policy. The maximum implementation potential of the policy assumes that all inputs, activities and intermediate effects in the causal chain are highly likely to occur as planned and at the implementation level intended by the policy. It represents the intended policy outcome or policy effectiveness. The maximum implementation potential is then refined to the likely implementation potential (e.g., most plausible policy scenario) by taking into account factors that could reduce the effectiveness of the policy.

Guidance is provided in the subsequent sections on how to estimate the implementation potential of the policy based on policy design characteristics and national circumstances (Section 8.2), financial feasibility

(Section 8.3), and other barriers (Section 8.4). Figure 8.2 outlines the steps to this process. Most of the analysis in Sections 8.2 – 8.5 will be qualitative and require expert judgment, expert elicitation and/or stakeholder input. Guidance on expert judgment is provided in Section 4.2.4.

Figure 8.2: Overview of steps for estimating the likely implementation potential of the policy

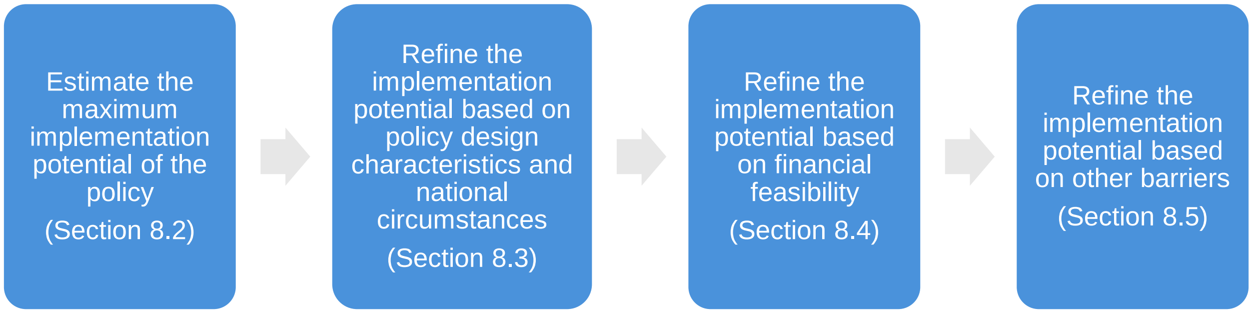
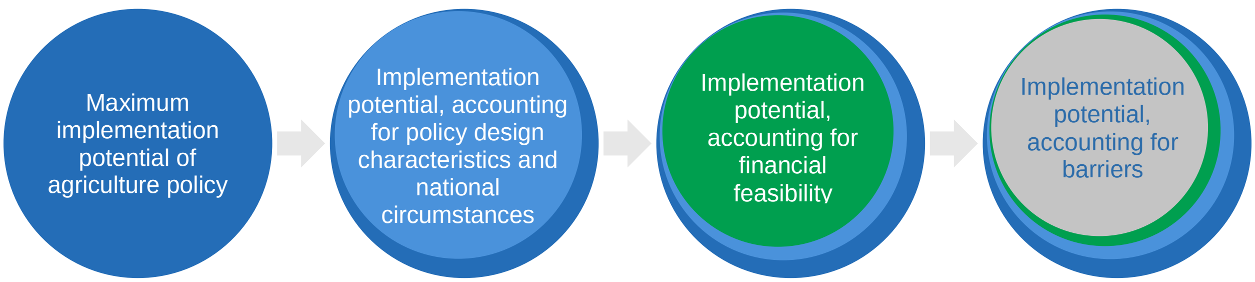


Figure 8.3 illustrates how the maximum implementation potential of the policy is refined after each step to achieve a more realistic estimate of the implementation potential. It is possible that the policy's likely implementation potential could exceed the estimated maximum implementation potential. This could occur where policies have a reinforcing effect (as discussed in Section 5.2).

Figure 8.3: Refining the maximum implementation potential to the implementation potential



These steps focus on estimating the implementation potential of the policy in terms of activity data rather than GHG emissions. Examples of such activity data are discussed in Section 8.1. The GHG impacts for each GHG source or carbon pool in the GHG assessment boundary will be determined using the final refined estimates of the activity data after completion of the four steps, following the guidance in Section 8.5.

Where quantitative information about how a factor is likely to impact the implementation potential of the policy is available, it can be used to estimate the effect of the policy. For example, an analysis may indicate that a barrier reduces the effectiveness of the policy intervention by 5%. The reduction of the effectiveness can apply at two different levels:

- **General level**: The barrier affects the entire policy (e.g., barriers that hinder the deployment across all components of the policy). In this case, the 5% reduction applies to the overall policy effect.
- **Component level**: The barrier only affects one specific aspect of the policy (e.g., a barrier may hinder the policy implementation for only a segment of the total population, one of the land-use categories considered, some regions of the country, or the adoption rate of one agricultural practice). In this case, the 5% reduction applies only to the specific aspect of the policy affected by the barrier.

To the extent possible, identify a single policy scenario that is considered to be the most likely. In certain cases, multiple policy scenario options may seem equally plausible. Users can develop multiple policy scenarios, each based on different sets of assumptions, rather than just one set. This approach produces a range of possible emission reductions scenarios. Users can then conduct a sensitivity analysis to see how the results vary depending on the selection of policy scenario options. More guidance about conducting a sensitivity analysis is provided in Chapter 12 of the *Policy and Action Standard*.

An example is used to demonstrate how to estimate the implementation potential of a policy. A description of the example is provided in Box 8.1. The implementation potential of the example policy is assessed on the basis of the estimated number of hectares of land on which the policy will be implemented.

Box 8.1: Example of agriculture policy for national level GHG mitigation

The government is planning to put in place a national programme for Sustainable Pastures and Livestock Production (SPLP) to promote reduction of CH_4 emissions from enteric fermentation through the improvement of management practices for pastoral lands and livestock.

Through the SPLP, the government will provide incentive payments to pastoralists for the implementation of improved pasture management practices. Interventions will target beef and dairy producers whose herds are managed on small areas (less than 500 hectares) and medium-size areas (500-2,500 hectares).

The programme will start in 2021 and continue for 15 years. The government has approved USD 2 million per year for 15 years to the agriculture extension service. However, financial resources for the incentive payments to pastoralists have not been secured and efforts are currently being made to identify both national and international sources of funding.

Further details on the policy can be found in Section 5.1.

8.2 Determine the maximum implementation potential

It is a *key recommendation* to determine the maximum implementation potential of the policy. For each GHG source or carbon pool in the GHG assessment boundary, choose a type of activity data to assess the implementation potential of the policy. The type of activity data chosen should be a parameter that is expected to change as a result of the policy (e.g., the number of livestock grazing on improved pasture), and be used to estimate GHG impacts. Therefore, the activity data serves as a proxy for the policy outcome. The maximum implementation potential is expressed in terms of the activity data. Table 8.1 provides examples of the types of activity data to consider.

Table 8.1: Examples of types of activity data for analysing implementation potential

GHG source or carbon pool	Policy	Activity Data
Biomass and soil carbon	• Payments for afforestation/reforestation • Technical assistance to improve grassland productivity • Public awareness campaign to promote use of no-till agriculture	• Hectares of cropland converted to forest land • Hectares of improved grassland • Hectares of cropland under no-till cultivation
Enteric fermentation	• Technical assistance to improve feeding strategies	• Number and type of livestock receiving improved feed

The maximum implementation potential can be estimated based on a number of elements. The options include a mitigation goal, expected adoption of practices or technologies, financial considerations, land area and other resource potential, and expert judgment. Each element is further explained below. The maximum implementation potential can be estimated using a single or combination of elements. A combination will likely yield a better estimate.

8.2.1 Mitigation goal

When there is an intended level of mitigation and/or an explicit goal for the policy, the goal, along with other details of the policy, can be used to estimate the maximum implementation potential. A mitigation goal may include, among other things, the target amount of emission reductions to be reduced or carbon stocks enhanced as a result of the policy, the targeted amount of land area or adoption rate or the total expected emission reductions and removals from a specific GHG source or carbon pool. The mitigation goal may not be in the same units as the activity data, and additional information from surveys and national statistics may be needed to estimate how the goal will translate into actions or land areas. For example, an explicit goal for an agriculture policy could be to have 100% of all corn cultivated using no-till methods by 2050.

Using a stated goal as the main indication of intended policy outcomes or policy effectiveness can be highly uncertain. At a minimum, the mitigation goal needs to be specific enough to reflect an intended level of mitigation.

8.2.2 Adoption of practices or technologies

The expected level of adoption of the practice or technology that is targeted by the policy can be used to estimate the maximum implementation potential. The main assumption would be that targeted stakeholders will fully engage voluntarily, or fully comply where the policy is mandatory.

