METHODOLOGY FOR THE QUANTIFICATION, MONITORING, REPORTING AND VERIFICATION OF GREENHOUSE GAS EMISSIONS REDUCTIONS AND REMOVALS FROM

AVOIDED CONVERSION OF GRASSLANDS AND SHRUBLANDS TO CROP PRODUCTION

VERSION 2.0

October 2019

ACR
AT WINROCK INTERNATIONAL

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ABOUT ACR[SM]

ACR is a leading global carbon crediting program operating in regulated and voluntary carbon markets. Founded in 1996 as the first private voluntary greenhouse gas (GHG) registry in the world, ACR creates confidence in the integrity of carbon markets to catalyze transformational climate results. ACR ensures carbon credit quality through the development of environmentally rigorous, science-based standards and methodologies as well as oversight of carbon offset project verification, registration, and credit issuance and retirement reporting through its transparent registry system. ACR is governed by Environmental Resources Trust LLC, a wholly-owned nonprofit subsidiary of Winrock International.

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The Nature Conservancy

ACR

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Acronyms

AC	Avoided conversion
ACoGS	Avoided conversion of grasslands and shrublands
AFOLU	Agriculture, forestry and other land use
APEX	Agricultural Policy Environmental eXtender Model
CO_2e	Carbon dioxide equivalent
CH_4	Methane
CDM A/R	Clean Development Mechanism Afforestation/Reforestation
CRP	Conservation Reserve Program
DAYCENT	Daily time step version of the CENTURY biogeochemical model
d.u.	Dimensionless unit
EF	Emission factor
EPA	Environmental Protection Agency
ERS	Economic Research Service
ERT	Emission reduction ton
GHG	Greenhouse gas
IA	Identified agent
IPCC	Intergovernmental Panel on Climate Change
LU/LC	Land use/land cover
LCA	Land conservation agreement
LCC	Land capability class

MLRA	Major land resource areas
NH_3	Ammonia
N_2O	Nitrous oxide
NLCD	National Cropland Data Layer
NO_X	Nitrogen oxides
PDA	Programmatic development approach
REDD	Reduced emissions from deforestation and degradation
SOC	Soil organic carbon
SSR	Sources, sinks and reservoir
UA	Unidentified agent
VVB	Validation/Verification Body

Contents

FIGURES

TABLES

EQUATIONS

1 Background and Applicability

1.1 Summary Description of Methodology

This methodology estimates the emissions avoided by preventing the conversion of Grasslands and Shrublands to annual crop production.[1] Conversion of Grassland and Shrubland to uses other than annual Cropland is not an eligible activity under this methodology. Conversion to orchards and vineyards is not an eligible activity under this methodology. Grassland and shrubland soils are significant reservoirs of organic carbon that will, if left uncultivated, continue to store this carbon belowground. Grassland and shrubland ecosystems may also support greater plant biomass than annual Cropland, especially belowground. In addition to the avoided cultivation and oxidation of soil organic carbon, several crop production practices with GHG implications, such as fertilizer applications, may also be avoided through the project activity. Livestock, primarily cattle, are anticipated to be common in the project scenario and their associated emissions from enteric fermentation and manure deposition are accounted.

This methodology accounts for two Avoided Conversion baseline scenarios: 1) where the conversion agent is identified and 2) where the conversion agent is unidentified. Projects that can identify the conversion agent are required to demonstrate proof of intent to convert by the identified agent. Where the specific conversion agent cannot be identified but a class of likely agents can, the Unidentified Agent baseline approach is used to determine the probability of conversion. This approach is based on historical rates of conversion of existing grasslands and shrublands within a county, in addition to the various land capability classes suitable for agriculture at the field level.

The removal of project lands from the supply of potential Cropland is expected to create leakage effects, all in the form of market leakage.[2] A default market leakage estimate is offered to account for

[1] Eligible project types may include, but are not limited to, the avoided conversion of native rangeland, and grasslands established under the Conservation Reserve Program (United States) that have been in grassland cover for a minimum of 10 years.

[2] Leakage and market leakage are defined in the *ACR Standard*. Leakage is a decrease in sequestration or increase in emissions outside project boundaries resulting from project implementation. Leakage may be caused by shifting of the activities present in the project area or by market effects whereby emission reductions are countered by emissions created by shifts in supply of and demand for the products and services affected by the project. See Section 6.3 for discussion of leakage as pertains to this project type.

these effects. Standardized values for leakage and baseline determination are specific to the United States.

Unless specified otherwise in this document, projects are subject to all requirements and specifications in the most current version the *ACR Standard*. Definitions specific to this methodology can be found at the end of the document.

1.2 Applicability Conditions

In addition to satisfying the latest ACR program requirements, project activities must satisfy the following conditions for this methodology to apply:

- All Participant Fields avoid the complete conversion[3] of Grasslands or Shrublands to annual Cropland. Conversion of Grassland and Shrubland to uses other than annual Cropland is not an eligible activity under this methodology.
- All Participant Fields in the Project Area are currently Grassland or Shrubland, have qualified as Grassland or Shrubland for at least 10 years prior to the Start Date,[4] will remain as Grassland or Shrubland throughout the Project Term, and are legally able to be converted and would be converted to Cropland in the absence of the project activity.
- All Participant Fields enrolled in the Project Area must be subject to a qualified Land Conservation Agreement (LCA) entered into by the Project Participant prohibiting the conversion of the land from Grassland or Shrubland for the duration of the minimum Project Term or longer. The area bound by the LCA does not have to match the Project Area nor Participant Field enrolled; however, the entire area of the Participant Field must be included in the area covered by the LCA. The LCA must also explicitly prohibit grassland conversion to another land use—often referred to as a “sodbuster” clause—such that avoidable reversals are sufficiently precluded as long as the LCA is enforced.[5] If the easement allows for alternative land use other than grassland preservation, such as building envelopes, gravel sites, road development, etc., those areas must be delineated and removed from the eligible portion of the Participant Field. The LCA must be recorded on the deed of the property encompassing all Participant Fields to ensure transferability among ownership.

[3] The complete removal of initial vegetation community through complete tillage, chemical treatment, fire, or combinations thereof which are followed by seeding of an annual crop.

[4] In the case of aggregated projects, Participant Fields must have qualified as Grassland or Shrubland for at least 10 years prior to the date the Project Participants agreed to enroll that field into the aggregate.

[5] ERTs will not be issued for any period of non-conformance with the LCA.

- In the case of an unidentified agent of conversion, the Project Area is located entirely in a county or counties listed in Appendix B.[6] In the case of an identified agent of conversion, written offers to lease or buy property must specify cropland as the intended/highest and best use, including reference to available water rights and infrastructure if irrigation is required; in the absence of written offers to lease or buy the property, landowner attestations or other documentation demonstrating threat to conversion must reference the highest and best use as cropland and other comparable conversion events in the region.
- Land may remain in use for livestock grazing and/or haying and be subject to prescribed burning or wildfires during the project scenario, so long as the provisions of the relevant qualified LCA are met. In the project scenario, detrimental overgrazing, overstocking, or overuse of prescribed fires leading to the progressive loss of vegetative cover shall not occur, allowing carbon pools to remain at a steady state. Supplemental management practices that increase carbon stocks in the project scenario are allowable but the resultant emissions avoided or removed are not eligible for crediting under this methodology.
- At least 50% of the project area is in Land Capability Class (LCC) I-IV and no more than 25% of the project area is LCC VII and VIII as assessed using the SSURGO non-irrigated lands database.
- When the landowner will hold title to the carbon rights, a statement of intent[7] to develop a carbon offset project is submitted to ACR no sooner than 12 months before and not longer than 12 months after the date that the qualified LCA is recorded.
- When the landowner will not hold title to the carbon rights, the date of any agreement (e.g., a carbon options agreement) transferring carbon rights from the landowner to the project developer must be enacted no sooner than 12 months before and not longer than 12 months after the date that the qualified LCA is recorded.
- The Project Area includes either one contiguous parcel, or multiple discrete parcels of land. If the Project Area consists of multiple discrete parcels, Project Proponents must demonstrate that each discrete parcel meets all applicability criteria of the methodology.
- Project Areas do not include Grasslands or Shrublands on organic soils or peatlands, nor include wetland acres within Grassland/Shrubland tracts. Additional information on how to appropriately identify and remove wetland acres and organic soils from GHG modeling and ERT calculation is provided in Section 2.1.2.
- An irrigated cropland scenario in the baseline and an irrigated project scenario are allowed. In the baseline scenario, a strong justification must be made for the likelihood of the irrigated cropland scenario that is ultimately subject to the verifier's professional judgement. The justification shall include, at a minimum, an assessment of irrigation water access—both legal and physical—to the

[6] Eligibility maps are updated at minimum every 5 years.

[7] Contact ACR administrator for a Statement of Intent template document or basic requirements.

Project Field(s) at the Project Start Date and evidence of ongoing irrigation practices on like parcels in the same county. Any biogeochemical models used for GHG modelling must have proven capabilities to account for GHG influences from specific irrigation practices.

- Where livestock are present in the project scenario, manure is not managed, stored, or dispersed in liquid form. Livestock are primarily forage fed and not managed in a confined area, e.g., feedlot. There are no restrictions on the application of synthetic or organic amendments, i.e., manure, in the baseline scenario.
- The Project Area is located in the United States.

1.3 Periodic Reviews and Revisions

ACR may require revisions to this Methodology to ensure that monitoring, reporting, and verification systems adequately reflect changes to project activities. This Methodology may also be periodically updated to reflect regulatory changes, emission factor revisions, or expanded applicability criteria. Before beginning a project, the project proponent should ensure that they are using the latest version of the methodology.

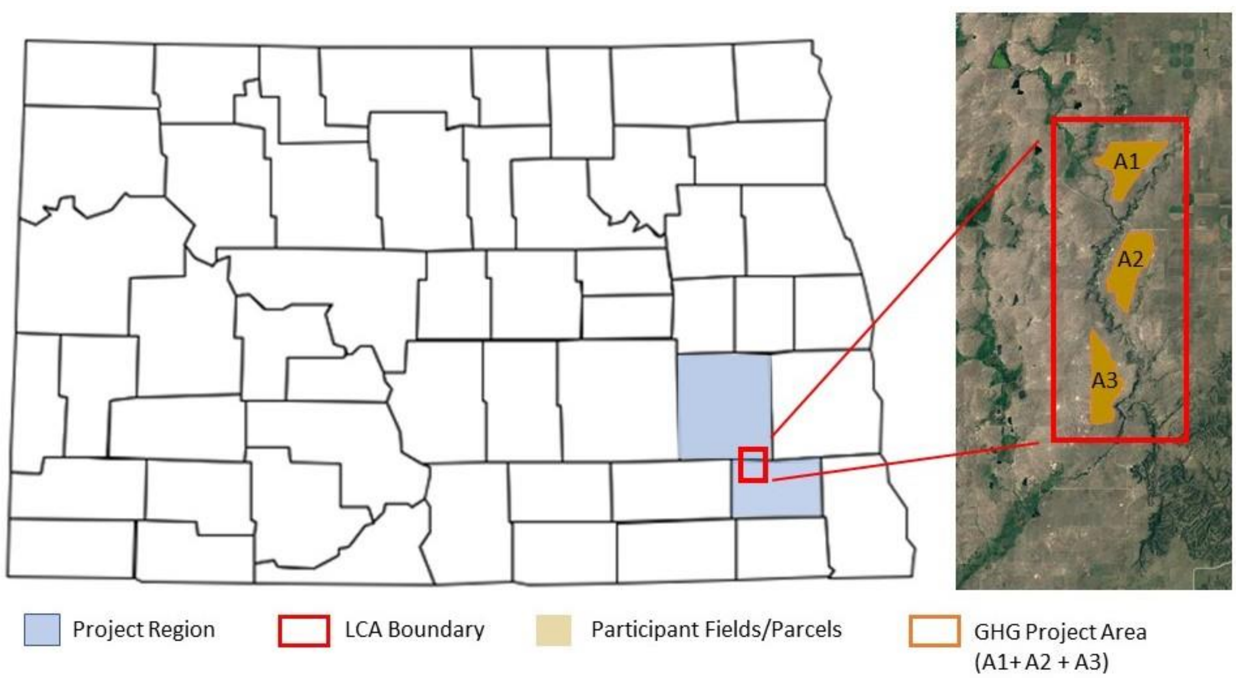
2 Project Boundaries

2.1 Spatial Boundary

2.1.1 FIELD, AREA, REGION BOUNDARY TERMS

Figure 1: Spatial Boundaries

Three spatial boundaries are relevant to this methodology: Participant Fields, Project Area and Project Region.



Participant Fields are the discrete parcels where project activities are implemented, when referred to individually.

All Participant Fields must be covered in full by the qualified LCA and an agreement specifying ownership of any ERTs issued, if not specified in the qualified LCA. The GHG project area (e.g., area within Participant Field boundaries) may be smaller than but must be completely within the qualified LCA boundary.

The Project Area is the collection of Participant Fields. Other areas that may fall within relevant property boundaries but for which Grassland-Shrubland to Cropland conversion is not applicable (e.g., non-Grassland or Shrubland land cover, waterways, residences, etc.) are not included in the Project Area.

The Project Region may be an eco-region or geographic administrative unit of relatively homogenous economic conditions and governance at which baseline activities are occurring, e.g., a state, county, watershed, irrigation district, Major Land Resource Area, etc. The Project Region is the highest-level geographical boundary and is used in this methodology for demonstrating baseline conditions identification of baseline management practices and the quantification of greenhouse gas emission reductions and avoidance, i.e., to define the applicability of models and emission factors. The Project Region shall be further stratified to account for heterogeneity within the Project Region according to the procedures in Section 4 Stratification.