Information about stakeholders can be identified from the causal chain, policy description and other sources. It can be used to infer the amount of land area or number of livestock affected by the policy, such as:

- The stakeholders targeted by the policy
- The average sized parcel of land owned or utilised by a stakeholder group

- The typical amount of forest products extracted or crops produced per person
- The number of cattle or other animals managed by stakeholders in a specific region

8.2.3 Financial considerations

Comparing the cost of implementing mitigation practices or using technology (e.g., $/head to provide a feed supplement to livestock) to the total financing available for the policy can be used to estimate the maximum implementation potential. Information on the unit cost of implementing new technologies or practices might be available through studies that have been commissioned and funded by the government, an international organisation or academia. Where unit cost information is not available, other sources can be used as a first approximation, including the following:

- Consultations with stakeholders on costs in different parts of the country and for different activities (such information could also be derived from scientific journals)
- Figures obtained from marginal abatement cost curve models or from articles or studies published in scientific journals

Where unit cost figures are derived from global data, journals or studies relating to other countries, users should ensure that unit cost information is suitable or representative of national circumstances.

Users also need an indication of the financial resources that will be allocated to a specific policy from the national budget and other funding sources (e.g., private sector, national or international donors, or international or regional funds) to estimate implementation potential from financial data. This information may be available from the description of inputs developed in Section 6.1.1, Step 2.

The unit cost combined with total investment level can be used to estimate maximum potential implementation levels. For example if a policy includes plans to invest USD 1 million in reducing enteric fermentation in dairy cattle and it costs USD 100 per head of cattle to implement, the maximum implementation level of the policy can be estimated as 10,000 cattle. Ideally this value would be reconciled with an estimate of the total number dairy cattle in the country to ensure that it is realistic to assume at least 10,000 cattle could be targeted by the policy measures.

Note that this analysis focuses on policy-level financing (e.g., national and sectoral-level). Guidance is provided in Section 8.2.3 for how to assess the financial feasibility of a policy from the perspective of landowners.

8.2.4 Land area and other resource potential

Analysing the availability of land is another way to estimate maximum implementation potential, meaning identifying the total area of land upon which there is technical potential for a specific mitigation practice or land-use change to occur. The assumption would be that all available land is affected by the change in management or land use as a result of the policy. For example, if a policy aims to convert highly degraded pasture to productive silvopastoral systems, and there are 50,000 hectares of highly degraded pasture within the policy jurisdiction, assume the policy will result in 50,000 hectares of pasture land used for silvopasture.

To use this approach for estimating maximum implementation potential, information on current land management and land uses is needed. Such data can be found in or derived from the following sources:

- National land cadastre
- National agricultural census data
- Land-use titles
- Local or regional land registration offices
- Farmer or logger associations

Analysing the technical potential of other resources besides land area can be used to estimate adoption rates for new practices or technologies. For policies that reduce emissions from enteric fermentation, the total number of livestock in the country or the total number of ranchers could be used to analyse the maximum implementation potential. For example, if a policy seeks to increase use of feed supplements in dairy cattle, it can be assumed that all dairy cattle within the policy jurisdiction will receive the feed supplements as a result of the policy.

8.2.5 Expert judgment

Expert judgment can be paired with any of the approaches above to derive an informed estimate of the maximum implementation potential. Sector specialists (e.g., farmers, ranchers, foresters, scientists who study the technologies or practices promoted by a policy, statisticians, and government staff familiar with the policy) can help to fill gaps in available data or provide a range for the maximum implementation potential. Experts can also help users identify suitable values of the policy outcome or policy effectiveness from estimated ranges. When consulting experts, information can be obtained through an expert elicitation process (described in Section 4.2.4).

8.2.6 Example of determining maximum implementation potential

The SPLP policy seeks to engage pastoralists in adopting more efficient land and livestock management practices to improve the quality of forage for livestock on pasture, through: (a) improved herd management strategies, (b) improved pasture management, and/or (c) improved silvopastoral systems.

Based on data from the latest national agriculture census, non-federally owned pasture cover approximately 34 million hectares (ha). The programme focuses on the improvement of pasture management on 3.5% of the eligible land (i.e., approximately 1.2 million hectares), which have been identified as the most vulnerable to degradation from overgrazing and mismanagement. On those lands, the average animal density is about 0.9 head/ha (higher than the national average of 0.6 head/ha) and no rotational grazing best practices are used.

Because the policy is formulated around pasture land and livestock management, the activity data chosen to determine the maximum implementation potential are land area and number of livestock. The maximum implementation potential in terms of the amount of land affected by the policy is 1.2 million hectares and in terms of total number of cattle affected is 1.08 million, over 15 years (Table 8.2).

The National Agriculture Agency is planning to engage farmers in voluntary contracts over 15 years. Pastoralists will receive annual payments for the first five years of participation to improve management practices for their land and livestock. Payments will range from USD 50/ha to USD 100/ha, and participation will be capped to keep the programme costs under USD 400 million over 15 years. An additional USD 2 million per year for 15 years will be made available to the agriculture extension service to provide training and support to participating pastoralists.

Table 8.2: Example of maximum implementation potential

Activity data	Maximum implementation potential
Implementation area (ha)	1,200,000
Number of animals (head)	1,080,000

8.3 Account for policy design characteristics and national circumstances

It is a *key recommendation* to analyse policy design characteristics and national circumstances that may reduce the effectiveness of the policy, and account for their effect on the maximum implementation potential.

Section 8.3.1 provides a method for analysing policy design characteristics and national circumstances that may reduce the effectiveness of the policy (Step 1) and estimating their effect on maximum implementation potential (Step 2). Section 8.3.2 provides some further guidance to help with this analysis. Section 8.3.3 provides a worked example to illustrate the steps.

8.3.1 Method for accounting for policy design characteristics and national circumstances

Step 1: Analyse policy design characteristics and national circumstances

Compile information on the policy design characteristics and national circumstances using the questions provided in Table 8.3. The questions relate to the effect of policy design characteristics and national circumstances on policy effectiveness. The questions can be revised or further questions can be added, as needed, to ensure that the analysis is relevant to policy and national circumstances.

Information can be gathered through expert elicitations with administration and government experts that are directly or indirectly involved in the policy under consideration, desk reviews and stakeholder consultations. Refer to the ICAT *Stakeholder Participation Guidance* (Chapter 8) for further information on designing and conducting consultations with stakeholders.

Answer each question and score each response based on its potential to have a positive or negative effect on the effectiveness of the policy, on a scale of 1 to 4, as follows:

1 = Likely to have a positive (reinforcing) effect

2 = Likely to have no effect (no discernible positive or negative effect)

3 = Likely to have a negative effect

4 = Unknown

Table 8.3: Questions for identifying policy design characteristics and national circumstances

1. Institutional arrangements and national circumstances	
a.	Can the policy be implemented with existing governance structures, institutional arrangements and legal mechanisms?
b.	Is there corruption in the areas or regions under consideration, and if so, how extensive?
c.	Is there clear title and rights to stakeholders receiving the benefits offered by the policy?
d.	How well will the levels of governance that influence land use be able to coordinate to achieve the intended outcome?
e.	How well can coordination (e.g., resources, enforcement or data sharing) be carried out at subnational levels (e.g., between local municipalities), if necessary, according to the policy?
2. Participation requirements	
a.	Is participation or compliance with the policy voluntary or mandatory?
3. Compliance monitoring and enforcement	
a.	Is there a monitoring programme planned or in place to inspect policy implementation?
b.	Is there an enforcement measure that is part of the policy? If so, to what degree are similar standards, rules and regulations enforced and how?
4. Complementarity and synergies	
a.	To what extent will supporting or complimentary policies and actions in effect during the policy implementation period improve policy effectiveness?
b.	To what extent is the policy part of an interdisciplinary approach linking food security, ecosystem services and/or sustainable development?
c.	Are there supportive measures in place to build the capacity and technical skills in affected stakeholders who will be implementing the policy?
5. Policy implementation risks	
a.	To what extent are the intended policy outcomes vulnerable to risks (including natural events and disasters) that could jeopardise or reverse the policy outcomes?
b.	Have research and pilot studies been conducted in the areas where the policy will be implemented and do they demonstrate that the expected outcomes of the policy are feasible?

Step 2: Evaluate the overall distribution of scores and estimate the effect on maximum implementation potential

Once policy design characteristics and national circumstances have been scored, evaluate the overall distribution of scores:

- A distribution with many scores of 1 or 2 indicates less need to refine the estimated maximum implementation potential of the policy.

- A distribution with many scores of 3 or 4 could suggest a downward adjustment of the maximum implementation potential or gathering more information and reassessing the impact, especially for scores of 4.

Carefully review each score of 3. Consider and, if possible, estimate to what extent the factor will decrease policy effectiveness. Describe and justify the reduction. In addition, look for crucial problems that have the potential to render the policy ineffective. If even one crucial problem is identified, it is recommended to reconsider the policy design. It is recommended to identify, where possible, potential corrective action to minimise the negative impacts. For example after following the guidance in this section the user may reduce the geographic scope of impact, reduce the expected adoption rates or delay the timing of the implementation of a policy.