In situations where the Project Proponent (e.g., an aggregator or developer) is not the Project Participant (e.g., an owner of a Participant Field), the Project Proponent must demonstrate that a qualified LCA restricts the management of conversion activities (e.g., via a conservation easement) for the duration of the Project Term on each Participant Field. In situations where the Project Proponent does not take fee-title possession of the land, a conveyance of the associated GHG benefits of the avoided conversion activity from the Project Participant to the Project Proponent must demonstrate clear ownership of any ERTs generated by the project activity.

2.1.2 RECORDING THE PROJECT AREA AND PROJECT REGION

Spatially explicit data files (e.g., shapefiles for GIS) recording the following boundaries must be provided in the GHG Project Plan:

1. Project Region
2. Project Area
3. Participant Fields
4. Wetlands, building envelopes, cultivated areas, streams, roads, gravel pits or other areas not covered by a sod-buster clause and/or excluded from but within the Project boundary
5. LCA Boundary[8]

[8] LCA boundary as recorded on the deed; if the LCA is not a recorded easement, adequate evidence, subject to verifier professional judgement, of due diligence in determining spatially accurate boundaries, must be provided.

6. ERT ownership boundary (if different than 3 or 5)

See Section 7 Monitoring and Data Collection for additional details.

The Project Area is the collection of shape file polygons for all individual Participant Fields boundaries and is not necessarily contiguous.

The Project Region(s) must include the entirety of the Project Area within its (their) boundaries. The Project Region(s) may be comprised of non-contiguous areas so long as all Participant Fields are contained within a Project Region (i.e., the Project Area must be fully contained within the boundaries of the Project Region(s)) and all Participant Fields are within the qualified LCA boundary.

All required shapefiles shall be made available in the GHG Project Plan at time of validation. Wetland acreage delineation can often be subjective given the influence of yearly precipitation and associated variability. Where wetland acres are explicitly accounted in the language of the qualified LCA or otherwise legally encumbered, Project Proponents are to rely on the qualified LCA language or other legal protections for identifying total wetland acreage that is ineligible. Spatially explicit boundary shapefiles must be provided that delineate the total wetland acres in the qualified LCA. These shapefiles can then be either directly uploaded into a GHG accounting platform, or overlaid with the soils maps provided through NRCS's Web Soil Survey (http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm) as required by biogeochemical models.

If wetland acres are not explicitly identified in the qualified LCA, Project Proponents must demonstrate at the time of project validation that no portion of the project area requires exclusion due to classification as a wetland, either permanent, emergent, seasonal or otherwise. Project Proponents must demonstrate to the satisfaction of the verifier that the project area is limited to the area that would reasonably be plowed under as part of conversion i.e., roads, building envelopes, infrastructure or wet areas are excluded.[9] These boundaries remain constant for the length of the project. The shapefiles delineating wetland acres must be provided and overlaid with the boundaries of the Participant Field(s).

[9] Verifiers may use SSURGO or other databases to inform the presence of soils that would be too wet or otherwise unsuitable for cultivation.

2.2 GHG Assessment Boundary

The GHG assessment boundary delineates the sources, sinks and reservoirs (SSRs) that must be included or excluded when quantifying the net changes in emissions associated with the avoided conversion of Grassland or Shrubland to Cropland.

All SSRs that are likely to result in a significant increase in GHG emissions or decreased carbon storage in the project scenario relative to the baseline must be accounted for, for each Participant Field.

Specific carbon pools and GHG sources, including carbon pools and GHG sources that cause project and leakage emissions, may be deemed de minimis and do not have to be accounted for if in aggregate the omitted decrease in carbon stocks (in carbon pools) or increase in GHG emissions (from GHG sources) amounts to less than three percent of the total ex ante estimate of GHG benefit generated by the project.

2.2.1 CARBON POOLS (RESERVOIRS)

Table 1: Carbon Pools

CARBON POOL	INCLUDED/ EXCLUDED	JUSTIFICATION
Tree biomass (above-ground, below ground)	Excluded	Tree biomass is conservatively excluded in both the baseline and project scenario.[10]
Above-ground non-tree, woody biomass	Optional	Likely to be a source of carbon loss in the baseline scenario and it is optional to include for both the baseline and project scenario. Where Project Proponents elect to include this pool in the project scenario, it must also be included in the baseline scenario.
Above-ground non-tree,	Optional	Likely to be a source of carbon loss in the baseline scenario and it is optional to include for both the baseline and project scenario. Where Project Proponents elect to

[10] All references to above-ground or below-ground biomass in this methodology are in reference to grassland, shrubland or cropland vegetation that does not meet the definition of a tree according to the U.S. Forest Service https://www.nrs.fs.fed.us/fia/data-tools/state-reports/glossary/default.asp

CARBON POOL	INCLUDED/ EXCLUDED	JUSTIFICATION
non-woody biomass		include this pool in the project scenario, it must also be included in the baseline scenario.
Litter	Excluded	Not a major pool in baseline or project scenarios.
Below-ground, non-tree biomass	Optional	Likely to be a significant source of carbon loss in baseline scenario. Projects may elect to account for below-ground biomass. Where Project Proponents elect to include this pool in the project scenario, it must also be included in the baseline scenario.
Soil organic carbon	Included	Major carbon pool subject to project activity.
Dead wood	Excluded	Not a major carbon pool in the baseline or project scenario.
Wood products	Excluded	Not a major carbon pool in the baseline or project scenario.

2.2.2 GHG SOURCES AND SINKS

Table 2: Greenhouse Gas Sources

SOURCE	GAS	INCLUDED/ EXCLUDED	JUSTIFICATION
Soil Management	CO_2	Included	Accounted for in soil organic carbon pool.
	CH_4	Excluded	Not a significant gas for this source.
	N_2O	Included	Covers direct emissions from synthetic and organic N amendment sources. Indirect emissions from synthetic and organic N amendments are excluded.[11]

[11] This methodology assumes that baseline emissions of N_2O (direct or indirect) due to N amendments are always larger than project emissions of N_2O.

SOURCE	GAS	INCLUDED/ EXCLUDED	JUSTIFICATION
Fossil Fuel Combustion	CO_2	Optional	Baseline emissions from fossil fuel are likely larger than in the project scenario and may be conservatively excluded. Where Project Proponents elect to include this pool in the project scenario, it must also be included in the baseline scenario.
	CH_4	Excluded	Not a significant gas for this source.
	N_2O	Excluded	Not a significant gas for this source.
Biomass Burning	CO_2	Excluded	Accounted for in biomass pools.
	CH_4	Excluded	Not a significant gas for this source.
	N_2O	Excluded	Not a significant gas for this source.
Livestock Emissions	CO_2	Excluded	Not a significant gas for this source.
	CH_4	Optional	When livestock are present in the baseline and/or project scenario, this is a major source of emissions and must be included.
	N_2O	Excluded	Emissions of N_2O from livestock waste are captured under Soil Management emissions.

2.3 Temporal Boundary

The dates and time frames for the following project events must be defined in the GHG Project Plan:

- Project Start Date for each Participant Field enrolled
- Project Crediting Period start and end dates
- Date of submittal of Project listing with ACR (date when GHG Project Plan was initially submitted) for initial Participant Fields if a PDA Project
- Date of signature of the agreement specifying ownership of ERTs (if project proponent is not participant field(s) landowner)

- Date of submittal of Statement of Intent to ACR (if project proponent is participant field(s) landowner)
- Projected dates and intervals of revaluation of baseline inputs (at minimum once every 5 years)
- Projected dates of enrollment[12] and validation for new Participant Fields included in the project, if applicable[13] and actual dates as Participant Fields are enrolled.
- Demonstration that each Participant Field was in a Grassland or Shrubland land cover at least 10 years prior to time of executing the qualified Land Conservation Agreement.

The GHG Project Plan shall also include anticipated timeline for monitoring, reporting, and/or verification activities.

2.3.1 START DATE

The earliest Project Start Date for AFOLU projects is specified in the most recent version of the *ACR Standard*.

The Project Start Date for this project type is the date on which the qualified LCA is recorded. The project shall be submitted for listing with ACR no more than 3 years after the date upon which the qualified LCA is recorded.[14]

2.3.2 CREDITING PERIOD

The Project Crediting Period must begin no earlier than the project start date.[15] The Project Crediting Period is the timeframe in which changes are conservatively estimated to occur in a Participant Field's terrestrial carbon pools, i.e., the time as predicted by a biogeochemical model or field

[12] The enrollment date is the date where a landowner entered into an agreement with the Project Proponent if not the landowner or the date where a new parcel was added to an existing GHG project plan where the landowner is the Project Proponent.

[13] Projects expecting to add new Participant fields over time must follow the requirements for Programmatic Design Approach in the *ACR Standard*.

[14] See *ACR Standard* Section 6A for Project Development Process, requirements for the step Project Listing. The Statement of Intent to develop or participate in a carbon project on the part of the land owner is separate from Project Listing and is required within 12 months of the LCA being recorded. Please contact ACR Administrator for a Statement of Intent template document or requirements.

[15] The start of the first reporting period may be after the project start date such that a project may forego credit issuance for a period of time in order to delay verification provided the validation occurs within 3 years of the start date.

measurements[16] that soil carbon loss would continue to occur in the baseline scenario of conversion to Cropland. The Crediting Period must be at least 5 years but no more than 40 years and cannot be renewed.

The establishment of the baseline scenario as conversion to Cropland is valid for the duration of the Project Term following a successful initial validation. Updates to the project's baseline land management scenarios shall occur at least once every five years from the project start date.[17]

2.3.3 PROJECT TERM

The Minimum Project Term refers to the required duration of crediting, monitoring and reporting of Project Activities. The minimum Project Term for AFOLU projects with a risk of reversal is defined in the latest *ACR Standard*.

[16] When changes in the soil carbon pool are not modeled and a default value 20 years is used for the parameter D, the transition period between soil organic carbon equilibrium states, the crediting period is also 20 years and cannot be renewed (See Appendix A).

[17] Verifications are required at the same minimum frequency (5 years) but updates to the baseline cropland management scenario not required at every verification necessarily.

3 Baseline Determination and Additionality

3.1 Baseline Determination

The baseline scenario is the conversion of Grassland or Shrubland to Cropland. Baseline determination requires: 1) demonstration of the land-use scenario of cropland in the absence of the project activity and 2) description of the avoided cropland management practices. Baseline determination should be performed in conjunction with Section 3.2 Additionality Assessment. The baseline land use scenario of conversion to cropland, once determined, is static and made ex ante, with no adjustments during the Project Term. The baseline management scenario must be updated every 5 years, as outlined below in 3.1.2.

3.1.1 DETERMINE BASELINE LAND-USE SCENARIO

All Participant Fields must demonstrate that Cropland is the likely land use scenario in the absence of the project activity with conversion of Grassland or Shrubland to Cropland occurring via either an identified or unidentified agent.

3.1.1.1 Conversion Via an Unidentified Agent

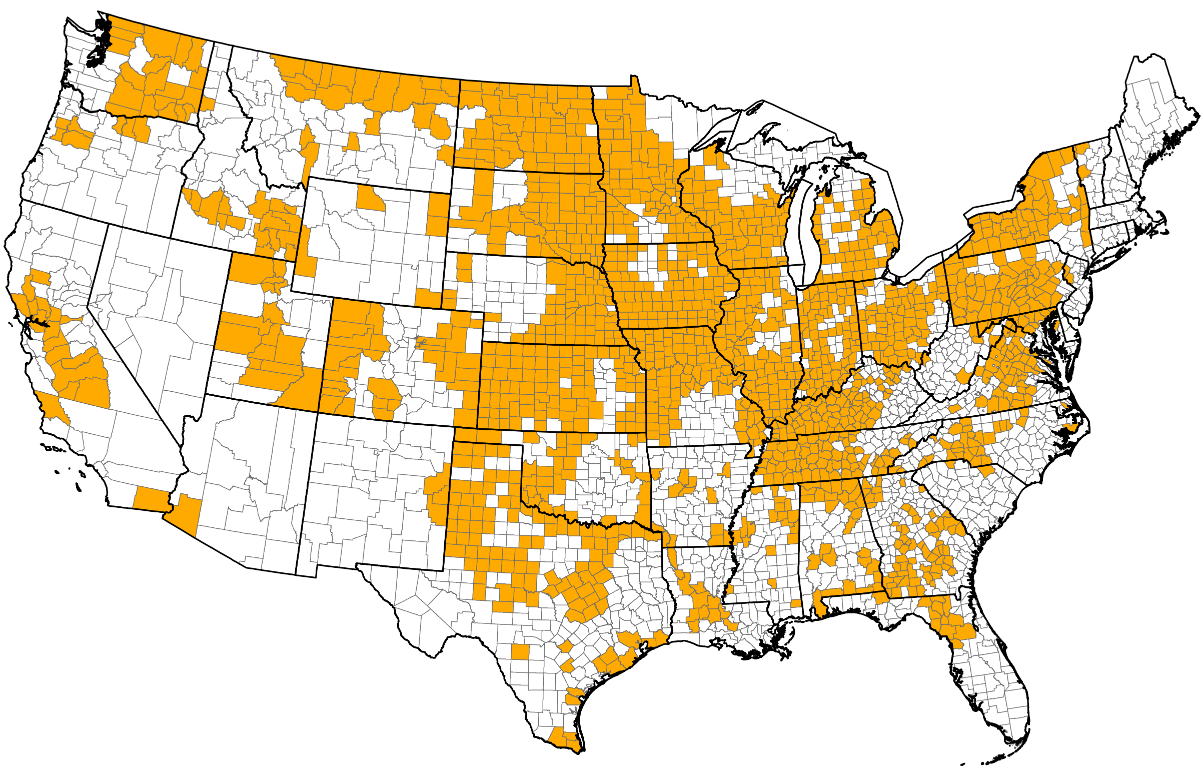
The baseline land use scenario is Cropland for all Participant Fields located in counties shown in the map below, listed in Appendix B and meeting all criteria in Section 1.2.