For scores of 4, attempt to gather enough information to assess the effect of the factor. If that is not possible, it is conservative to assume it will have a negative effect.

A positive impact may reinforce the implementation of the policy through, for example, synergetic effects between policies. Where a situation may increase policy effectiveness, it is conservative to not estimate any potential positive impact or make any positive adjustments to the expected policy outcomes.

8.3.2 Considerations for accounting for policy design characteristics and national circumstances

This section describes a number of considerations to bear in mind when following the steps in Section 8.3.1.

Institutional arrangements and national circumstances

Institutional arrangements are formal or informal legal and procedural agreements between agencies executing a policy. They can include arrangements between government agencies or with government and non-government or private sector agencies. National circumstances are the conditions present in the country. They include, among others, the government structure, population profile, cultural context, geographic profile, climate profile and the structure of the economy.

Lack of a governance structure, coordination between national and subnational levels, and legal basis for providing incentives to stakeholders are critical considerations that can inhibit the successful implementation of the policy if not addressed appropriately. In countries without established institutional arrangements or an effective legal framework to secure the cooperation between different government levels and the involvement of key stakeholders (including private, public or non-governmental), policies will likely be limited in their effectiveness.

Many ministries or other government agencies often have difficulties in hiring and retaining new staff primarily due to budgetary and administrative constraints. Where staff and infrastructure (e.g., offices, equipment, vehicles or fuel) necessary for the policy implementation are not in place prior to policy implementation, policy implementation may not move forward as expected, reducing the effectiveness of the policy.

Corruption in national or subnational government structures can also play a detrimental role in the implementation of the policy. Corrupt practices may involve politicians, local leaders, governmental and/or non-governmental actors and result in implementation problems relating to land concessions, the allocation of contracts (e.g., favouring friends or relatives), allowing illegal practices (e.g., logging without permits), and misuse of funds intended for the policy.

Participation requirements

Participation in the policy, by people or organisations, can be voluntary or mandatory. Voluntary participation relies on the willingness of stakeholders to respond to a policy, offers flexibility in terms of who participates and how, and can involve less oversight and enforcement. In the absence of strong incentives, voluntary participation is unlikely to result in high participation and is more likely to result in a policy whose impacts are indistinguishable from the baseline scenario. Other factors that can help or hamper participation include effective communications and training for target stakeholder groups.

Mandatory participation can be accompanied with specific obligations and can be enforced through strict procedures, including penalties for cases of non-compliance. Mandatory participation works better in cases where the progress of the policy implementation can be effectively monitored and enforced. However, bribery and corruption could reduce the potential impact of the policy.

Compliance monitoring and enforcement

Monitoring and enforcement are mechanisms to compel stakeholders to comply with a policy. Monitoring is the process of inspecting that the policy is being implemented and enforcement is an action taken against those who are not in conformance with the policy. The policy may include measures to monitor and/or enforce policy implementation.

When stakeholders understand that policy implementation will be monitored, it is more likely that implementation will occur. If monitoring procedures are already in place or are planned (e.g., due to the existence of other similar policies or projects in a region), this should be taken into account, as it can help ensure that the policy is implemented effectively. In the absence of monitoring procedures, the policy may not be implemented as effectively as expected.

Local enforcement agencies and other stakeholders should be consulted to determine the likelihood that standards, rules or laws will be enforced. The likelihood of enforcement (e.g., 90% chance of enforcement) should then be used to refine the implementation potential of the policy (e.g., reduce the impact by 10%). If penalties for non-conformance with the policy are minor, enforcement may not be as effective at ensuring compliance.

Complementarity and synergies

GHG mitigation policies that contribute to local sustainable development and promote better local conditions are far more acceptable to local communities and usually have a far better chance of uptake and success (e.g., policies that have health benefits due to reduction of local air pollution, reduce loss of biodiversity, address desertification issues, protect water resources, or improve food security for poor communities).

The implementation of GHG mitigation policies can be positively or negatively affected by other complementary policies. For example, a policy to reduce water pollution from agricultural runoff may drive changes in land management that reduce fertiliser use and increase use of cover crops, which are practices that can reduce N_2O emissions from soils and increase soil carbon sequestration.

Interventions that provide education and technical assistance do not reduce GHG emissions directly. However, they may be pivotal in developing the capacity of land managers to implement new technologies and practices that reduce GHG emissions. Therefore, the presence of such interventions can be synergistic with GHG mitigation policies.

Policy implementation risks

Agriculture and forest productivity are greatly impacted by weather conditions, climate and water. Food, forests and wood production are often impacted by natural events and disasters. For example, forest fires, floods, droughts, extreme weather events (e.g., hurricanes and tornadoes), diseases and pests can have negative consequences.

The assessment should consider the effect of natural events and disasters. If areas that are known to be prone to extreme conditions are included in the geographic scope of the policy, the expected implementation potential of the policy impacts should be reduced because the policy will likely be ineffective in those areas. However, even if there is no previous history of disaster risk, users may still consider reducing the implementation potential of the policy to account for unanticipated disasters.

The evaluation should also consider the risk that the policy will not be as successful as anticipated at reducing GHG emissions as a result of limited data and research. For example, where research and pilot studies have not been conducted in the areas where the policy will be implemented there is risk that implementation and/or impacts of the policy will be hampered by lack of experience and proof of concept, and this could reduce policy effectiveness.

8.3.3 Example of accounting for policy design characteristics and national circumstances

The screening questions from Table 8.3 were reviewed and policy design characteristics and national circumstances were analysed (Step 1). Three of the questions related to institutional arrangements and national circumstances were considered to be not relevant. Extensive consultation with experts resulted in responses and scores shown in Table 8.4 below.

Table 8.4: Example of accounting for policy design characteristics and national circumstances

1. Institutional arrangements and national circumstances		**Score**
a.	*Can the policy be implemented with existing governance structures, institutional arrangements or legal mechanisms?* The Agriculture Extension Agency has worked effectively with pastoralists for decades. Agriculture extension specialists will conduct routine site visits to assist with implementation of management plans drawn by participating pastoralists. There is past experience with the participation of farmers in government-funded projects relating to land management.	1
b.	*Is there corruption in the areas or regions under consideration, and if yes, how extensive?* Corruption is generally a problem in the country. However, the direct involvement of individual farmers/pastoralists (instead of associations or collaboratives that have chronic corruption issues) is expected to minimise any negative impacts on the policy implementation. After consulting with local agricultural offices, it became clear that in certain parts of the country (comprising approximately 45,000 ha) it will not be possible to directly involve pastoralists because of corruption, in which case it was assumed that any funds provided in those regions would not result in the expected policy outcomes	3
c.	*Is there clear title and rights to stakeholders receiving the benefits offered by the policy?*	N/A

d.	*How well will the levels of governance that influence land use be able to coordinate to achieve the intended outcome?*	N/A
e.	*How well can coordination (e.g., resources, enforcement or data sharing) be carried out at subnational levels (e.g., between local municipalities), if necessary, according to the policy?*	N/A
2. Participation requirements		
a.	*Is participation or compliance with the policy voluntary or mandatory?* Because of the voluntary nature of the policy, experts believe that only about 75% of the targeted pastoralists will be willing to participate owing to the financial incentives (the government payment of USD 50/ha to USD 100/ha corresponds to a 2.5-5% increase of income) in addition to the expected productivity gains. These pastoralists manage about 93% of the total target area and about 90% of the number of animals.	3
3. Compliance monitoring and enforcement		
a.	*Is there a monitoring programme planned or in place to inspect policy implementation?* Yes, the agriculture extension specialists will monitor with site visits.	1
b.	*Is there an enforcement measure that is part of the policy? If so, to what degree are similar standards, rules, and regulations enforced and how?* Agriculture extension specialists will conduct routine site visits to monitor implementation of the policy. If site visits reveal implementation has not occurred or not occurred effectively, future payments will be withheld. It is highly likely to be enforced. There are no similar standards, rules or regulations to compare to.	2
4. Complementarity and synergies		
a.	*To what extent will supporting or complimentary policies and actions in effect during the policy implementation period improve policy effectiveness?* The Climate-Smart Agriculture programme aims to reduce GHG emissions from agriculture and deforestation through capacity building in a region containing 5 million ha of pasture land eligible for the SPLP programme. This may have a slight positive impact in the region, but it represents such a small fraction of the eligible land, that the impact on policy effectiveness is probably very minimal.	2
b.	*To what extent is the policy part of an interdisciplinary approach linking food security, ecosystem services and/or sustainable development?* The policy will contribute to improving water quality as a result of better water retentions and reduced runoff. The policy is also expected to halt expansion of land degradation through agricultural intensification, which may reduce deforestation pressure in some regions.	1
c.	*Are there supportive measures in place to build the capacity and technical skills in affected stakeholders who will be implementing the policy?* The policy incorporates training and technical assistance to raise awareness and enhance technical skills of pastoralists	1
5. Policy implementation risks		
a.	*To what extent are the intended policy outcomes vulnerable to risks (including natural events and disasters) that could jeopardise or reverse the policy outcomes?* About 12% of the pastoral areas targeted by the policy are regions susceptible to wildfires due to a serious drought over the last 3 years. However, according to expert judgment, only half of that area is at risk of being destroyed by fires during the next 15 years. Should fires occur, they can damage infrastructure investments and decimate forage species, which may not re-establish	3

	without further management interventions costing time and money; it has also been established that of the high-risk area, 40% overlap with areas where corruption issues are expected (see 1c above).	
b.	*Have research and pilot studies been conducted in the areas where the policy will be implemented and do they demonstrate that the expected outcomes of the policy are feasible?* A small-scale pilot project was implemented during the period 2002-2006. The project targeted a select number of small pastoralists. The results were promising, and the experience from that project has helped with the design of SPLP.	1

The distribution of scores was evaluated (Step 2). Out of the 10 factors above, seven received a score of 1 or 2, indicating most factors considered are expected to have either a positive or no impact on the implementation of the policy. Three factors are likely to have a negative impact and received a score of 3. They were related to corruption (1b), participation requirements (2a), and policy implementation risks (5a). No factors had a score of 4.

The extent to which policy effectiveness may be reduced as a result of each factor was evaluated (Step 2). None of the factors receiving a 3 appear to be crucial problems that could completely hamper policy effectiveness. The impact on policy effectiveness was adjusted quantitatively[9]:

The exclusion of communities with corruption problems (1b), the expectation of lower than planned voluntary participation of landowners (2a), and the potential risk of disasters (5a) will all result in an overall reduction in the amount of land area where the policy is effectively implemented. Table 8.5 below summarises the estimated extent to which these factors will reduce policy outcomes.

Table 8.5: Example description and justification for reducing expected policy effectiveness

Description and justification for reducing expected policy effectiveness	**Percent reduction in policy effectiveness**	
	Land area	**Number of animals**
Reduce policy effectiveness by removing from the analysis pasture areas where farmers cannot participate directly but only through collaboratives that have a reputation for corrupt practices.	3.75%	3.75%
Experts estimate that only about 75% of pastoralists targeted will participate; therefore the policy is likely to be effective on 93% of the total area targeted and on 90% of the number of animals. Reduce the estimated area affected by the policy by 7% and the number of animals by 10%.	7.00%	10.00%
Six percent of the total area targeted by the policy is at risk of severe wildfires, 40% of that area overlaps with areas subject to corruptions issues, which was already accounted for in the first row of this table.	3.60%	3.60%
Total potential adjustment (percent reduction in policy effectiveness)	14.35%	17.35%

[9] In cases where quantifiable information is not available, estimated adjustments to policy effectiveness may be made using expert judgment based on the best available information. While it may be subjective, this is more conservative than not making an adjustment where the factor considered is likely to have a negative effect.

Complementarity and synergy factors 4a, 4b and 4c could create interest and possibly increase participation from farmers or pastoralists who see the benefits of the policy. However, the potential positive effect is not quantified.

At the end of the analysis, the maximum area and number of animals affected by the policy has been adjusted to reflect the quantifiable impacts of lower than originally designed participation and expected policy outcomes. The results are shown in Table 8.6 below.

Table 8.6: Example of refined implementation potential

Activity data	Maximum implementation potential	Refined implementation potential based on policy design and national circumstances
Implementation area (in ha)	1,200,000	1,027,800
Number of animals (head)	1,080,000	892,620

8.4 Account for financial feasibility

It is a *key recommendation* to analyse the financial feasibility of the policy for each stakeholder group, and account for the effect on the implementation potential of the policy.

Financial feasibility analysis determines whether enough money is being invested in the policy to ensure that stakeholders will participate or otherwise respond to the policy. Where the policy's implementation costs outweigh its benefits for a given stakeholder critical to the implementation of the policy, its effectiveness can be affected.

There is no one single way to perform a financial feasibility analysis. It may take the form of a complex and rigorous assessment (e.g., a detailed financial return on investment model) or a simple analysis (e.g., a checklist of financial costs and benefits). Determine the specific type of analysis based on the data available.

Sources of information for conducting financial feasibility are, in order of preference:

- Existing calculations of the costs and benefits of policies for an individual stakeholder that were done during the policy design phase (as long as these are deemed reliable)
- Implementation cost analyses
- Exiting national cost studies
- Global cost studies
- Expert judgment based on assessments or desk review

In the absence of other available resources, guidance is provided in the section below for performing a basic cost analysis. Section 8.4.1 provides a method for analysing financial feasibility. Section 8.4.2 provides some further guidance to help with this analysis. Section 8.4.3 provides a worked example to illustrate the steps.

Before starting the cost analysis, some questions to consider are:

- Do some stakeholders bear significant new net costs under the proposed policy? If so, which ones and what are the costs?
- Do some stakeholders realise significant new net financial gain under the proposed policy? If so, which ones and what are the gains?
- What goods and services are produced commercially from lands that are the target of the policy, both before and after policy implementation? Is production likely to increase or decrease as a result of the policy?
- Is the policy potentially in conflict with economic development?
- Will the policy strengthen important supply chains?

8.4.1 Method for accounting for financial feasibility

Step 1: Identify stakeholder groups to analyse

In Section 6.1.1, users identified the stakeholders of the policy. Those stakeholders are the focus of this analysis, in particular stakeholders that implement changes in practices, technologies or land use in response to the policy. Each stakeholder group should be included in the financial feasibility analysis and the net costs and benefits for each group considered separately. Where there is not sufficient data and information to analyse all stakeholder groups separately, at minimum include the following groups in the analysis:

- Stakeholders with official land tenure rights or de facto control of lands addressed by the policy
- Stakeholders that use the lands addressed by the policy but have limited actual control over the lands

It can be difficult to distinguish between stakeholders with official tenure to land and stakeholders that use the lands affected by the policy without tenure. In such cases, focus on the main stakeholder group that expected to implement the mitigation measures.

Step 2: Calculate net cash flows for each stakeholder group

In a basic implementation cost analysis, net cash flows are estimated for a typical stakeholder in each stakeholder group under baseline and policy scenarios. It is best if the financial feasibility analysis is done in the local currency. If foreign investment is required, or if loans are denominated in a foreign currency, it is still best to do the analysis in the local currency and then convert the results to the foreign currency. Often some factors will be in foreign currency. In this case, the exchange rate should be entered in only one location in the analysis calculations, allowing updating of the entire analysis upon changing the exchange rate at that one location. Then if the exchange rate changes, the quantification can be easily updated. If the analysis is done in a foreign currency, there is a risk of currency fluctuations altering the conclusions of the analysis.

Where inflation is likely (e.g., over longer periods of time) apply a discount rate and calculate a net present value for the cash flows to take into account the future value of money. Non-discounted values can be used if significant inflation is not expected during the analysis period (e.g., five years or less). Table 8.7 provides more for information on metrics for financial analysis.

Different stakeholders should have different discount rates. For example, the discount rate for a government is generally much lower than a discount rate for a corporation, and the discount rate for a corporation that has access to capital is often much lower than the discount rate of a smallholder farmer. Appendix B provides additional information on discount rates. To enable comparison between stakeholder groups, the costs should be normalised, for example per hectare, per operation, per head of livestock or per person.

Table 8.7: Definitions of common terms used in financial analysis

Term	Definition
Cash flows	The net amount of cash and cash-equivalents moving into and out of a business. Positive cash flow indicates that a company's liquid assets are increasing, enabling it to settle debts, reinvest in its business, return money to shareholders, pay expenses and provide a buffer against future financial challenges. Negative cash flow indicates that a company's liquid assets are decreasing. Some stakeholders will not implement an action that has a negative net cash flow at any time.
Discount rate	The interest rate you need to earn on a given amount of money today to end up with a given amount of money in the future. The discount rate accounts for the time value of money, which is the idea that a dollar today is worth more than a dollar tomorrow given that the dollar today has the capacity to earn interest.
Present value	The current worth of a future sum of money or stream of cash flows given a specified discount rate. Future cash flows are discounted at the discount rate, and the higher the discount rate the lower the present value of the future cash flows.
Rate of return	The gain or loss on an investment over a specified time period, expressed as a percentage of the investment's cost. Gains on investments are defined as income received plus any capital gains realised on the sale of the investment. The general equation of the rate of return is: (Gain of Investment –Cost of Investment) / Cost of Investment

Source: Adapted from Investopedia.

To estimate net cash flows:

1. Estimate baseline scenario costs and revenues using present day data for a typical stakeholder that will take part in the policy, repeating this separately for each stakeholder group. Taking into account how the land area under consideration would be used without the policy (e.g., what is produced on the land and how much, considering for example, animal farming, croplands, set asides or logging).