3.1.1.2 Conversion Via an Identified Agent

The baseline land use scenario is Cropland for all Participant Fields not located in counties shown in the map below and listed in Appendix B but: 1) meet all criteria in Section 1.2 and 2) are unambiguously identified in written rental or purchase offers with Cropland named as the intended use OR unambiguously identified in other documentation, subject to verifier and ACR review, including landowner affidavits, that can demonstrate a threat to conversion to cropland.

Figure 2: County Map for Unidentified Agents of Conversion, Baseline Land Use Scenario and Practice-Based Performance Standard

Project fields/parcels located in the counties highlighted in orange have a baseline scenario of cropland for unidentified agents of conversion and surpass the practice-based performance standard for demonstrating additionality. Project fields/parcels in white counties must determine the baseline land-use scenario and demonstrate additionality according to sections 3.1.1.2 and 3.2.2.2 respectively.



3.1.2 DETERMINE BASELINE CROPLAND MANAGEMENT SCENARIO

The baseline crop management scenario is determined ex ante and must be updated at minimum every 5 years from the project start date for the duration of the project term. This re-assessment updates the avoided crop management practices (i.e., the baseline) for the subsequent 5-year period. The baseline management scenario for the previous 5 years will not be altered. New baseline management scenarios are applied to all Participant Fields, including those previously enrolled, such that the baseline scenario for each Participant Field may change every 5 years.[18]

Required projected baseline management practices are listed below. Management practices (including as inputs to approved biogeochemical models) shall be informed from producer surveys conducted by government agricultural agencies or university extension offices;[19] the expert opinion of university extension personnel working in the region and systems of interest; personnel of a governmental agriculture agency field office (e.g., United States Department of Agriculture's Risk Management Agency, Farm Service Agency, Natural Resources Conservation Service) with jurisdiction in the Project Region; or Cropland management plans approved by a lending agency. Alternatively, a survey conducted by the Project Proponent may be used where the above sources are unavailable, unreliable or outdated, or aggregated at a scale larger than the Project Region.

The following baseline data should be defined:

- Field preparation techniques
- Tillage practices and intensity
- Typical cropping sequence (including fallow)
- Timing of planting and harvest of all crops
- Average applied N rates per identified crop
- Type of applied N and application methods employed
- Average application rates of other nutrients, or inputs, if applicable
- Irrigation practice and frequency
- Presence and type of cover crop
- Residue management practice

[18] Verifications are required at the same minimum frequency (5 years) but updates to the baseline cropland management scenario not required at every verification necessarily.

[19] The smallest geographic extent for such data shall be used. For example, if fertilizer rates are available at the county level and state level, the county-level estimate shall be used.

- Fire practice and frequency
- Other necessary inputs for modeling relevant biogeochemical processes
- Stocking rates, season dates for grazing, livestock type
- Equipment types and usage or volumes of fossil fuels by type

3.2 Additionality Assessment

Avoided emissions from the project must be additional. Assessment of the additionality of a project will be made based on passing the tests cited below. These tests require the project proponent to demonstrate that the project activity is surplus to regulations and reduces emissions below "business-as-usual" for rates of conversion of grassland to cropland in the U.S.

- Regulatory Surplus Test (all participant fields)
- Practice Based Performance Standard (participant fields in counties in Appendix B) OR Implementation Barrier (participant fields in all other U.S. locations)

3.2.1 REGULATORY SURPLUS TEST

The project activity must meet the requirements of regulatory surplus set out in the latest *ACR Standard*. The project activity shall not be mandated by any law, statute or other regulatory framework. Specifically, there must not be any federal, state, or local regulations for the project region/area (pre-existing or subsequent), nor other pre-existing legally binding contracts, deed restrictions or encumbrances that require the project fields to be maintained as grassland other than the LCA that is recorded for the project (assessed at Project Start Date and upon initial verification). Furthermore, there must be no federal, state, or local regulation which would prohibit ongoing management of the project area as cropland in the baseline scenario (assessed at Project Start Date and initial verification).

Voluntary agreements that can be rescinded, such as rental contracts, are not considered legal requirements. Non-perpetual payment programs administered by government entities (e.g., Conservation Reserve Program) are not considered legal barriers to participation in a carbon offset program, given that the recordation of a new perpetual 99-year easement would disqualify the lands from continued participation in any such program. Enhancement payments administered by government entities (e.g., Environmental Quality Incentives Program or Conservation Stewardship Program) do not purport to pay for the preservation of grasslands, and thus, are considered compliant with this methodology's regulatory surplus requirements.

3.2.2 PRACTICE-BASED PERFORMANCE STANDARD (IF APPLICABLE)

3.2.2.1 Unidentified Agent

Participant Fields located in counties listed in Appendix B pass the Practice Based Performance Standard Test. Participant Fields which meet the eligibility criteria for this methodology can use the performance standard to demonstrate additionality without providing additional implementation barrier analysis.

An assessment of the rate at which unencumbered (available for conversion) Grassland and Shrubland acres as defined by the NCDL on a per county basis were converted to the Cropland land use type over a 10-year period, shows that the counties listed in Appendix B experience a high rate of loss of Grassland and Shrubland to Cropland.[20] Conversion of Grassland and Shrubland to Cropland is considered common practice in these areas, therefore the activity of encumbering fields within a qualified LCA in these counties is considered beyond business as usual.

3.2.2.2 Identified Agent

Participant Fields not located in counties listed in Appendix B may also pass the Practice Based Performance Standard Test when a specific agent of conversion has been identified. Participant Fields which meet the eligibility criteria for this methodology and can document likelihood to conversion via an identified agent and can use the performance standard to demonstrate additionality without providing additional implementation barrier analysis.

The county level analysis conducted to produce the maps in Appendix B may not reflect recent hot spots of conversion, real threats at a smaller scale than county level or where data is incorrect or lacking in the underlying databases. In instances where the Project Participants have received an offer

[20] Counties listed in Appendix B represent the top 50% of U.S. counties in terms of loss of available Grassland and Shrubland to Cropland. Loss rates in these counties represent areas where grassland loss in the United States is most extreme, relative to current conditions in the U.S. This calculation produced a county list of grassland conversion rates, normalized by the unique number of grassland/shrubland acres available for conversion in each county in each time step. It would be inaccurate to assume that one county is more at-risk just because more cumulative grassland acres were converted compared to another. By deriving the proportion of converted acres in relation to the grassland base acreage, the analysis avoids this potential bias. A brief description of the analysis to determine counties with high rates of conversion where Grasslands and Shrublands are most under threat can be found in Appendix B. The analysis will be updated every 5 years to reflect the current areas of highest conversion in the United States.

to rent or purchase the Participant Fields for the purposes of cultivation or can otherwise document such an offer, conversion of grassland and shrubland to cropland is considered common practice in this area (as it is a demonstrable threat), therefore the activity of encumbering fields within a qualified LCA is considered beyond business as usual.

Projects do not need to reassess additionality with each verification during their crediting period. However, ACR will re-assess the performance standard every 5 years.

4 Stratification

The objective of stratification is to reduce uncertainty of pool and emission estimates at the Project Area level.

When the DAYCENT model (or other approved process based biogeochemical models) are used for quantification of carbon pools, spatial heterogeneity must be accounted for in both baseline and project scenarios via stratification, for example, soil type, climate, cropping scenario and/or previous land use history. For modeling efforts, this requires parameterizing and running the model for each stratum and estimating parameter values separately for
each category. The stratification approach must be included in the GHG Project Plan and is subject to verifier review during project validation.

When soil sampling is conducted in the Project Area and this area is not homogeneous, stratification may be used to improve the precision of carbon stock estimates. For estimation of baseline carbon stocks, strata may be defined by parameters that are key variables for estimating changes in baseline and project carbon stocks, for example: soil type, climate, cropping scenario and/or previous land use history.

Stratification accuracy, precision and details such as sample design and plot selection shall be determined following best practices and detailed in the GHG Project Plan. Stratification must consider the biogeochemical and/or empirical models (see Chapter 5) that will be applied for the methodology, where each stratum can be represented by a unique model parameterization. It is not necessary to use the same stratification categories for each pool or for baseline and project scenarios.

5 USE OF MODELS FOR QUANTIFICATION OF GHG EMISSIONS

Under this methodology, the following classes of models shall be used to quantify carbon pools and GHG emissions:

1. Process based biogeochemical models (e.g., DAYCENT)
2. Empirical models based on time series measurements and proxy sites

The DAYCENT model is approved for use with this methodology throughout the continental United States, excluding Alaska. Additional process based biogeochemical models may be approved by ACR,[21] according to the criteria specified in the *ACR Standard*, Section A.6.

Empirical models may be approved on a case by case basis where available. Please contact ACR for approval of new empirical models for use with this methodology. Proposed models shall, at a minimum, meet the following criteria:

- Be published in peer-reviewed, scientific literature;
- Be empirically based;
- Be able to account for changes to soil organic matter and nutrient dynamics that occur following the conversion of Grassland or Shrubland to Cropland;
- Be able to estimate size of relevant carbon pools on an annual basis (mass of carbon/year);
- Be able to make predictions at the scale of a Stratum or Project Area, whichever is smallest;

[21] Proposed biogeochemical or empirical models will be reviewed by ACR and/or Winrock staff as well as ACR's AFOLU Technical Committee. ACR's AFOLU Technical Committee supports the objective of bringing to market high-quality AFOLU carbon offsets based on scientifically sound methodologies. The AFOLU Technical Committee will provide ACR independent advice on a range of agriculture, forestry, grassland, rangeland, wetland and other land-use topics needed for greenhouse gas (GHG) methodologies being brought to ACR and/or developed by Winrock. ACR approves new methodologies, tools and significant methodology modifications through a process of public consultation and expert peer review. The AFOLU Technical Committee will not replace that process, but rather complement it. This is a standing committee with a subset of Committee members, serving on two-year terms, consulted for specific issues that match their expertise.

- A baseline site must be identified and accessible on which one or more parameters are monitored in the baseline scenario; baseline and project site must have similar soil types, climate, and management history.[22]
- Directly measure soil carbon (soil carbon loss) in baseline and project sites OR dependent variable is soil carbon (soil carbon loss) and relationship between proxy variable and emissions must be significant at $P < 0.1$ and unbiased (i.e., with minimal trend in residuals)
- Uncertainty in predicted soil carbon loss (emissions - dependent variable) is known and calculated as the root mean squared error (RMSE);
- Be validated for the Project Region to demonstrate that the model can accurately estimate each carbon pool and GHG source in the Project Region including the management systems identified in both the project and baseline scenario and regional weather and climate conditions (average annual precipitation and temperature) applicable to the Project Area. Model validation shall use peer-reviewed or other quality-controlled data (i.e., such as that collected as part of a Government soils inventory or experiment), appropriate for the Project Region. For an example see Ahlering et al. (2016) or Chamberlain et al. (2011).
- Be based on a time series experimental design that includes cropped and grassland sites and t=0 is the conversion event

Output from models should include estimates of uncertainties associated with all pools and sources. In cases where variances are not included in model outputs, additional uncertainty analyses should be performed (e.g., Monte Carlo simulations). In cases where input variances can be calculated through Monte Carlo simulations, then these shall be performed and reported as well. See Section 6.5 Uncertainty Assessment and Conservativeness.

[22] Suitability of the project and baseline sites ultimately to the discretion of the verifier and ACR validation review

6 QUANTIFICATION OF GHG EMISSIONS REDUCTIONS

6.1 Quantification of Baseline GHG emissions

Baseline GHG emissions for all Participant Fields in the project area in a single year are calculated according to Equation 1. Baseline emissions for a single Participant Field are calculated according to Equation 2.

Equation 1: Baseline Emissions

$$\mathbf{BE_y = \sum_{p}^{P} BE_{p,y}}$$

WHERE

BE_y	Baseline emissions in year y, y = 0 at project start date; $MTCO_2e$
$BE_{p,y}$	Baseline emissions from Participant Field p in year y; $MTCO_2e$
P	Total number of Participant Fields in the Project Area
p	Participant Field
y	Year

Equation 2: Baseline Emissions from Each Participant Field

$$\mathbf{BE_{p,y} = \left(C_{AGB,BL_{p,y-1}} - C_{AGB,BL_{p,y}} + C_{BGB,BL_{p,y-1}} - C_{BGB,BL_{p,y}} + C_{SOC,BL_{p,y-1}} - C_{SOC,BL_{p,y}}\right) + E_{N_2O,BL_{p,y}} + E_{FERM,BL\ p,y} + E_{FF,p,y}}$$

WHERE

$BE_{p,y}$	Baseline emissions from Participant Field **p** in year **y**; $MTCO_2e$
$C_{AGB,BL_{p,y}}$	Carbon stock of above-ground biomass for Participant Field **p,** in year **y,** in the baseline scenario; $MTCO_2e$ (optional)
$C_{BGB,BL_{p,y}}$	Carbon stock of below-ground crop biomass for Participant Field **p,** in year **y,** in the baseline scenario; $MTCO_2e$ (optional)
$C_{SOC,BL_{p,y}}$	Carbon stock of soil organic carbon for Participant Field **p,** in year **y,** in the baseline scenario; $MTCO_2e$
$E_{N_2O,BL_{p,y}}$	N_2O emissions from Participant Field **p,** in year **y** in the baseline scenario for; $MTCO_2e$
$E_{FERM,\mathbf{BL}\ p,y}$	CH_4 emissions from livestock – enteric fermentation in Participant Field **p** in year **y** in the baseline scenario; $MTCO_2e$
$\mathbf{E_{FF,p,y}}$	Emissions due to the use of fossil fuels in agricultural management in field **p** and year **y** in the baseline scenario; $MTCO_2e$ (optional)

6.1.1 ACCOUNTING BASELINE EMISSIONS FROM ABOVEGROUND BIOMASS (WOODY AND NON-WOODY)

Accounting for this pool is optional. If included, woody biomass is non-tree. If included, in the baseline scenario, projects must account for remaining Grassland and Shrubland aboveground biomass as Participant Fields are converted over time, as well as the aboveground biomass in annual crops grown following conversion. The aboveground biomass in the baseline scenario shall be calculated each year according to Equation 3.

Equation 3: Baseline Above Ground Biomass

$$C_{AGB,BL_{p,y}} = C_{AGB_{grass},BL_{p,y}} + C_{AGB_{crop},BL_{p,y}}$$

WHERE

$C_{AGB,BL_{p,y}}$	Carbon stock of aboveground biomass in Participant Field **p** in year **y** in the baseline scenario; $MTCO_2e$

$C_{AGB_{grass},BL_{p,y}}$	Remaining carbon stock of pre-existing aboveground biomass for Participant Field **p** in year **y** in the baseline scenario; $MTCO_2e$
$C_{AGB_{crop},BL_{p,y}}$	Carbon stock of aboveground crop biomass in Participant Field **p** in year **y** in the baseline scenario, as calculated from Section 6.1.1.2; $MTCO_2e$

6.1.1.1 Carbon Stocks of Woody and Non-woody, Non-crop Aboveground Biomass ($C_{AGB,\ grass,BL,p,y}$)

In the conversion of Grassland to Cropland, this methodology treats carbon in aboveground, biomass[23] to be primarily released to the atmosphere in the first 5 years following conversion. Projects that opt to account for the removal of aboveground biomass in conversion to Cropland will do so by first quantifying initial carbon stocks for above-ground grass and shrub biomass in the project scenario (see Section 6.2.1). That is, for projects accounting for the loss of aboveground biomass due to conversion, the initial (year y=0) carbon stocks in aboveground biomass for each Participant Field in both the project and baseline scenarios shall be equal and based upon the estimation of initial carbon storage in aboveground biomass.

The loss of carbon from aboveground biomass due to conversion shall be based upon the proportion of that field that is converted and the decomposition of biomass in the portion of the field that is converted. The most conservative scenario is that biomass would decompose as slow as litter in an untilled Cropland.[24] Project Proponents may use a less conservative estimate of 100% decomposition of aboveground biomass the year following conversion in cases where tillage is used in the baseline scenario. The aboveground biomass estimate, for biomass from the project scenario, shall be the annual peak biomass, i.e., maximum annual growth prior to grazing, harvest or other disturbance.

[23] Because this methodology treats the loss of aboveground biomass upon conversion as lost to the atmosphere over a 5-year period, projects are permitted to account for aboveground biomass that is lost upon conversion to Cropland. However, project may not include aboveground Tree biomass in this calculation as the decay period is much longer. Tree biomass removed from the Participant Field during conversion in the baseline scenario may be expected to decay over several years and/or some portion could remain intact over long periods in harvested wood products. This methodology conservatively excludes accounting for the loss of aboveground Tree biomass in the baseline scenario.

[24] Most fields are prepared for conversion to Cropland by destroying existing aboveground biomass through herbicide application and plowing, although it is possible to direct seed into Grassland.

Equation 4: Baseline Carbon Stocks of Woody and Non-Woody, Non-Crop Above Ground Biomass Loss

$$C_{AGB_{grass},BL_{p,y}} = C_{AGB,PR_{p,y}} \times \left(1 - \sum_{t=0}^{y} FC_{p,t,y}\right) + C_{AGB,PR_{p,y}} \times \sum_{t=0}^{y}\left(FC_{p,t,y} \times e^{(-0.77 \times (y-t))}\right)$$

WHERE

$C_{AGB_{grass},BL_{p,y}}$	Carbon stock of aboveground woody and non-woody biomass from Participant Field **p** in year **y** in the baseline scenario; MT CO_2.
$C_{AGB,PR_{p,y}}$	Carbon stock of aboveground non-woody biomass for Participant Field **p**, in the project scenario, as determined from Section 6.2.1; $MTCO_2e$
$FC_{p,t,y}$	The proportion of Participant Field **p** that is converted to Cropland in year **t**, time of conversion, in year **y** of the baseline scenario. If the entire field will be converted in year 1, **FCp,t,y** =1, d.u.
$e^{(-0.77 \times (y-t))}$	Decay rate of aboveground biomass following conversion. Note that because conversion often occurs over multiple years, and decay is a nonlinear function, it is necessary to track carbon loss from a given year's conversion event. The decay rate (0.77) is based on leaf decomposition in no-till Cropland (Kochsiek et al. 2009)
t	Time since conversion of Grassland to Cropland in the baseline scenario, maximum value of 40 years

6.1.1.2 Carbon Stocks of Aboveground Crop Biomass ($C_{AGB,crop,BL,p,y}$)

In the baseline scenario, the aboveground biomass each year is assumed equal to biomass losses from harvest and mortality in that same year. There is no carryover of aboveground crop biomass between years. There is no net accumulation of aboveground biomass stocks once areas have been converted for the duration of the Project Crediting Period (IPCC GL AFOLU 2006, Ch. 5, 5.2.1.1). After 100% conversion for a Participant Field, $C_{AGB_{crop},BL_{p,y}}$ will remain static, except in rotational cropping systems where aboveground biomass values will conform to each crop year.

$C_{AGB_{crop},BL_{b,y}}$ can be estimated by either:

- Approved models (see Section 5)[25]
- Field measurements for crop or forage productivity and Project Region published in peer reviewed literature
- Agricultural statistics for crop or forage productivity and Project Region, including State Agricultural Extension Offices
- Values for the annualized average dry matter ($DMBL,p,y$) and carbon fraction (CFb) for each crop type (Equation 6). Values for $DMBL,p,y$ can be obtained from fixed ratio of crop yield to plant biomass, the Harvest Index ratio, available from peer reviewed literature, or government or University extension for crop and region of interest. A default harvest index of 0.50 can be used for maize (Ciampitti and Vyn 2012), of 0.46 for soybean (Johnson et al. 2006), and 0.45 for wheat (Johson et al. 2006). 5-year average crop yields must be used and yield data obtained from government or extension crop yield reports for the smallest available administrative unit containing the Participant Field, e.g., county.

Carbon stocks in aboveground crop biomass in the baseline scenario should be calculated for each Participant Field in the Project Area, each year according to Equations 5 and 6.

Equation 5: Baseline Above Ground Crop Biomass

$$C_{AGB_{crop},BL_{p,y}} = \sum_{b}^{B} C_{AGB_{crop},BL_{b,y}}$$

WHERE

$C_{AGB_{crop},BL_{p,y}}$	Carbon stock of aboveground crop biomass for Participant Field **p** in the baseline scenario in year **y;** $MTCO_2e$
$C_{AGB_{crop},BL_{b,y}}$	Carbon stock of aboveground crop biomass in the baseline for crop type **b** in year **y**; $MTCO_2e$
B	Total number of crop types

[25] Where process models require specific crops in a given year, crop selection and assignment to years shall not be done in a manner that would underestimate $C_{AGB_{crop},BL_{b,y}}$.

Equation 6: Baseline Above Ground Crop Biomass for Crop Type b

$$C_{AGB_{crop},BL_{b,y}} = DM_{BL,b,y} \times CF_b \times \frac{44}{12} \times A_b$$

WHERE

$C_{AGB_{crop},BL_{b,y}}$	Baseline above ground crop biomass for crop type b
$DM_{BL,b,y}$	Annualized average dry matter in the baseline for crop type **b** in year **y**; MT dry matter per ha
CF_b	Carbon fraction of dry matter for biomass type **b**; MT-C (MT dry matter)$^{-1}$
A_b	Area of crop type **b**; hectares
$\frac{44}{12}$	Ratio of molar mass of CO_2 to **C**

6.1.2 ACCOUNTING BASELINE EMISSIONS FROM BELOWGROUND BIOMASS

Accounting for this pool is optional. If included, woody biomass is non-tree (i.e., shrubs). The conversion of Grassland to Cropland is expected to result in the removal or rapid decomposition of belowground biomass.

$C_{BGB,BL_{p,y}}$ can be estimated by either:

- Approved models (see Section 5)[26]
- $C_{AGB,BL_{p,y}}$ (Equation 3) and appropriate root-to-shoot ratios for crop and woody and non-woody components

Below-ground biomass carbon stocks are assumed to decompose at a rate specified in Equation 8 upon conversion to Cropland in the baseline scenario.

[26] Where process models require specific crops in a given year, crop selection and assignment to years shall not be done in a manner that would underestimate $C_{BGB,BL_{p,y}}$.

Equation 7: Baseline Belowground Biomass

Carbon stocks in belowground biomass in the baseline shall be calculated for each Participant Field in the Project Area according to Equation 7.

$$C_{BGB,BL_{p,y}} = C_{BGB_{grass},BL_{p,y}} + C_{BGB_{crop},BL_{p,y}}$$

WHERE

$C_{BGB,BL_{p,y}}$	Carbon stock of belowground biomass in Participant Field **p** in year **y** in the baseline scenario; $MTCO_2e$
$C_{BGB_{grass},BL_{p,y}}$	Carbon stock of woody and non-woody belowground biomass for Participant Field **p** in year **y** in the baseline scenario; $MTCO_2e$
$C_{BGB_{crop},BL_{p,y}}$	Carbon stock of belowground crop biomass in Participant Field **p** in year **y** in the baseline scenario; $MTCO_2e$

6.1.2.1 Accounting Carbon Stocks of Woody and Non-woody, Non-crop Belowground Biomass ($C_{BGB,grass,p,y}$)

Projects that opt to account for the decomposition or removal of belowground biomass in conversion to Cropland will do so by first quantifying initial carbon stocks for belowground woody and non-woody biomass in the project scenario (see Section 6.2.2 Below-Ground Biomass). That is, for projects accounting for the loss of belowground biomass due to conversion, the initial (year y=0) carbon stocks in belowground biomass for each Participant Field in both the project and baseline scenarios shall be equal and based upon the estimation of initial carbon storage in belowground biomass.

The loss of carbon from belowground biomass due to conversion shall be based upon the proportion of that field that has been converted ($FC_{p,t,y}$) and the decomposition of biomass in the portion of the field that was converted. The decomposition rate is specified in Equation 8.

Equation 8: Baseline Pre-existing Belowground Grass Biomass

$$C_{BGB_{grass},BL_{p,y}} = C_{BGB,PR_{p,y}} \times \left(1 - \sum_{t=0}^{y} FC_{p,t,y}\right) + C_{BGB,PR_{p,y}} \times \sum_{t=0}^{y} FC_{p,t,y} \times e^{(-1.41 \times (y-t))}$$

WHERE

$C_{BGB_{grass},BL_{p,y}}$	Carbon stock of belowground woody and non-woody biomass from Participant Field **p** in year **y** in the baseline scenario; $MTCO_2e$
$C_{BGB,PR_{p,y}}$	Carbon stock of belowground biomass for Participant Field **p**, in year **y,** in the project scenario, as determined from Section 6.2.2; $MTCO_2e$
$FC_{p,t,y}$	The cumulative proportion of Participant Field **p** that has been converted to Cropland in year **t**, time of conversion, as of year **y** in the baseline scenario. If the entire field will be converted in year 1, $FC_{p,t,y}$ =1, d.u.
$e^{(-1.41 \times (y-t))}$	The decay function for belowground biomass following conversion. Note that because conversion often occurs over multiple years, and decay is a nonlinear function. It is necessary to track carbon loss from a given year's conversion event, and then sum the loss from all years, as shown in Equation 8. The decay rate (1.41) is based on average grass root decomposition from 46 studies (Silver and Miya 2001). For woody biomass, a decay rate of 0.44 should be used for broadleaved species and a decay rate of 0.30 should be used for conifer species (Silver and Miya 2001)[27]
t	Time since conversion of Grassland to Cropland in the baseline scenario, maximum value of 40 years

6.1.2.2 Accounting Carbon Stocks of Belowground Crop Biomass

$C_{BGB_{crop},BL_{b,y}}$ can be estimated by:

[27] Project Proponents may replace the default decomposition rate with a site-specific value based on peer reviewed literature.

- Approved models (see Section 5)[28]
- Field measurements for crop or forage productivity and Project Region published in peer reviewed literature
- Agricultural statistics for crop or forage productivity and Project Region, including State Agricultural Extension Offices
- $C_{AGB_{crop},BL_{b,y}}$ and suitable root-to-shoot ratio for crop and region (Equation 9). For maize a default value of 0.07 should be used.[29]

If using a root-to-shoot ratio, carbon stocks in belowground crop biomass in the baseline scenario should be calculated for each Participant Field in the Project Area, each year, and for each crop according to Equation 9.

Equation 9: Baseline Belowground Crop Biomass Using Root to Shoot

$$C_{BGB_{crop},BL_{p,y}} = \sum_{b}^{B} R_b \times C_{AGB_{crop},BL_{b,y}}$$

WHERE

$C_{BGB_{crop},BL_{p,y}}$	Carbon stock of belowground crop biomass for Participant Field **p** in the baseline scenario in year **y**; $MTCO_2e$
R_b	Root carbon-to-shoot carbon ratio of (crop) biomass type **b**; d.u.
$C_{AGB_{crop},BL_{b,y}}$	Carbon stock of aboveground crop biomass of crop type **b** and year **y** of the baseline scenario, as calculated in 6.1.1; $MTCO_2e$
B	Total number of crop types

[28] Where process models require specific crops in a given year, crop selection and assignment to years shall not be done in a manner that would underestimate $C_{BGB_{crop},BL_{b,y}}$.