   Average cost and revenue figures can be used for groups of land categories. For example, use average expense and income from all cropland areas (irrespective of the type of the crop); group together fallow land and set asides and derive average values for those lands; or use national average timber harvest statistics and prices.

   Include costs of inputs and costs of production, in addition to revenues from sale of goods. Key input costs include raw materials, equipment, labour, permits to operate, and other costs entailed in producing and selling the goods. For example, in agriculture costs include fertiliser and seed for crops, cost of fencing for cattle, feed, feed additives and medications. Input costs may include taxes on operations or land that must be paid from revenues from the sale of goods.[10]

2. Estimate the baseline scenario net cash flow (i.e., revenues minus costs) over the assessment period, separately for each stakeholder group.
3. Estimate the policy scenario costs and revenues over the assessment period, separately for each stakeholder group. This includes determining:
    - The amount and type of government or private funding committed to implementing the policy
    - The cost to the stakeholder to implement the policy
    - The revenues that the stakeholder will gain from the policy
4. Estimate the net cash flow for a typical stakeholder in the policy scenario, separately for each stakeholder group

Step 3: Assess financial feasibility

Compare the net cash flow for the baseline scenario with that for the policy scenario to assess financial feasibility, as follows:

1. Determine whether the total net cash flow for the policy scenario exceeds the net cash flow for the baseline scenario; this must be the case for the policy to be financially feasible.
2. Determine whether the total net cash flow for the policy scenario is positive; this must be the case for the policy to be financially feasible.
3. When the net cash flow for the policy scenario is positive, compare the discounted cash flow (net present value) and rate of return (for the general formula see Table 8.7) in the baseline and policy cases. For the policy to be financially feasible, the rate of return on the policy case must be higher than the baseline rate of return by more than three percentage points.

Repeat this analysis for each stakeholder group identified and all activities covered by the policy.

Step 4: Estimate the extent to which financial aspects will limit policy outcomes

Based on the results of the financial feasibility assessment, decide how the implementation potential of the policy will be affected, as follows:

- Where the policy does not appear to provide sufficient incentive for stakeholders to participate or otherwise respond to the policy, either reconsider the design of the policy (or the relevant component of the policy) or refine the implementation potential of the policy.

---

[10] The European Commission Guide to Cost-Benefit Analysis of Investment Projects can be a useful resource for how to identify costs and revenues, calculate discounted cash flows, and implement other aspects of financial and economic feasibility analysis. Available at: http://ec.europa.eu/regional_policy/sources/docgener/guides/cost/guide2008_en.pdf

- Where the policy appears to provide sufficient incentive for stakeholders to participate or otherwise respond to the policy, continue to the next step without revising the implementation potential of the policy.

8.4.2 Considerations for accounting for financial feasibility

Below are additional considerations when deciding how the implementation potential of the policy will be affected.

- In addition to discounted costs and revenues, the financial analysis should consider the relative timing of costs and revenues, and the capital needed to achieve these cash flows. If costs occur before revenues, stakeholders must have access to funds to pay the costs or they may not behave as expected.

  Shifts in timing of returns can be large for afforestation and reforestation. There are considerable costs in establishing stands of trees, but there may be negligible revenues for years while the trees grow to have commercial value. As a result, many forestry projects are only financially feasible with low discount rates. For entities with high discount rates, such as most smallholder farmers, even modest seasonal delays in revenue relative to expenditures can create a significant barrier to implementation. Delaying the harvest season can be a barrier to food insecure households that do not have other crops to eat during the delay.

- In general, unless the policy increases net revenue to stakeholders, or reduces their risks, the policy is unlikely to be adopted voluntarily.

  Policies that provide a net financial benefit may have little incentive for adoption if the net gain is small relative to overall cash flows.

- Investors, farmers, landowners and other stakeholders are often risk averse. Some policies offer stakeholders a positive financial return, yet still fail to be adopted, because stakeholder's view returns as too uncertain or risky. For example, they may not be confident payments in the future will be made, contracts will be honoured, or the policy will have ongoing political and budgetary support. As a result, assessing simple return on investment alone may not give a reliable indication of the likelihood of policy adoption. Financial risk can be quantitatively incorporated into the analysis by increasing stakeholder's discount rate, or qualitatively considered by consulting stakeholders on their likely response to specific real-world policy incentives.

- Some changes may have non-obvious costs. For example, a change may involve significant management labour costs to revise organisational processes or training new workers that are needed to provide different skills into the organisation.

- It may be important to identify other financial considerations and sectoral policies and trends that may affect the outcome of the financial feasibility of the policy, and to consider whether these sectoral policies or trends reinforce or counteract the intended implementation (e.g., through price signals and consumer behaviour).

When a government is considering what policies to adopt, it may also want to consider the financial effects on society as a whole. However, such an evaluation is beyond the scope of this guidance.[11]

8.4.3 Example of accounting for financial feasibility

To estimate net cash flows, data on a per-hectare basis are used for annual costs and benefits for land areas affected by the policy, from the perspective of pastoralists managing the land. This example considers 15 years of policy implementation.

First, the costs and revenues for the baseline scenario are estimated assuming that current pasture and livestock management practices would continue in the absence of the policy. Results are shown in Table 8.8, which presents annual data for Year 1-2, Years 3-5 and Year 6-15 of the policy. Negative numbers represent costs (expenses) and positive numbers represent revenues (income).

Table 8.8: Example calculation of baseline costs and revenues

Baseline	**Annual costs and revenues for Year* (USD/ha):**			**Total**
	1-2	**3-5**	**6-15**	
Costs				
Labour	-30	-30	-30	
Inputs (seed, feed, equipment, fuel, vet costs)	-15	-15	-15	
Land cost, taxes, concession fees	-20	-20	-20	
Total baseline cost	-65	-65	-65	
Revenues				
Revenues from animals	550	550	550	
Net baseline revenue, undiscounted	485	485	485	7,275
Net baseline revenue, present value	[485 – 422]	[367 – 277]	[241 – 69]	3,261

* Years are grouped for simplicity. Square brackets indicate the range of values during that time period. For example, [367 -277] means values range from USD 367/ha in Year 3 to USD 277/ha in Year 5.

Table 8.8 provides average present day estimates for costs and revenues per hectare under the baseline scenario. The costs identified are labour, inputs (seed, feed, equipment, fuel, vet costs), and land cost, taxes concession fees. The revenues identified include all income from selling animals. It is assumed that mature, slaughter-ready beef cattle weighs 450 kg/head. It takes 1.75 years and 1.1 hectares of grazing land to reach maturity. Beef can be sold for USD 2.40 per kg. Based on these assumptions, it is estimated that the annual per-hectare revenue for beef cattle on grazing land is USD 550/ha/year.

The cost and revenue were kept constant for all 15 years. Based on these assumptions, a typical farmer has net annual revenues (or cash flow) of USD 485/ha. Applying a discount rate of 15% reduces the annual revenue from USD 485/ha in Year 1 to USD 69/ha by Year 15.

[11] A variety of sources are available that provide guidance on estimating net economic effects on society, including EC 2008.

Next, the costs and revenues for the policy scenario were estimated by assuming that the SPLP results in an increase in productivity through rotation practices and fencing. The results are shown in Table 8.9.

Table 8.9: Example calculation of policy scenario costs and revenues for the SPLP

Policy Scenario: SPLP	**Annual costs and revenues for Year* (USD/ha):**			**Total**
	1-2	**3-5**	**6-15**	
Costs				
Labour	-50	-35	-35	
Inputs (seed, feed, equipment, fuel, vet costs)	-183	-20	-20	
Land cost, taxes and concession fees	-20	-20	-20	
Total cost	-253	-75	-75	
Revenues				
Revenues from animals	550	578	578	
Government payment for improvements made	75	75	0	
Total revenue	625	653	578	
Net SPLP revenue, $/ha, undiscounted	372	578	503	7,502
Net SPLP revenue, $/ha, present value	[372 – 323]	[437 – 330]	[250 – 71]	3,284

* Years are grouped for simplicity. Square brackets indicate the range of values during that time period.

Table 8.9 provides average present day estimates for costs and revenues per hectare under the policy scenario. The costs identified, in addition to those in the baseline scenario, are for labour and improvements to be made. The improvement costs are anticipated to be USD 375/ha and split between Year 1 and Year 2 (USD 188 each year). Labour costs are expected to be higher than in the baseline scenario. For the first 2 years, additional labour is required for the installation of fencing. For the following years, costs are higher because rotational grazing requires more active movement of cattle, and growing the right forage can require reseeding and applying fertiliser annually.

The revenues identified are expected to be the same as in the baseline (i.e., USD 550/ha) for the first two years. For the following years, the revenue increases by 5% as result of productivity improvements (beef and dairy production increases) made under the policy. Payments by the government are made for the first five years to compensate for the additional expenses for the improvements. The payments are made in equal instalments of USD 75/ha per year.