[29] This is based on a comprehensive analysis of root-to-shoot ratios in maize (Amos and Walters 2006). The review of root-to-shoot ratio in maize provides a value based on an analysis that does not include grain or cobs in its measure of shoot; our default value represents a modified value that can be used to calculate root biomass based on total aboveground biomass, including grain and cobs (Amos and Walters 2006).

6.1.3 ACCOUNTING BASELINE EMISSIONS FROM SOIL ORGANIC CARBON

Accounting for this pool is required. The soil carbon pool is expected to be the primary source of emissions for the project activity, as soil carbon accounts for approximately 90% of ecosystem carbon in Grassland and rangeland systems (Schuman et al. 2001).

$C_{SOC,BL_{p,y}}$ can be estimated by:

- Approved models (see Section 5).[30] This method assumes emissions from SOC following conversion proceed according to the best fit decay curve to the model SOC and for the time up until when SOC levels in the model are changing by no more than ± 3%, not to exceed 40 years.
- Direct measurement of SOC according to requirements in ISO 10381-2:2003 Soil quality – sampling – Part 2: Guidance on sampling techniques.[31] This method assumes the emissions from SOC following conversion proceed linearly for 20 years (i.e., D = 20), at which point a new equilibrium level of SOC is reached in the converted state. A linear EF function may be used per the IPCC GL AFOLU 2006 (adapted from Eq. 2.25, Ch2, p 2.30).[32, 33]
- Direct measurement of SOC according to requirements in ACR Tool for Estimation of Stocks in Carbon Pools and Emissions from Emission Sources.[34] This method assumes the emissions from SOC following conversion proceed linearly for 20 years (i.e., D = 20), at which point a new equilibrium level of SOC is reached in the converted state. A linear EF function may be used per the IPCC GL AFOLU 2006 (adapted from Eq. 2.25, Ch2, p 2.30).[35]

Whatever approach is deployed, estimates should be available to the affected depth at which SOC changes are expected to occur in response to baseline activities.[36] The affected depth chosen for sampling or modeling shall be justified to the validator using peer-reviewed scientific data and/or

[30] Where process models require specific crops in a given year, crop selection and assignment to years shall not be done in a manner that would underestimate $C_{BGB_{crop},BL_{b,y}}$.

[31] Please see Section B.1.1 Stratification.

[32] http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_02_Ch2_Generic.pdf

[33] Determination of the equilibrium SOC value resulting after a linear decay of 20 years requires the selection of an appropriate proxy site or chronosequence study. Site similarity or appropriateness must be demonstrated satisfactorily at the time of validation or a literature study used which meets the standards of best practice for soil chronosequence studies by the USGS e.g., https://pubs.usgs.gov/bul/1648/report.pdf.

[34] Please see Section B.1.1 Stratification.

[35] http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_02_Ch2_Generic.pdf

[36] Recent syntheses commonly find losses of soil carbon down to 1 meter (Sanderman et al. 2017).

professional expert opinion. Further, direct sampling shall separate and exclude visible root biomass from SOC estimates. If models are utilized, they shall similarly be calibrated with samples that have excluded visible root biomass.

Equation 10: Total Soil Organic Carbon in the Baseline Scenario

Through one or a combination of the above approaches, total soil organic carbon stocks in the baseline scenario for each Participant Field in the Project Area shall be calculated according to Equation 10.

$$C_{SOC,BL_{p,y}} = \sum_{i}^{p,i} C_{SOC_{i,y=0}} \times A_{p,i} \times (1 - EF_{t,y}) \times FC_{p,y}$$

WHERE

$C_{SOC,BL_{p,y}}$	Carbon stock of soil organic carbon for Participant Field **p** in the baseline scenario in year **y**; $MTCO_2e$
$C_{SOC_{i,y=0}}$	Total initial (year **y**=0) soil organic carbon stock for soil stratum **i**, fixed for project duration; $MTCO_2e\ (ha)^{-1}$
$A_{p,i}$	Area of participant field **p** in soil strata **i**; hectares
$EF_{t,y}$	Emission factor for the fraction of soil organic carbon pool remaining **t** years since conversion to Cropland in year **y**; d.u.
$FC_{p,y}$	Proportion of Participant Field **p** that has been converted to Cropland in the baseline scenario for year **y**. If the entire field will be converted in year 1, $FC_{p,y}$=1, d.u.
t	Time since conversion of Grassland to Cropland in the baseline scenario, maximum value of 40; years

When direct measurement approaches are used to estimate $C_{SOC,BL_{p,y}}$, $EF_{t,y}$ for each soil organic carbon stratum may be determined by:

- Equation 11
- A peer-reviewed study of soils and a region similar to the Project Area or Project Region that examines long-term changes in soil carbon, with samples from sites that have a minimum of 20 years since conversion to cropland.

- An empirical result from field measurements at sites that have and have not been converted to Cropland but are otherwise materially similar to each other and to the Project Area (e.g., in soil type and climate), provided that soil samples are collected from the relevant soil layers that would be affected by the conversion process and baseline activity. A sample-based emission factor shall not be projected for a period of time longer than the Cropland sample sites have been converted to Cropland, and at a minimum shall be measured following the same management treatments for duration of 5 years. Empirical data on soil carbon emissions shall be adjusted for uncertainty as described in Section 5.2.3.5 of IPCC GL AFOLU 2006.
- Approved process based biogeochemical models (see Section 5), e.g., DAYCENT.

Equation 11: Emission Factor for Decay Rate of SOC Following Conversion

$$EF_{t,y} = \frac{1 - (FSOC_{LU} \times FSOC_{MG} \times FSOC_{IN})}{D} \times t$$

WHERE

$EF_{t,y}$	Emission factor describing the fraction of soil organic carbon pool remaining **t** years since conversion to Cropland in year **y**; d.u.
$FSOC_{LU}$	Fraction of soil organic carbon pool remaining after transition period, accounting for land use factors; d.u.
$FSOC_{MG}$	Fraction of soil organic carbon pool remaining after transition period, accounting for management factors; d.u.
$FSOC_{IN}$	Fraction of soil organic carbon pool remaining after transition period, accounting for input of organic matter; d.u.
D	Transition period for soil organic carbon, time period for transition between equilibrium SOC values, default value of 20; years
t	Time since conversion of Grassland to Cropland in the baseline scenario, maximum value of 20; years

6.1.4 ACCOUNTING BASELINE EMISSIONS FROM SOIL N_2O

Accounting for this pool is required. Direct and indirect soil N_2O emissions in the baseline scenario result from nitrogen fertilizer application, both synthetic and organic, as well as the presence of N-fixing plant species such as legumes. Quantification of indirect N_2O emissions from nitrogen fertilizer application is highly uncertain. GHG benefits from this pool cannot be assured to be real and are therefore conservatively excluded from both the baseline and project scenario.[37]

$E_{BL,N_2O_{p,y}}$ may be determined by:

- Approved models (see Section 5).[38]
- Equations 12, 13 and 14.[39]

Equation 12: Baseline N_2O Emissions

Baseline emissions of N_2O from the application of nitrogen fertilizer can be calculated for each Participant Field in the Project Area according to Equation 12.

$$E_{BL,N_2O_{p,y}} = E_{BL,N_2O,direct_{p,y}} = \left(F_{BL,SN_{p,y}} + F_{BL,ON_{p,y}}\right) \times EF_N \times \frac{44}{28} \times GWP_{N_2O}$$

WHERE

$E_{BL,N_2O_{p,y}}$	Total N_2O emissions from Participant Field **p** in year **y**; $MTCO_2e$
$E_{BL,N_2O,direct_{p,y}}$	Direct N_2O emissions from the addition of **N** to Participant Field **p** in the baseline scenario for year **y**; $MTCO_2e$
$F_{BL,SN_{p,y}}$	Mass of synthetic fertilizer nitrogen applied to Participant Field **p** in the baseline scenario in year **y** adjusted for volatilization as NH_3 and NO_x; (See Section 3.1.2. Baseline Cropland Management Scenario); MT N

[37] Nitrogen application is assumed to be higher in the baseline scenario, crop cultivation, relative to the project scenario, grassland with or without grazing.

[38] Where process models require specific crops in a given year, crop selection and assignment to years shall not be done in a manner that would underestimate $C_{BGB_{crop},BL_{b,y}}$.

[39] CDM A/R Methodological Tool, Estimation of direct nitrous oxide emission from nitrogen fertilization. https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-07-v1.pdf

$F_{BL,ON_{p,y}}$	Mass of organic **N** amendments applied to Participant Field **p** in the baseline scenario in year **y** adjusted for volatilization as NH_3 and NO_x; See Section 3.1.2. Baseline Cropland Management Scenario); MT N
EF_N	Emission Factor for emission from **N** inputs; MT N_2O-N (MT N input)$^{-1}$. A default emission factor of 0.0254 (2.54%) of applied synthetic fertilizer N and 0.02 (2%) of applied organic fertilizer **N** can be assumed to be emitted (Davidson 2009).
$\frac{44}{28}$	Ratio of molecular weights of N_2O to **N**; MT N_2O (MT N)$^{-1}$
GWP_{N_2O}	Global Warming Potential for N_2O[40]

Equation 13: Baseline Mass of Synthetic Fertilizer Nitrogen

$$F_{BL,SN_{p,y}} = \sum_{j}^{J} M_{BL,SN_{p,j,y}} \times N_{BL,SN_j} \times (1 - Frac_{SN})$$

WHERE

$F_{BL,SN_{p,y}}$	Mass of synthetic fertilizer nitrogen applied to Participant Field **p** in the baseline scenario in year **y** adjusted for volatilization as NH_3 and NO_x; (See Section 3.1.2. Baseline Cropland Management Scenario); MT N
$M_{BL,SN_{p,j,y}}$	Mass of synthetic fertilizer type **j** applied to Participant Field **p** in year **y**; (See Section 3.1.2. Baseline Cropland Management Scenario); MT fertilizer
N_{BL,SN_j}	Nitrogen content of synthetic fertilizer type **j**; MT N (MT input)$^{-1}$
$Frac_{SN}$	Fraction of synthetic fertilizer nitrogen that volatilizes as NH_3 and NO_X;
J	Total number of synthetic **N** inputs of type **j**

[40] Project proponents shall refer to the ACR Program Standard for the approved IPCC GWP for nitrous oxide value, which will be updated periodically as new information becomes available.

Equation 14: Baseline Mass of Organic Fertilizer Nitrogen

$$F_{BL,ON_{p,y}} = \sum_{k}^{K} M_{BL,ON_{p,k,y}} \times N_{BL,ON_k} \times (1 - Frac_{ON})$$

WHERE

$F_{BL,ON_{p,y}}$	Mass of organic **N** amendments applied to Participant Field **p** in the baseline scenario in year **y** adjusted for volatilization as NH_3 and NO_X; (See Section 3.1.2. Baseline Cropland Management Scenario); MT N
$M_{BL,ON_{p,k,y}}$	Mass of organic **N** amendment type **k** applied to Participant Field **p** in year **y**; (See Section 3.1.2. Baseline Cropland Management Scenario); MT fertilizer
N_{BL,ON_k}	Nitrogen content of organic **N** amendment type **k**; MT-N (MT inputs)$^{-1}$
$Frac_{ON}$	Fraction of organic amendment nitrogen that volatilizes as NH_3 and NO_X;
K	Total number of organic **N** amendments types

6.1.5 ACCOUNTING BASELINE EMISSIONS FROM ENTERIC FERMENTATION

Livestock, such as cattle, bison and sheep, produce CH_4 due to enteric fermentation in their rumen. Enteric fermentation emissions vary by species, breed, animal size, feed, environment and management systems (Ominski et al. 2007). Estimates of enteric fermentation can also vary widely depending on the level of specificity input data and use of defaults (Ominski et al. 2007). It is therefore encouraged that Project Proponents utilize the most representative input data where possible. Further, calves less than 6 months in age are assumed to have zero CH_4 emissions as their diet will be primarily milk (US EPA 2013).

Accounting for GHG emissions from livestock enteric fermentation is required when livestock would be present in the baseline scenario. In some areas, it is common practice for livestock to graze cultivated fields in the winter or to graze stover following harvest. It must be shown at time of validation that:1) winter grazing is common practice in the region as part of the baseline crop management scenario, per the requirements in section 3.1.2, and 2) winter grazing is feasible and likely at the specific project location because cattle are already present or have been present in the project area[41] or LCA area.

Estimates of enteric CH_4 emissions are restricted to rangeland/pasture manure systems where manure is left unmanaged once deposited by livestock per the Applicability Conditions in Section 1.2. It is recognized that in Grassland ecosystems, the net contribution of livestock in the system may be net GHG sequestration (Liebig et al. 2010). Any stimulation to vegetation growth from soil nutrient amendments, grazing and/or natural manure management, present from pre-project conditions/practices, are assumed to be captured through the model parameterization of soil and biomass carbon pools in the project scenario. Any net sequestration benefits from these activities in the project scenario are conservatively excluded from this methodology but could be eligible for ERTs under a separate but complimentary Grazing Land and Livestock Management methodology. Manure deposited by livestock present in the project scenario shall be accounted for in Soil Nitrogen Emissions, Section 6.1.4 Soil Nitrogen Emissions. Baseline emissions from livestock due to enteric fermentation shall be calculated for each Participant Field in the Project Area according to Equation 15 and 16.

Equation 15: Baseline Enteric Fermentation

$$E_{Ferm,p,y} = \sum_{l}^{L} P_{p,l} \times EF_l \times GD_{p,l,y} \times GWP_{CH_4} \div 1,000$$

WHERE

$E_{Ferm,p,y}$	CH_4 emission from enteric fermentation due to livestock on Participant Field p in year y; $MTCO_2e$
L	Total number of livestock types in project scenario
$P_{p,l}$	Population of livestock type l on Participant Field p; head
$GD_{p,l,y}$	Grazing days per livestock type l on Participant Field p in year y; grazing days
EF_l	Enteric CH_4 emission factor for livestock type l; $kgCH_4$ $(head^{-1})$ $(grazing\ day^{-1})$

[41] These emissions are conservatively excluded in the baseline scenario if the project scenario does not also include grazing. These emissions are conservatively excluded if it cannot be demonstrated that grazing was already occurring within the project boundary or by the land manager. These emissions are conservatively excluded if it cannot be demonstrated that grazing is both feasible and likely for the project area in addition to common practice in the region.

GWPCH4	Global warming potential for CH_4 (See *ACR Standard*)
1,000	Conversion kg to MT

Equation 16: Enteric Emission Factor per Head of Livestock

$$EF_l = \frac{GE \times \left(\frac{Y_m}{100}\right)}{55.65}$$

WHERE

EF_l	Enteric methane emission factor per head of livestock
GE	Gross energy intake MJ head^{-1} day^{-1}
Y_m	Methane conversion factor, per cent of gross energy in feed converted to methane
55.65	Energy content of methane; MJ/kg CH_4

6.1.6 ACCOUNTING BASELINE EMISSIONS FROM FOSSIL FUELS

Accounting for GHG emissions from fossil fuels is optional. The combustion of fossil fuels used in farm machinery, and potentially construction equipment, to assist with the conversion and ongoing crop management process produces emissions that may optionally be accounted for with Equation 17 and included in Equation 2.

Equation 17: Baseline Fossil Fuel Emissions

Projects that elect to account for fossil fuel emissions in the baseline scenario shall be calculated according to Equation 17.

$$E_{BL,FFp,y} = \sum_{v}^{V}\sum_{f}^{F}\left(FF_{BL_{p,v,f,y}} \times EF_{f,y}\right)$$

WHERE

$E_{BL,FFp,y}$	Emissions due to the use of fossil fuels in agricultural management in the baseline scenario on Participant Field **p** in year **y**; $MTCO_2e$
$FF_{BL_{p,v,f,y}}$	Volume of fossil fuel consumed in the baseline scenario on Participant Field **p** in vehicle/equipment type **v** with fuel type **j** during year **y**; (See Section 3.1.2. Baseline Cropland Management Scenario); liters
EF_f	Emission factor for the type of fossil fuel combusted in vehicle or equipment, **j**. (See U.S. Energy Information Agency, EIA)[42]
v	Type of vehicle/equipment
V	Total number of types of vehicle/equipment used in the project activity
f	Type of fossil fuel
F	Total number of fuel types

6.2 Quantification of Project GHG Emissions

The greatest net GHG benefit from the project activity is anticipated to be the avoided release of SOC. This methodology conservatively assumes that avoided conversion results in the maintenance (without increase) of carbon stocks in the pools of soil organic carbon, and above-ground and below-ground biomass remain at steady state throughout the project scenario. That is, for each included pool, projects must estimate initial carbon stocks and are only allowed to generate credits based on avoided losses from these stocks (i.e., assuming the change in these stocks is on average, zero), rather than accounting for activities that may increase these stocks.

Project GHG emissions for all Participant Fields in the project area in a single year are calculated according to Equation 18. Project GHG emissions for a single Participant Field are calculated according to Equation 19.

[42] https://www.eia.gov/environment/emissions/co2_vol_mass.php

Equation 18: Total Project Emissions

$$PE_y = \sum_{p}^{P} PE_{p,y}$$

WHERE

PE_y	Total project emissions in year y; $MTCO_2e$
$PE_{p,y}$	Total project emissions for Participant Field p in year y; $MTCO_2e$
P	Total Project Participant Fields

Equation 19: Project Emissions

$$PE_{p,y} = C_{AGB,PR_{p,y-1}} - C_{AGB,PR_{p,y}} + C_{BGB,PR_{p,y-1}} - C_{BGB,PR_{p,y}} + E_{PR,N_2O_{p,y}} + E_{FERM_{p,y}} + E_{FF,PRy,p}$$

WHERE

$PE_{p,y}$	Project emissions per participating field p in year y
$C_{AGB,PR_{p,y}}$	Carbon stock of above-ground crop biomass for Participant Field p in the project scenario in year y; $MTCO_2e$ (optional)
$C_{BGB,PR_{p,y}}$	Carbon stock of below-ground crop biomass for Participant Field p in the project scenario in year y; $MTCO_2e$ (optional)
$E_{PR,N_2O_{p,y}}$	Emissions due to the use of fossil fuels in agricultural management in the project scenario on Participant Field p in year y; $MTCO_2e$
$E_{FERM,p,y}$	Project emissions from livestock – enteric fermentation in Participant Field p in year y; $MTCO_2e$
$E_{FF,PRy,p}$	Emissions due to the use of fossil fuels in project management, fermentation in Participant Field p in year y; $MTCO_2e$ (optional)

6.2.1 ACCOUNTING PROJECT EMISSIONS FROM ABOVEGROUND BIOMASS (WOODY AND NON-WOODY)

This pool is optional. If included, woody biomass is non-tree. If included, projects must account for these emissions by determining initial above ground carbon stocks for each biomass type using one of the following methods:

- Models meeting the criteria in Section 5 Use of Models for GHG Estimation.[43]
- Direct field measurements of $C_{AGB_{b,y=0}}$ or $DM_{b,y=0}$ and CF_b (Equation 21) for each biomass type, b, in a year where growing season precipitation is within 30% of average annual growing season precipitation or averaged over three years.[44]
- Remote sensing of $C_{AGB_{b,y=0}}$ or $DM_{b,y=0}$ and CF_b (Equation 21) for each biomass type, b, in a year where growing season precipitation is within 30% of average annual growing season precipitation or averaged over three years. Remote sensing data should be calibrated to the Project Area with field samples.[45]
- Data as available from government agency or University extension office for $DM_{b,y=0}$ and CF_b

This methodology assumes all aboveground biomass from these pools is lost following conversion to Cropland. Typical aboveground biomass may include grasses, leguminous and non-leguminous forbs, shrubs and trees. Above-ground biomass is highly variable in rangeland systems, both geographically and temporally, and is highly dependent upon precipitation. A conservative estimate of peak annual above-ground biomass (excluding trees) shall therefore be assumed to remain at a steady state for the duration of the Project Crediting Period.

Equation 20: Project Aboveground Biomass

$$C_{AGB,PR_{p,y}} = \sum_{b}^{B} C_{AGB_{b,y=0}}$$

[43] Where process models require specific crops in a given year, crop selection and assignment to years shall not be done in a manner that would underestimate $C_{BGB_{crop},BL_{b,y}}$.

[44] Conducted for project or available in peer reviewed literature.

[45] Conducted for project or available in peer reviewed literature.

WHERE

$C_{AGB,PR_{p,y}}$	Carbon stock of above-ground biomass for Participant Field **p** in the project scenario in year **y**
$C_{AGB_{b,y=0}}$	Initial (year **y**=0) carbon stock of above-ground biomass for biomass type **b;** $MTCO_2e$

Equation 21: Initial Project Aboveground Biomass

$$C_{AGB_{b,y=0}} = DM_{b,y=0} \times CF_b \times \frac{44}{12} \times A_b$$

WHERE

$C_{AGB_{b,y=0}}$	Initial (year **y**=0) carbon stock of above-ground biomass for biomass type **b;** $MTCO_2e$
$DM_{b,y=0}$	Dry matter for biomass type **b** at project initiation (year **y=0**); MT dry matter ha^{-1}
CF_b	Carbon fraction of dry matter for biomass type **b**; MT C (MT dry matter)$^{-1}$
A_b	Area of biomass type **b**; hectares
$\frac{44}{12}$	Ratio of molar mass of CO_2 to **C**

6.2.2 ACCOUNTING PROJECT EMISSIONS FROM BELOWGROUND BIOMASS

This pool is optional. If included, projects must account for these emissions by determining initial below ground carbon stocks for each biomass type using one of the following methods:

- Models meeting the criteria in Section 5 Use of Models for GHG Estimation[46]

[46] Where process models require specific crops in a given year, crop selection and assignment to years shall not be done in a manner that would underestimate $C_{BGB,BL_{p,y}}$.

- $C_{AGB,PR_{p,y}}$ (Equation 22) and appropriate root-to-shoot ratios for crop and woody and non-woody components

Equation 22: Project Belowground Biomass

$$C_{BGB,PR_{p,y}} = \sum_{b}^{B} R_b \times C_{AGB_{b,y=0}}$$

WHERE

$C_{BGB,PR_{p,y}}$	Carbon stock of below-ground biomass for Participant Field **p** in the project scenario in year **y**; $MTCO_2e$
B	Total number of biomass types
R_b	Root carbon-to-shoot carbon ratio of biomass type **b**; default value 4.2 for temperate Grassland, 4.5 for cool temperate Grassland, and 1.8 for Shrubland (Mokany et al. 2006); d.u.[47, 48]
$C_{AGB_{b,y=0}}$	Initial (year **y=0**) carbon stock in above-ground biomass of biomass type **b**; $MTCO_2e$

As stated in Section 6.2.1, above-ground biomass stocks are assumed to remain in steady-state throughout the project duration; the corresponding carbon stock change in below-ground biomass pools is therefore also assumed to be zero over the project life. Although management activities in the project scenario, such as grazing, haying or prescribed fires have been demonstrated to stimulate below-ground biomass growth, these potential gains are conservatively excluded.

[47] Project Proponents can replace the default rate with a site-specific value or more recent value from peer reviewed literature.

[48] In Grasslands, a global database finds that carbon concentration in roots and shoots are relatively equivalent across sites (median 44% in leaves and 43% in roots; Craine et al. 2005). Therefore, root-to-shoot ratios are equivalent to the root carbon-to-shoot carbon ratios in Grasslands.

6.2.3 ACCOUNTING PROJECT EMISSIONS FROM SOIL ORGANIC CARBON

SOC stocks are conservatively assumed to be in a steady state from the date of recording of the easement, such that soil organic carbon stocks in the project scenario are fixed over the project life i.e., do not increase. Because there is no change in SOC during year y in the project scenario, this term is not included in the total project emissions for year y, Equation 19.

6.2.4 ACCOUNTING PROJECT EMISSIONS FROM SOIL N_2O

Direct soil N_2O emissions in the project scenario result from nitrogen fertilizer application, both synthetic and organic. Quantification of indirect N_2O emissions from nitrogen fertilizer application is highly uncertain. GHG benefits from this pool cannot be assured to be real and are therefore conservatively excluded from both the baseline and project scenario.[49]

$E_{PR,N_2O_{p,y}}$ may be determined by:

- Models meeting the criteria in Section 5 Use of Models for GHG Estimation.[50]
- Equations 23- 27.[51]

Equation 23: Project N_2O Emissions

$$E_{PR,N_2O_{p,y}} = E_{PR,N_2O,direct_{p,y}} = [\left(F_{PR,SN_{p,y}} + F_{PR,ON_{p,y}}\right) \times EF_N + F_{PRP,p,y} \times EF_{MNR}] \times \frac{44}{28} \times GWP_{N_2O}$$

WHERE

$E_{PR,N_2O_{p,y}}$	Total N_2O emissions from Participant Field **p** in year **y**; $MTCO_2e$

[49] Nitrogen application is assumed to be higher in the baseline scenario, crop cultivation, relative to the project scenario, grassland with or without grazing.

[50] Where process models require specific crops in a given year, crop selection and assignment to years shall not be done in a manner that would underestimate $C_{BGB_{crop},BL_{b,y}}$.

[51] CDM A/R Methodological Tool, Estimation of direct nitrous oxide emission from nitrogen fertilization. https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-07-v1.pdf

$E_{PR,N_2O,direct_{p,y}}$	Direct N_2O emissions from the addition of **N** to Participant Field **p** in the project scenario for year **y**; $MTCO_2e$
$F_{PRP,p,y}$	Mass of manure and urine **N** deposited by grazing animals on pasture, range and paddock on participant field **p**, in year **y**
$F_{PR,SN_{p,y}}$	Mass of synthetic fertilizer nitrogen applied to Participant Field **p** in the project scenario in year **y** adjusted for volatilization as NH_3 and NO_x; MT N
$F_{PR,ON_{p,y}}$	Mass of organic **N** amendments applied to Participant Field **p** in the project scenario in year **y** adjusted for volatilization as NH_3 and NO_x; MT N
EF_N	Emission factor for emission from **N** inputs; MT N_2O-N (MT N input)$^{-1}$
EF_{MNR}	Emission factor for emissions from manure inputs MT N_2O-N (MT N input)$^{-1}$
$\frac{44}{28}$	Ratio of molecular weights of N_2O to **N**; MT N_2O (MT N)$^{-1}$
GWP_{N_2O}	Global Warming Potential for N_2O[52]

Equation 24: Project Mass of Synthetic Fertilizer Nitrogen

$$F_{PR,SN_{p,y}} = \sum_{j}^{J} M_{PR,SN_{p,j,y}} \times N_{PR,SN_j} \times (1 - Frac_{SN})$$

WHERE

$F_{PR,SN_{p,y}}$	Mass of synthetic **N** amendments applied to Participant Field **p** in the project scenario in year **y** adjusted for volatilization as NH_3 and NO_x; See Section 3.1.2. Baseline Cropland Management Scenario); MT N
$M_{PR,SN_{p,j,y}}$	Mass of synthetic fertilizer type **j** applied to Participant Field **p** in year **y**; MT
N_{PR,SN_j}	Nitrogen content of synthetic fertilizer type **j**; MT-N (MT input)$^{-1}$

[52] Project proponents shall refer to the ACR Program Standard for the approved IPCC GWP for nitrous oxide value, which will be updated periodically as new information becomes available.