Based on these assumptions, the net annual revenues will be lower for the first two years for a typical pastoralist (USD 372/ha compared to USD 485/ha), but higher in the following years (USD 578 for Years 3-5, and USD 503 for Years 6-15). Applying a discount rate of 15% reduces the annual revenue from USD 372/ha in Year 1 to USD 71/ha by Year 15.

The net cash flow in the policy scenario is positive and exceeds the net cash flow for the baseline scenario. Comparison of discounted net revenues in baseline (USD 3,261/ha) and policy (USD 3,284/ha) scenarios indicates that the USD 75/ha payment and 5% increase in revenues as result of higher productivity do not make the situation profitable enough to be financially feasible for the stakeholder. This level of productivity increase, however, is considered as a minimum and according to national experts, higher productivity gains are possible.

Yearly cash flow trends in the policy scenario show a reduction of income during the first two years of policy implementation compared to the baseline. Because of this, some pastoralists (this is likely to be the case for small scale operations) may decide not to participate. For others (e.g., medium or larger operations) it may not create severe cash flow problems and they would be more likely to participate.

Given this, the policy is adjusted to increase the payment by the government to the maximum end of the range (i.e., USD 100/ha) for small operations (less than 200 ha). Based on data from national statistics, small farms account for about 35% of the land area. The modifications in incentive payments will affect the overall budget as shown in Table 8.10.

To confirm these changes will improve financial feasibility, the cash flow analysis was recalculated with payments of USD100/ha and 10% productivity improvements. With these changes, the results indicate clear financial feasibility. The net present value of the policy scenario under these conditions is USD 3,514/ha, which is over 7% higher than the baseline net present value of USD 3,261/ha

With the modification in payment amounts and assurances from experts that higher productivity gains are possible, the policy appears to be financially feasible for all participants.

Table 8.10: Distribution of land area, number of animals and annual payments for small and medium-size landowners/farmers

	Small landowners/ farmers	Medium landowners/ farmers	Total
Area (ha)	359,730	668,070	1,027,800
Number of animals (head)	312,417	580,203	892,620
Annual payment	USD 100/ha	USD 75/ha	
Total payment over 5 years	USD 179,865,000	USD 250,526,250	USD 430,391,250

However, participation levels must be reduced to keep the policy on budget. As shown in Table 8.10, the revisions lead to an overall budget that is higher than the financial cap of the policy. To maintain the overall budget to no more than USD 400 million, participation of medium-size farmers will be decreased by 13% thus decreasing the original estimate of potential impact. This would result in a refined implementation potential as shown in Table 8.11.

Table 8.11: Example of refined implementation potential

Activity data	Maximum implementation potential	Refined implementation potential based on policy design and national circumstances	Refined implementation potential based on financial feasibility
Implementation area (in ha)	1,200,000	1,027,800	940,951
Number of animals (head)	1,080,000	892,620	817,194

8.5 Account for other barriers

It is a *key recommendation* to analyse other barriers that could reduce the effectiveness of the policy and account for their effect on the implementation potential. This analysis is similar to that in Section 8.3 but focuses on institutional, cultural and physical barriers that may limit effectiveness of the policy.

Section 8.5.1 provides a method for analysing these barriers and estimating their effect on implementation potential of the policy. Section 8.5.2 provides some further guidance to help with this analysis. Section 8.5.3 provides a worked example to illustrate the steps.

8.5.1 Method for accounting for other barriers

Step 1: Analyse institutional, cultural and physical barriers

Compile information on the barriers identified in Table 8.12 and consider how these barriers may affect the implementation potential using the questions provided. The questions can be adapted or further barriers and questions can be added as needed, to ensure that the analysis is relevant to national circumstances.

Information can be gathered through expert elicitations with administration and government experts that are directly or indirectly involved in the policy under consideration, as well as through desk reviews and additional stakeholder consultations. Refer to the ICAT *Stakeholder Participation Guidance* (Chapter 8) for further information on designing and conducting consultations.

Answer each question and score each response based on its potential to limit the effectiveness of the policy, on a scale of 1 to 4, as follows:

1 = Likely to have no effect

2 = Likely to limit effectiveness

3 = Likely to prevent implementation

4 = Unknown

Table 8.12: Other barriers to policy implementation

1. Institutional barriers	
a.	Are there any conflicting goals or jurisdictions between ministries or other agencies with respect to the implementation of the policy?
b.	Is there the potential for institutional racism, gender bias or age discrimination that could limit the policy effectiveness, for example by limiting participation of certain stakeholders based on their race, religion, gender or age?
2. Cultural barriers	
a.	Are different languages used in the region where the policy will be implemented?
b.	Is the policy congruent with cultural or aesthetic norms and values?
c.	Are there gender issues in access to resources or communication?
d.	Are there generational differences in work ethics and work approaches that can result in conflicts or disputes among stakeholders that limit ability to effectively implement the policy?
e.	Are there any areas or landmarks with religious significance of the region under consideration?
f.	Is there a group that has very strong opposition to the policy?
3. Physical barriers	
a.	Are land areas proposed for intervention easily accessible?
b.	Is the necessary physical infrastructure in place for the proposed policy?
c.	Are there any war conflicts in the country that would limit access to certain land areas?

Step 2: Evaluate the overall distribution of scores and estimate the effect on implementation potential

Once each barrier has been analysed and scored, evaluate the overall distribution of scores.

- A distribution with many scores of 1 indicates less of a need to refine the implementation potential of the policy.
- A distribution with many scores of 2, 3 or 4 could suggest a downward adjustment of the implementation potential or gathering more information and reassessing the impact, especially for scores of 4.

Carefully review each score of 2 and 3. For a score of 2 consider and, if possible, estimate to what extent the barrier will decrease policy effectiveness. Describe and justify the reduction. For a score of 3, the barrier is considered crucial and has the potential to render the policy ineffective. If even one crucial barrier is identified, it is recommended to reconsider the policy design and discontinue the impacts assessment. For scores of 4, attempt to gather enough information to assess the effect of the barrier. If that is not possible, it is conservative to assume it limits effectiveness.

Consider and determine to what extent the effects of the barriers overlap. An overlapping effect occurs where one barrier limits implementation in one area and another barrier also limits implementation in the same area. These overlapping effects should be appropriately accounted for when calculating the potential effect of all barriers. The combined effect of the barriers together may be greater than or less than the sum of the individual barriers. If information is available, uncertainty ranges should also be incorporated in the final results.

During the data-gathering phase, it is recommended that information also be collected on any other relevant policies in the country that might help overcome specific barriers. Where such policies exist, the scoring of the barrier effect should be changed accordingly (most likely to a score of 1).

8.5.2 Considerations for accounting for other barriers

Institutional barriers

Conflicting goals between different ministries and other government agencies could result in overlapping regulation and ambiguous roles and responsibilities of the stakeholders involved. For example, proposed areas for the policy may overlap with other existing types of area protection (e.g., based on national policies or international conventions), which could lead to confusing regulations for specific sites.

Institutional barriers relating to discrimination often include racism, gender bias, age discrimination, favouritism and other selection approaches that are not based on the actual performance of individual workers. Where discrimination is present, certain stakeholders may not have equal access to the opportunities afforded by a policy (e.g., incentive payments, technical assistance or education) and this can limit overall effectiveness. Often such barriers are linked to corrupt practices (addressed in Section 8.3). Safeguards to prevent discrimination can be built into policies. For example, it can be required that enrolment in programmes such as education opportunities must be diverse in terms of race and gender. If safeguards against discrimination do not exist, either as part of the policy being analysed or in institutions involved in implementing the policy, it is possible that discrimination will be a barrier to policy implementation.

Cultural barriers

The use of language and terminology that is not widely understood by the target stakeholders could be a crucial cultural barrier as it could result in communications problems causing misunderstandings, mistrust and non-participation/compliance among the local population. Where language barriers exist and there is no mechanism in place to overcome them, the effectiveness of the policy is likely to be reduced.

In many countries, the successful implementation of mitigation policies may require consideration of gender or social class sensitivities to reduce resistance of local communities to the proposed intervention. Cultural preferences may have more potential for change than physical limits, but change may take time and almost certainly will benefit from considering existing mechanisms of social influence. There may also be generational differences in work ethics and work approaches that have the potential to result in conflicts between older and younger workers. If the policy is sensitive to such factors, including potential language barriers, age distribution and cultural norms of stakeholders, they may not present a barrier to implementation.

In some countries, gender considerations can have a very important effect on the success or failure of implementation of the policy. It is important to consider who makes decisions about land use actions, and who has access to information and money. For a policy to be implemented effectively, the person who is responsible for managing land will also need to have the ability to access information and financing to implement management changes. If they do not, this will likely limit policy effectiveness.

Certain land areas or landmarks have important religious significance for local communities. Policies that may affect ancestral homes or sacred grounds would be more likely to face resistance from indigenous peoples and local communities.

Strong opposition to a policy, for example from a particular stakeholder group or political party, could hamper efforts to secure financing, gain trust, and otherwise implement policy interventions, especially if that group is influential.