$Frac_{SN}$	Fraction of synthetic fertilizer nitrogen that volatilizes as NH_3 and NO_X;
J	Number of synthetic fertilizer types
j	Synthetic fertilizer type

Equation 25: Project Mass of Organic Fertilizer Nitrogen

$$F_{PR,ON_{p,y}} = \sum_{k}^{K} M_{PR,ON_{p,k,y}} \times N_{PR,ON_k} \times (1 - Frac_{ON})$$

WHERE

$F_{PR,ON_{p,y}}$	Mass of organic N amendments applied to Participant Field p in the project scenario in year y adjusted for volatilization as NH_3 and NO_X; See Section 3.1.2. Baseline Cropland Management Scenario); MT N
$M_{PR,ON_{p,k,y}}$	Mass of organic fertilizer type k applied to Participant Field p in year y; MT
N_{PR,ON_k}	Nitrogen content of organic fertilizer type k; MT-N (MT input)$^{-1}$
$Frac_{ON}$	Fraction of organic fertilizer nitrogen that volatilizes as NH_3 and NO_X;
K	Number of organic fertilizer types
k	Organic fertilizer type

Equation 26: Percent Excreta Nitrogen

$$F_{PRPp,y} = \sum_{l}^{L} (P_{p,l} \times Nex_{l,p,y})$$

WHERE

$F_{PRPp,y}$	Percent excreta nitrogen
L	Number of livestock types

l	livestock type
$P_{p,l}$	Population of livestock type **l**, on participant field **p**; number of head
$Nex_{l,p,y}$	Annual average **N** excretion per head of species/category, kg N $(animal)^{-1}$ of livestock type l

Equation 27: Nitrogen Excreta per Head of Livestock

$$Nex_{l,p,y} = \frac{N_{rate(l)} \times \frac{TAM_l}{1,000} \times GD_{p,l,y}}{1,000}$$

WHERE

$Nex_{l,p,y}$	Nitrogen excreta per head of livestock on participant field **p** in year **y** (kg N (animal)-1 (year)-1
$N_{rate(l)}$	**N** excretion rate; kg **N** (1,000 kg animal mass)$^{-1}$ day^{-1}
TAM_l	Typical animal mass for livestock category **l**; kg animal^{-1}
$GD_{p,l,y}$	Grazing days per livestock type **l** on Participant Field **p** in year **y**; grazing days

6.2.5 ACCOUNTING LIVESTOCK EMISSIONS FROM ENTERIC FERMENTATION

Livestock, such as cattle, bison and sheep, produce CH_4 as a result of enteric fermentation in their rumen. Enteric fermentation emissions vary by species, breed, animal size, feed, environment and management systems (Ominski et al. 2007). Estimates of enteric fermentation can also vary widely depending on the level of specificity of input data and use of defaults (Ominski et al. 2007). It is therefore encouraged that Project Proponents utilize the most representative input data where possible. Further, calves less than 6 months in age are assumed to have zero CH_4 emissions as their diet will be primarily milk (US EPA 2013).

Estimates of enteric CH_4 emissions are restricted to rangeland/pasture manure systems where manure is left unmanaged once deposited by livestock per the Applicability Conditions in Section 1.2. It is recognized that in Grassland ecosystems, the net contribution of livestock in the system may be net GHG sequestration (Liebig et al. 2010). The effects of vegetation stimulation and soil nutrient amendments that grazing and natural manure management, as maintained from pre-project conditions, are assumed to be captured through estimates of soil and biomass carbon pools in the project scenario. Any net sequestration benefits from these activities in the project scenario are conservatively excluded from this methodology but could be eligible for ERTs under a separate but complimentary Grazing Land and Livestock Management methodology. Manure deposited by livestock present in the project scenario shall be accounted for in Soil Nitrogen Emissions, Section 6.2.4 Soil Nitrogen Emissions. Project emissions from livestock due to enteric fermentation shall be calculated for each Participant Field in the Project Area according to Equation 28 and 29.

Equation 28: Project Enteric Fermentation

$$E_{Ferm,p,y} = \sum_{li}^{L} P_{p,l} \times EF_{l} \times GD_{p,l,y} \times GWP_{CH_4} \div 1,000$$

WHERE

$E_{Ferm,p,y}$	CH_4 emission from enteric fermentation due to livestock on Participant Field **p** in year **y**; $MTCO_2e$
L	Total number of livestock types in project scenario
$P_{p,l}$	Population of livestock type l on Participant Field p; head
$GD_{p,l,y}$	Grazing days per livestock type **l** on Participant Field **p** in year **y**; grazing days
EF_{l}	Enteric CH_4 emission factor for livestock type **l**; $kgCH_4$ $(head^{-1})$ $(grazing\ day^{-1})$
GWP_{CH4}	Global warming potential for CH_4 (See *ACR Standard*)
1,000	Conversion kg to MT

Equation 29: Enteric Emission Factor per Head of Livestock

$$EF_l = \frac{GE \times \left(\frac{Y_m}{100}\right)}{55.65}$$

WHERE

EF_l	Enteric CH_4 emission factor for livestock type l; $kgCH_4$ ($head^{-1}$) (grazing day^{-1})
GE	Gross energy intake MJ $head^{-1}$ day^{-1}
Y_m	Methane conversion factor, per cent of gross energy in feed converted to methane. 6.5%; Lambs (<1-year-old): 4.5%; and Mature Sheep: 6.5% Source: Chapter 4, Tables 10.12 and 10.13, IPCC 2006 AFOLU GL
55.65	Energy content of methane; MJ/kg CH_4

6.2.6 ACCOUNTING PROJECT EMISSIONS FROM FOSSIL FUELS

Accounting for GHG emissions from fossil fuels is optional. Where fossil fuel emissions are accounted for in the baseline, project fossil fuel emissions must also be estimated.

Equation 30: Project Fossil Fuel Emissions

$$E_{FF,PRp,y} = \sum_{v}^{V} \sum_{f}^{F} \left(FF_{PR_{p,v,f,y}} \times EF_f\right)$$

WHERE

$E_{FF,PRp,y}$	Emissions due to the use of fossil fuels in project management, on participant field p in year y; $MTCO_2e$
$FF_{PR,p,v,f,y}$	Consumption of fossil fuel in vehicle/equipment type v during year y per fuel type f; Liters $(yr.)^{-1}$ on participant field p

EF_f	Emission factor for the type of fossil fuel combusted in vehicle or equipment, v. See U.S. Energy Information Agency.[53]
v	Type of vehicle/equipment
V	Total number of types of vehicle/equipment used in the project activity
f	Type of fuel
F	Total number of fuel types

Unlike the baseline scenario, Project Proponents can monitor machinery and equipment use in the project scenario and the quantity of fuel consumed. Where this information is not easily attainable or difficult to estimate, default fuel usage rates from the same sources used to identify fuel usage for the baseline scenario may be used.

6.3 Leakage

Market leakage is the primary source of potential leakage from the avoided conversion of Grassland and Shrubland. Conversion is most likely driven by commodity crops, rather than food crops which would be consumed locally and potentially induce activity shifting leakage. For commodity crops, attempts to estimate activity shifting leakage will double count market leakage. For food crops, the default values provided in this section for market shifting leakage will provide a conservative estimate of activity shifting leakage where it occurs.

Equation 31: Leakage Emissions

$$LE_y = LE_{M,y}$$

WHERE

LE_y	Leakage factor in year y
$LE_{M,y}$	Market Leakage in year y

[53] https://www.eia.gov/environment/emissions/co2_vol_mass.php

6.3.1 DESCRIPTION OF LEAKAGE

6.3.1.1 Commodity and Food Crop

The crops identified in the baseline analysis shall be assessed for leakage type if they are a food or commodity crop. A commodity crop is traded and consumed in national and/or international markets, traded on a recognized futures exchange, and individual producers are price takers (no ability to affect price). If the majority of crops in a rotation are considered a commodity crop, production is determined to be commodity-dependent, and leakage will therefore be market-driven. Attempts to monitor and estimate activity-shifting leakage in this scenario will lead to double counting of market leakage.

In contrast, non-commodity or food crops are more likely to be purchased or consumed locally or regionally and the displacement of their production will lead to unmet local demand, providing a driver for Activity Shifting leakage. The ability to estimate activity shifting leakage in scenarios where conversion is driven by non-commodity crops is extremely poor with available data. Estimation errors based on aggregation, sampling error or classification error from remotely sensed images may exceed estimates of annual conversion rates. In these situations, it is considered conservative to use the default market leakage rate to account for all leakage.

6.3.1.2 Market Leakage

Avoiding the conversion of Grassland and Shrubland will directly remove arable Cropland that would otherwise enter production. Food demand is relatively inelastic globally, requiring that the foregone production will be made up either through changes at the intensive (fertilizer use, crop yield response) or extensive (indirect land use conversion) margin. Since the commodities being displaced are traded in national and international markets, and production is responsive to numerous dynamic phenomena, estimation of market leakage requires use of detailed economic data and complex general equilibrium models. Completion of these analyses are expected to be beyond the capabilities of most Project Proponents, and therefore a simplified default approach is used to provide a default value of LE_{MY} applicable to avoided conversion to commodity crops in North America that can be used for all Projects using this methodology.

Market leakage is based on the law of supply and demand. Avoided conversion reduces the supply of otherwise arable Cropland, which all else being equal, puts upward pressure on prices, which puts downward pressure on quantity demanded and upward pressure to increase production on non-project lands. The relationship between price and supply and demand are quantified by price elasticities. Price increases can also lead to increased supply through mechanisms other than conversion of additional non-Project lands (i.e., changes at the intensive margin). Price signals inspire farmers to produce more crops on their existing farmland, e.g., by investing in more labor, advanced technology, or inputs (Taheripour 2006). Price signals can also inspire increased investment in yield improvement (Ruttan and Hayami 1984). Thus, avoiding conversion to Cropland is expected to reduce the net amount of land needed for crop production both by increasing yields on existing farmland and by decreasing the quantity of demand. Methods based only on short-run price elasticities generally capture decreased demand but may not capture these additional mechanisms that contribute to meeting demand without requiring Cropland expansion. Therefore, methods based only on price elasticities will tend to overestimate leakage, making them conservative from the standpoint of calculating offsets generated by a project.

The default leakage value is derived from Equation 32, which is derived from Murray, McCarl and Lee (2004).

Equation 32: Market Leakage

$$LE_{M,y} = \frac{E_S}{E_S - E_D}$$

WHERE

$LE_{M,y}$	Market leakage in year y; (0-1.0)
E_S	Price elasticity of supply
E_D	Price elasticity of demand

Note that Price elasticity of demand (E_D) is generally a negative number (demand goes down as price goes up) and Price elasticity of supply (E_S) is generally a positive number (supply goes up as price goes up), so market leakage will be a percentage that ranges from 0 to 100.

Elasticities may be obtained from the Food and Agriculture Policy Research Institute (FAPRI) Elasticity Database[54, 55] as well as peer reviewed literature and state government reports.

To obtain a default value that can be reliably used in the United States, we considered a range of approaches to estimating leakage and used the most conservative result. Several researchers have

[54] The USDA Commodity and Food Elasticity Database is no longer being updated (https://www.ers.usda.gov/data-products/commodity-and-food-elasticities/).

[55] http://www.fapri.iastate.edu/tools/elasticity.aspx

used estimates of leakage associated with the USDA Conservation Reserve Program (CRP). The retirement of land from crop production as in the Conservation Reserve Program should have similar or larger leakage effects as an avoided conversion project that keeps land out of crop production. Both approaches preclude marginal Cropland from entering crop production. One might expect CRP to have greater leakage because of both the large scale of land retirement and because CRP typically removes land entirely from all productive uses, although some emergency haying and grazing is allowed, whereas, conservation through a carbon offset program such as this one still allow grazing and livestock production.

Table 3: Literature Values for Leakage Associated with the USDA CRP

SOURCE	ESTIMATE OF MARKET EFFECTS LEAKAGE	APPROACH
Taheripour, (2006)	≤20%	General equilibrium model of CRP leakage.
Wu (2000)	20%	Statistical estimate of leakage based on empirical land use data associated with the implementation of the CRP.
Barr et al. (2011)	<20%	Price elasticity of Cropland supply was found to be 0.029. When combined with reasonable estimates of price elasticity of demand, this consistently results in leakage estimates of <20%.
Murray et al. (2007)	0-20%	Plausible leakage discount for Cropland retirement based on previous literature.

A peer reviewed paper studied actual responses of U.S. land area to changes in prices and found that the price elasticity of Cropland area in the United States is very low (0.029 was the highest of several estimates in the paper) (Barr et al. 2011). Unfortunately, this paper does not provide a comparable estimate for price elasticity of demand. In the absence of a definitive estimate of demand, we are able to show that any reasonable estimate of the price elasticity of demand yields a leakage estimate that is no greater than 20% when paired with Barr et al.'s estimate for price elasticity of supply. Any estimate of the price elasticity of demand that is less than -0.116 would result in leakage of 20% or lower. In drafting of version 1.0 of this methodology, 241 estimates were obtained from the USDA ERS database on own-price demand elasticities for commodities relevant to the United States (corn, soy, legume, grain, cereal, oil, food) for the period prior to 2014. The mean demand elasticity was -0.44, and more than 90% of all values were less than -0.116.

Therefore, a conservative default value of 20% market leakage may be used for avoided conversion of Grasslands or Shrublands to commodity crops in the United States.