Failure to identify and address cultural barriers will more than likely have detrimental impacts on the policy implementation. Effective stakeholder participation from early in policy design is important to identify and address cultural barriers. Refer to the *ICAT Stakeholder Participation Guidance* for further information about all elements of effective stakeholder participation for policy design, implementation and evaluation.

Physical barriers

In mountainous countries or countries with inaccessible regions, policies relating to agriculture and forests should take into account whether certain land areas are remote or are difficult to access. Minimal existing road networks or insufficient transportation infrastructure would be expected to limit the implementation potential.

Conflicts in a country (such as civil war or territorial disputes with a neighbouring country) could limit access to areas that could be considered for policy intervention. Depending on the severity of the conflict, and to safeguard the welfare of the people involved, certain parts of the country may be excluded until the conflict is resolved. This would reduce the impact of the policy at least through the time period during which conflicts remain active, and possibly longer.

8.5.3 Example of accounting for other barriers

The screening questions from Table 8.12 were reviewed (Step 1). Not all of the screening questions were identified to be relevant. In consultation with experts, responses were tabulated and scored in Table 8.13.

Table 8.13: Example of accounting for other barriers

1. Institutional barriers		**Score**
a.	*Are there any conflicting goals or jurisdictions between ministries or other agencies?* There are no other ministries beside the agriculture extension agency that work with pastoralists; therefore, no conflicts are expected.	1
b.	*Is there the potential for institutional racism, gender bias or age discrimination that could limit the policy effectiveness, for example by limiting participation of certain stakeholders based on their race, religion, gender or age?* Experts believe it is unlikely but there is very limited information available. There are no safeguards to prevent discrimination in place at the agriculture extension agency	4
2. Cultural barriers		
a.	*Are different languages used in the region where the policy will be implemented?*	1

	Spanish is the main language spoken in the country (more than 99%). A small number of communities use Amerindian and Creole languages. Most local offices have sufficient capacity to communicate in these languages.	
b.	*Is the policy congruent with cultural or aesthetic norms and values?*	N/A
c.	*Are there gender issues in access to resources or communication?*	N/A
d.	*Are there generational differences in work ethics and work approaches that can result in conflicts or disputes among stakeholders that limit ability to effectively implement the policy?* In the last few years, more young people are interested in staying in rural areas to farm rather than move to urban areas in search of work. This has resulted in more willingness of local people to consider the adoption of new and novel ideas and technologies for their farms/ranches.	1
e.	*Are there any areas or landmarks with religious significance of the region under consideration?*	N/A
f.	*Is there a group that has very strong opposition to the policy?*	N/A
3. Physical barriers		
a.	*Are land areas proposed for intervention easily accessible?* According to expert judgment, the vast majority of lands considered for the policy are accessible. Routine road improvement projects that are already being implemented will help maintain access to all farms and ranches. However, very remote areas (approximately 38,500 ha of the eligible land) are unlikely to be monitored effectively. To account for this, it is assumed that the policy will not be effectively implemented on all of those lands.	2
b.	*Is the necessary physical infrastructure in place for the proposed policy?*	N/A
c.	*Are there any war conflicts in the country that would limit access to certain land areas?* A conflict in the country has recently been resolved. Land areas in the conflict region were originally excluded from the policy. Depending on the progress of implementation, some of these areas will be considered in a future phase of the project pending availability of resources.	1

The distribution of scores was evaluated (Step 2). Four barriers received a score of 1. One barrier received a score of 2. One barrier received a score of 4. None of the barriers received a score of 3.

The extent to which policy effectiveness may be reduced as a result of each barrier was evaluated. Five of the barriers considered are not expected to limit policy effectiveness. None of the barriers received a 3 (e.g., appear to be crucial problems that could completely hamper policy effectiveness). To account for physical barrier 3a, the implementation potential will be modified by reducing the target area affected by the policy by 1,350 ha (corresponding to 3.5% of the 38,500 ha of very remote land eligible for the policy). This also results in a reduction in the number of animals that could be grazed on those lands. The national average density for grazing beef cattle is six head per hectare. Over 1,350 hectares, this barrier reduced the number of animals by 8,100 head.

Based on the above assessment, the land area and number of animals of the policy will be adjusted as shown in Table 8.14.

Table 8.14: Example of refined implementation potential

Activity data	Maximum implementation potential	Refined implementation potential based on policy design and national circumstances	Refined implementation potential based on financial feasibility	Refined implementation potential based on other barriers
Implementation area (ha)	1,200,000	1,027,800	940,951	936,601
Number of animals (head)	1,080,000	892,620	817,194	809,094

Table 8.14 illustrates how land area and number of animals were refined after each step. The refined values in the last column are considered the likely implementation potential of the policy, which are the values that should be used to estimate the GHG impacts of the policy.

8.6 Estimate GHG impacts

It is a *key recommendation* to estimate the GHG impacts of the policy. There are two ways to estimate GHG impacts: the emissions approach or activity data approach. Where baseline emissions were estimated, users can calculate the change in emissions between the baseline and policy scenarios (emissions approach). Where baseline emissions were not estimated, the GHG impacts can be estimated by calculating the net GHG emission reductions and removals directly from the likely implementation potential of the policy (activity data approach). Guidance for estimating the GHG impacts for each approach is given below.

8.6.1 Emissions approach

Use the likely implementation potential of the policy (derived following the guidance in Sections 8.2 – 8.5) to determine the most-likely policy scenario. Derive new parameter values and, if relevant, new emission factors that reflect conditions under the policy scenario.

Use the adjusted values and emission factors to estimate GHG emissions of the policy scenario. Subtract the policy scenario emissions and removals from the baseline emissions and removals to estimate net change in GHG emissions and removals resulting from the policy.

8.6.2 Activity data approach

The likely implementation potential of the policy represents the effects that are expected to occur as a result of the policy. Implicitly, these effects are relative to the baseline scenario. Use the guidance below to calculate the impact of the policy on each GHG source and carbon pool in the GHG assessment boundary. This guidance covers enteric fermentation and soil carbon sequestration. Sum the GHG impacts for all GHG sources and carbon pools to yield total policy impact on GHGs.

Enteric Fermentation

Using the estimates of how much the policy will increase or decrease the average annual number of animals in livestock categories affected by the policy (determined following the guidance in Sections 8.2 –

8.5), identify the livestock categories that are affected by the policy. These categories are called the target group. Guidance is provided in Section 7.2.2 on how to define livestock categories.

Derive new emission factors (EF_{policy_impact}) for the target groups (i.e., the policy impact on GHG emissions of a typical animal in the target group). Calculate the annual GHG emissions and removals of the policy by multiplying EF_{policy_impact} by the increase or decrease in average annual number of animals in the target groups. Multiply the annual GHG emissions and removals by the number of years in the assessment period for the cumulative GHG emissions and removals. Sum all target groups to estimate total policy impact on CH_4 from enteric fermentation. Multiply the result by the 100-year GWP of CH_4 to convert CH_4 to CO_2e and multiply by 0.001 to convert kg to tonnes.

Guidance is provided below for three options for deriving new emissions factors for target groups. The steps should be repeated for each target group.

Tier 1

- Step 1: Estimate how the policy will change the weight, growth rate and milk production (dairy cattle only) of the target group.
- Step 2: Choose a Tier 1 emission factor from IPCC 2006 GL, Table 10A.1 that best matches the weight, growth rate and milk production (dairy cattle only) of a typical animal in the target group if the policy were not enacted ($EF_{without\_policy}$). See Section 7.2.4 for guidance on choosing a Tier 1 emission factor. The emission factor units are kg CH_4/head.
- Step 3: Use the information from Step 1 to choose a different Tier 1 emission factor from IPCC 2006 GL, Table 10A.1 that matches the weight, growth rate and milk production (dairy cattle only) of a typical animal in the target group as a result of the policy (EF_{with_policy}).

  If significant quantitative information from Step 1 exists to justify choosing a different Tier 1 emission factor, users should consider deriving a preliminary Tier 2 emission factor.
- Step 4: Subtract the emission factor in Step 2 ($EF_{without\_policy}$) from emission factor in Step 3 (EF_{with_policy}) to yield the emission factor for the policy impact (EF_{policy_impact}).

Published Tier 2

Published Tier 2 emission factors can be used in place of the calculated Tier 2 emission factors in the steps above. See Section 7.2.4 for guidance on using published Tier 2 emission factors.

Derived Tier 2

- Step 1: Estimate how the policy will change feed intake of the target group affected by the policy. See Section 7.2.2 for guidance on how to estimate feed intake.
- Step 2: Calculate a Tier 2 emission factor for a typical animal in the target group based on estimated gross energy intake of the animal without the policy ($EF_{without\_policy}$). See Section 7.2.4 for guidance on how to estimate a Tier 2 emission factor or preliminary Tier 2 emission factor.
- Step 3: Use the information from Step 1 to estimate gross energy intake for a typical animal in the target group with the policy and use it to calculate a new Tier 2 emission factor (EF_{with_policy}).
- Step 4: Subtract the emission factor in Step 2 ($EF_{without\_policy}$) from emission factor in Step 3 (EF_{with_policy}) to yield the emission factor for the policy impact (EF_{policy_impact}).

Soil Carbon Sequestration

Using the estimates of how much the policy will increase or decrease the area of land (hectares) in land categories affected by the policy (determined following the guidance in Sections 8.2 – 8.5), subdivide the land categories into strata according to guidance in Section 7.3.1. These are the policy scenario strata.

Determine the policy impact on GHG emissions for each policy scenario stratum, following the steps below. Repeat the steps for each policy scenario stratum.

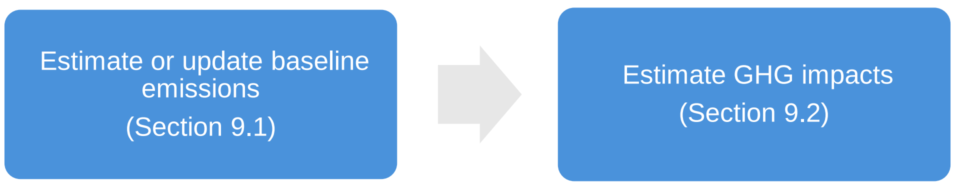
- Step 1: Determine the baseline stratum, which is the most likely alternative stratum in the absence of the policy (without policy). The climate region and soil type in the baseline stratum should be the same as in the policy scenario stratum. The land category and/or management category should be different from the policy scenario stratum.
- Step 2: Calculate the category-specific soil carbon density for the baseline stratum following guidance in Section 7.3.3 ($SOC_{without\_policy}$). Soil carbon density units are tonnes C/ha.
- Step 3: Calculate the category-specific soil carbon density for the policy scenario stratum following guidance in Section 7.3.3 (SOC_{with_policy}).
- Step 4: Subtract the category-specific soil carbon density (also known as soil organic carbon or SOC) in Step 2 ($SOC_{without\_policy}$) from category-specific soil carbon density in Step 3 (SOC_{with_policy}) to yield the policy impact on soil carbon density (SOC_{policy_impact}).
- Step 5: Multiply the SOC_{policy_impact} by the increase or decrease in hectares of land in the policy scenario stratum over the assessment period.

Calculate the total policy impact on soil carbon density (SOC) by summing the results for all policy scenario strata. Convert the change on soil carbon density to GHG emission reductions or removals, expressed as tonnes of CO_2e, by multiplying by 44/12 and by -1. This generates the cumulative policy impact in terms of tonnes CO_2e emissions (positive) or removals (negative). Divide the cumulative policy impact by the number of years in the assessment period for the annual GHG impacts of the policy.

9. ESTIMATING GHG IMPACTS EX-POST

Ex-post impact assessment is a backward-looking assessment of the GHG impacts achieved by a policy to date. The GHG impacts can be assessed during the policy implementation period or in the years after implementation. Ex-post assessment involves evaluating the performance of the policy, and estimating the impact of the policy by comparing observed policy scenario values (based on monitored data) to ex-post baseline values. In contrast to ex-ante assessment, which is based on forecasted values, ex-post assessment involves monitored or observed data collected during the policy implementation period. The impact of the policy (ex-post) is estimated by subtracting baseline estimates from policy scenario estimates. Users that are estimating GHG impacts ex-ante only can skip this chapter.

Figure 9.1: Overview of steps in the chapter



Checklist of key recommendations

- Estimate or update baseline emissions using observed values for parameters that are not affected by the policy and estimated values for parameters that are affected by the policy
- Ascertain whether the inputs, activities and intermediate effects that were expected to occur according to the causal chain, actually occurred (if relevant)
- Estimate the GHG impacts of the policy over the assessment period for each GHG source and carbon pool included in the GHG assessment boundary

9.1 Estimate or update baseline emissions

It is a *key recommendation* to estimate or update baseline emissions using observed values for parameters that are not affected by the policy and estimated values for parameters that are affected by the policy. The baseline emissions can be estimated following the guidance in Section 7.2 or 7.3. Further guidance on monitoring parameters is provided in Chapter 10. The baseline and policy scenarios have the same GHG assessment boundary.

Where the baseline scenario was determined and baseline emissions estimated in a previous ex-ante impact assessment, this should be updated by replacing estimated values with observed data (e.g., milk production or land classification).

9.2 Estimate GHG impacts

Evaluate performance of the policy (if relevant)

The performance of the policy should be evaluated to ensure that the GHG impacts calculated ex-post can be attributed to policy. To do this, it is a *key recommendation* to ascertain whether the inputs, activities and intermediate effects that were expected to occur according to the causal chain, actually occurred. For ex-post impact assessments where no previous ex-ante assessment has been conducted this evaluation step can be skipped.

Chapter 10 provides examples of the inputs and activities that should be monitored to evaluate the performance of the policy. If the user cannot ascertain that the inputs or activities occurred, it is not possible to attribute GHG impacts to policy implementation.

Users should also examine whether the intermediate effects in the causal chain occurred. It may not be feasible to monitor all intermediate effects. At minimum, each of the intermediate effects linked to GHG sources and carbon pools included in the GHG assessment boundary should be monitored with at least one parameter. Table 6.2 and Table 6.3 in Chapter 6 provide examples of intermediate effects that should be monitored. If the user cannot confirm that these intermediate effects occurred, it is not possible to attribute GHG impacts to policy implementation.

Note that inputs, activities and/or intermediate effects may be lower or higher in magnitude than expected but this does not mean that GHG impacts cannot be attributed to the policy.

Estimate the GHG impact of the policy

It is a *key recommendation* to estimate the GHG impacts of the policy over the assessment period for each GHG source and carbon pool included in the GHG assessment boundary. The same methods used to estimate baseline emissions should be used to estimate policy scenario emissions to allow for meaningful tracking of performance over time.

Calculate policy scenario emissions using the estimation methods provided in Section 7.2 or 7.3. Use observed, measured or recently collected activity data, and measured or re-estimated emission factors. Further guidance on monitoring parameters is provided in Chapter 10.

If using the emissions approach, calculate the GHG impacts of the policy by subtracting baseline emissions (estimated in Section 9.1) from the ex-post policy scenario emissions for each GHG source and carbon pool included in the GHG assessment boundary.

If using the activity data approach, calculate the GHG impact of the policy directly, by determining the actual implementation level using observed, measured, or recently collected data and measure or re-estimate emission factors. It is not necessary to estimate the GHG emissions of the baseline scenario when using this approach. Rather, users should follow the guidance in Section 8.6.2 using ex-post activity data and emission factors. Under this approach users should carefully consider the policy’s inputs, activities and intermediate effects that occurred ex-post as a result of policy. Users should report and justify that the actual implementation level (e.g., the observed change in activity data) is the result of the policy.

Further resources

Comprehensive guidance on estimating livestock GHG emissions and soil carbon stock changes can be found in numerous resources.

- IPCC 2003 Good Practice Guidelines for Land Use, Land-Use Change and Forestry[12]
- IPCC 2006 GL for AFOLU, Volume 4[13]
- Global Research Alliance (GRA) Livestock Research Group[14]
- Standard Assessment Of Agricultural Mitigation Potential And Livelihoods (SAMPLES) Tool[15]
- Winrock International Grazing Land and Livestock Management methodology, A MICROSCALE excel tool for estimating emission factors[16]
- Measurement, reporting and verification of livestock GHG emissions by developing countries in the UNFCCC: current practises and opportunities for improvement[17]
- Livestock development and climate change: The benefits of advanced greenhouse gas inventories[18]
- Methods for Measuring Greenhouse Gas Balances and Evaluating Mitigation Options in Smallholder Agriculture[19]
- Reducing greenhouse gas emissions from livestock: Best practice and emerging options[20]

[12] Available at: http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf.html

[13] Available at: http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol4.html

[14] Available at: https://globalresearchalliance.org/research/livestock/

[15] Available at: http://samples.ccafs.cgiar.org/

[16] Available at: https://americancarbonregistry.org/carbon-accounting/standards-methodologies/grazing-land-and-livestock-management-gllm-ghg-methodology

[17] Available at: https://ccafs.cgiar.org/publications/measurement-reporting-and-verification-livestock-ghg-emissions-developing-countries#.WoHiYSXwa00

[18] Available at: https://ccafs.cgiar.org/publications/livestock-development-and-climate-change-benefits-advanced-greenhouse-gas-inventories#.WoHg3yXwaHs

[19] Available at: https://ccafs.cgiar.org/publications/methods-measuring-greenhouse-gas-balances-and-evaluating-mitigation-options-smallholder#.WoHhgyXwa00

[20] Available at: http://www.saiplatform.org/uploads/Modules/Library/lrg-sai-livestock-mitigation_web2.pdf