6.3.2 QUANTIFICATION OF LEAKAGE DEDUCTION

Equation 33: Leakage Deduction

$$LD_y = LE_y \times \sum_{p}^{P} \left(C_{AGB,BL_{p,y-1}} - C_{AGB,BL_{p,y}} + C_{BGB,BL_{p,y-1}} - C_{BGB,BL_{p,y}} + C_{SOC,BL_{p,y-1}} - C_{SOC,BL_{p,y}} \right)$$

WHERE

LD_y	Leakage deduction in year y
LE_y	Leakage in year y, $MTCO_2e$ (Equation 31)
$C_{AGB,BL_{p,y}}$	Carbon stock of aboveground biomass in Participant Field p in year y in the baseline scenario; $MTCO_2e$. (Equation 3, optional pool)
$C_{BGB,BL_{p,y}}$	Carbon stock of below-ground crop biomass for Participant Field p in the baseline scenario in year y; $MTCO_2e$. (Equation 7, optional pool)
$C_{SOC,BL_{p,y}}$	Carbon stock of soil organic carbon for Participant Field p in the baseline scenario in year y; $MTCO_2e$. (Equation 10)

6.4 Net GHG Emissions

Equation 34: Net Emission Reductions

$$ER_y = BE_y - PE_y - NP_y - LD_y$$

WHERE

ER_y	Net GHG emissions reductions and/or removals in year y, $MTCO_2e$
BE_y	Baseline emissions in year y, (Equation 1) $MTCO_2e$

PE_y	Project emissions in year y, (Equation 16) $MTCO_2e$
NP_y	Non-Permanence deduction in year y, (Equation 35) $MTCO_2e$
LD_y	Leakage deduction for year y, (Equation 31) $MTCO_2e$

Where BEy < PEy, no ERTs shall be issued for that year.

Equation 35: Non-Permanence Deduction

$$NP_y = BF_y \times \sum_{p}^{P}\left(C_{AGB,BL_{p,y-1}} - C_{AGB,BL_{p,y}} + C_{BGB,BL_{p,y-1}} - C_{BGB,BL_{p,y}} + C_{SOC,BL_{p,y-1}} - C_{SOC,BL_{p,y}}\right)$$

WHERE

NP_y	Non-Permanence deduction for year y
BF_y	Non-Permanence buffer in year y, result of project analysis using the latest version of the ACR Tool for Risk Analysis and Buffer Determination to determine the overall project risk rating, applied as **BFy**.[56]
$C_{AGB,BL_{p,y}}$	Carbon stock of aboveground biomass in Participant Field p in year y in the baseline scenario; $MTCO_2e$ (Equation 3, optional pool)
$C_{BGB,BL_{p,y}}$	Carbon stock of below-ground crop biomass for Participant Field p in the baseline scenario in year y; $MTCO_2e$ (Equation 7, optional pool)
$C_{SOC,BL_{p,y}}$	Carbon stock of soil organic carbon for Participant Field p in the baseline scenario in year y; $MTCO_2e$ (Equation 10)

6.5 Uncertainty

Estimation of uncertainty is required for each baseline and project carbon pool and GHG sources. When sampling is conducted, and the 90% confidence limit (high or low) is greater than 10% of the

[56] As described in the most recent version of the *ACR Standard*, the Project Proponent shall use the ACR Tool for Risk Analysis and Buffer Determination.

mean value, the confidence limit (resulting in the lowest ERT value) shall be used rather than the sampled mean to ensure conservativeness. Uncertainty estimates or lower bounds are required for default values (such as those by the IPCC), estimates from peer-reviewed literature, and direct measurements or empirical relationships based on measurements. They should be directly estimated per general requirements in the *ACR Standard*. Where process models are used to estimate pools and sources, key sources of uncertainty in model parameters and inputs should be used to model uncertainty.[57] Models approved for use by ACR with this methodology must meet all criteria for process based biogeochemical models in the *ACR Standard*. When the DAYCENT model is used, an uncertainty deduction factor of 10% must be subtracted from the difference between baseline and project SOC.[58]

6.6 Permanence and Reversals

Carbon offsets generated through the sequestration of carbon in soil or biomass are inherently at some risk of reversal or termination. Reversals can be unintentional or intentional. Internal risk factors include project management, financial viability, opportunity costs and project longevity. External risk factors include factors related to easement violations and natural risks including fire, flood, and extreme weather events. See specific instructions for agriculture/grassland projects within the ACR Risk Assessment Tool. The risk assessment, overall risk rating, and proposed mitigation or buffer contribution shall be included in the GHG Project Plan.

Per the Buffer Pool Terms and Conditions (see the *ACR Standard*) sequestration projects will terminate automatically if a Reversal causes project stocks to decrease below baseline levels prior to the end of the Minimum Project Term.

[57] Where a range of plausible uncertainty values are available for a parameter or input, Project Proponents shall select the most conservative value so as not to overestimate project emission reductions. An alternative value may be used if Project Proponents can justify why the selected parameter or input value is more appropriate than the most conservatively available value, with the justification transparent in the GHG Project Plan Document and/or Monitoring Report.

[58] Based on Ogle et al. 2007 for CRP lands

6.6.1 ASSESSMENT OF RISK

To assess the risk of reversal or termination, the Project Proponents shall conduct a risk assessment addressing internal, external and natural risks using the most recently approved ACR Risk Assessment Tool.[59]

6.6.2 MITIGATION OF RISK

While prescribed burns are allowed under this Methodology, fire could have negative ecological impacts and reduce aboveground biomass in shrublands in addition to potentially reversing carbon storage resulting from the project when best practices for prescribed burns are not followed. Project Proponents shall know and follow best management practices for use of fire for the vegetation type and region.

6.6.3 BUFFER POOL CONTRIBUTIONS

ACR's Risk Assessment Tool produces a total risk rating for the project which equals the percentage of offsets that must be deposited in the ACR buffer pool to compensate for reversal or termination (unless another ACR approved risk mitigation mechanism is used in lieu of buffer contribution). The risk assessment, overall risk rating, and proposed mitigation or buffer contribution shall be included in the GHG Project Plan.

[59] http://acrcarbon.org/program_resources/

7 MONITORING AND DATA COLLECTION

Each project shall include a GHG project plan sufficiently meeting the requirements of the *ACR Standard*. The plan shall describe the collection of all data required to be monitored and in a manner which meets the requirements for accuracy and precision of this Methodology. Project Proponents shall use the template for GHG project plans available at http://www.acrcarbon.org/. Additionally, projects are required to submit a GHG monitoring report for each reporting period. Project Proponents shall use the template for GHG monitoring reports available at http://acrcarbon.org/program_resources/.

7.1 The GHG Project Plan

Requirements for GHG Project Plans for all ACR projects are listed in the *ACR Standard*. See sections 7.2 and 7.3 for additional GHG Project Plan requirements, specific to this methodology.

7.2 Data Collection And Parameters Monitored

See Appendix A for a list of parameters available at validation, parameters monitored, and parameters determined from equations. Project Proponents are strongly encouraged to maintain area-based parameters in per Hectare (or per acre) units as well per field p, to assist validation and verification events.

7.2.1 DESCRIPTION OF THE MONITORING PLAN

The Monitoring Plan is developed at time of validation, contained in the GHG Project Plan and submitted at each verification event. In addition to the parameters listed in Appendix A the monitoring plan must also include:

- Baseline Crop Management Scenario (Section 3.1.2); updated at minimum every 5 years
- Spatially explicit shapefiles for project boundaries (Section 2.1.2)

- Conversion Agents
- Livestock presence, average annual AUMs of grazing and average annual forage availability in AUMs within the Project Area and the dates of grazing activity[60]
- Cover of Grassland versus Shrubland in Project Area
- Any effects of disturbance, especially of burning (wildfire or prescribed), on aboveground shrub biomass.

The Monitoring Report shall further describe the following:

- Monitoring tasks included or required as part of the LCA and responsible party
- Frequency of monitoring tasks and reporting
- Measurement procedures and frequency of collection (if applicable)
- Biogeochemical model parameter definitions[61]
- Quality Assurance/Quality Control measures
- Archiving measures
- Responsibilities, roles and qualifications of monitoring team
- Any due diligence for boundaries in the LCA

7.2.2 SAMPLING DESIGN

Where Project Proponents elect to employ direct measurements, the Monitoring Plan in the GHG Project Plan Document shall specify the sampling design, sample size, plot size and determination of plot locations. All sampling must be carried out such that a 90% Confidence Interval does not exceed 10% of the mean. Where uncertainty exceeds 10% of the mean, estimated GHG benefits or values must be discounted by using the boundary of the confidence interval. All measurements will be conducted according to approved sampling standards and subject to Quality Assurance/Quality Control measures, as specified in the Monitoring Plan.

[60] A Grazing Management Plan, when available, meets this monitoring requirement. Grazing practices, including intensity, shall be consistent with the conservation goals set forth in the easement.

[61] Necessary environmental parameters for use in biogeochemical modeling and determination of ex post pools and sources estimated with a biogeochemical model are to be recorded. Sources for such variables may include national databases, or published data with the selection and collection of such data provided in a transparent manner in the Monitoring Report for easy verification and replication. Where meteorological data is collected from a regional meteorology station in the Project Region, information from the nearest station is advised, preferably within 100km of the Participant Field. Where the Project Area exceeds a 100km radius, a single or averaged set of meteorological data may be utilized.

7.3 Data Archiving

The VVB shall retain reports, measurements and other project related documents, including documentation of LU/LC conversion, per requirements in the *ACR Standard*. Where soil samples are collected, these shall be maintained by the project developer until at least the next scheduled verification event, i.e., 5 years. Soil and other durable samples shall be stored in an air-dry condition in a cool, dry location.

8 Validation and Verification

8.1 ACR VV Standard and Deviations

Aspects of the avoided conversion project type are unique such that certain validation and verification procedures are allowed that supersede the ACR Verification and Validation Standard.[62] Specific instances where this methodology supersedes requirements in the ACR Validation and Verification Standard are described below. Unless otherwise stated, the requirements in the most recent version of the ACR Validation and Verification Standard apply to all projects.

8.1.1 LISTING REQUIREMENTS

Submittal of a full GHG Project Plan is not required at listing for this project type. Project Proponents can submit basic project information and the Statement of Intent or GHG ownership agreement and estimated future properties (if PDA) within ± 12 months of date of recording of the LCA. A complete GHG Project Plan can be submitted up until the time of validation.[63]

8.1.2 SITE VISITS

Site-visits are not required at validation nor at subsequent verifications for this project type, provided the verifier can reach a reasonable level of assurance via review of required documents and supplemental material (e.g., images, on-going monitoring reports as required as part of the LCA, telephone interviews, including those with the responsible entity for the LCA, remote sensing, third party datasets etc.). The verifier has discretion to request a site-visit at the following times in the project life cycle IF he/she determines that a reasonable level of assurance is unattainable without a site visit: at validation, if a reversal occurs, if LCA or regulatory infraction occurs, or change in VVB.

[62] These include: 1) the baseline scenario is a counter factual scenario and cannot be monitored, rather the baseline assumptions are justified ex ante 2) the project activity requires a qualified LCA be recorded, which in and of itself includes due diligence prior to recording and on-going monitoring and reporting and 3) LCAs are complex legal agreements that vary geographically and upon the nature of the organizations entering into the agreement; it is difficult to predict with accuracy when an LCA will be completed and recorded and thus to know in advance the official project start date.

[63] Per the *ACR Standard*, AFOLU projects must COMPLETE validation within 3 years of the start date of the project; i.e., the date of qualified LCA recording.

At a minimum, the following must be included in a remote verification:

- Spatially-explicit boundary shape file of Project Region, Project Area, and Participant Fields, including delineation of any wetlands, building envelopes, cultivated areas, gravel pits, or other acres not governed by a sod-busting/no-conversion clause. Participant Field boundaries will not be made public.
- Spatially-explicit boundary shapefiles of the area covered by the qualified LCA.
- Copy of the recorded Land Conservation Agreement(s)/Easement(s) that encompass all Participant Fields.
- Record of due diligence for accurate boundary definition prior to LCA recording.
- Links to recent LANDSAT imagery of the project area or time stamped LANDSAT image files.
- Record or image of the Participant Fields being Grassland or Shrubland at 10 years prior to start date.
- Monitoring Plan for the qualified LCA.
- Evidence of ownership/right-to the GHG offsets for Project Participant on all Participant Fields for the crediting period being verified.
- GHG Project Plan and associated components. This includes documentation on how any models were parameterized and a detailed Monitoring Plan.
- GHG Quantification documents with modeling output, assumptions, and net GHG calculations.
- If applicable, an electronic copy of the appraisal and valid appraiser's license.

Annual easement monitoring reports are sufficient for demonstrating that the land has not been converted or undergone significant changes and is being managed in a way consistent with the protected conservation values. If an easement violation occurs, the registry must be informed in accordance with ACR’s Standard, and it must be referenced in the project plan being verified, including any remediation steps taken.

8.1.3 REQUIREMENTS FOR PDA PROJECTS

Requirements for PDA projects as defined in the *ACR Standard* apply. Regarding site visits, this methodology supersedes requirements in the *ACR Standard* (See Section 8.1.2).

8.1.4 SIGNIFICANT CHANGES TO A PROJECT

If a significant or a substantial change occurs to the project after validation and/or initial verification, a site visit may be required either by the verifier or ACR, before the next issuance of ERTs. Examples of significant changes include:

- Partial reversal of credits issued to date for a specific parcel and it intends to continue to participate in the project.
- Unintentional reversals resulting from extreme weather events that cause a change to the baseline soil carbon stocks.
- If a parcel is considered a full reversal and it's intentional.
- Material regulatory violations that exclude parcels from future inclusion.

Definitions

If not explicitly defined here, the current definitions in the latest version of the *ACR Standard* apply.

Cropland	A land-use category that includes areas used for the production of crops for harvest on cultivated lands. Cultivated crops include row crops or close grown crops and also hay or pasture in rotation with cultivated crops. Cropland also includes land with alley cropping and windbreaks as well as lands in temporary fallow.[64]
Grassland and Shrubland	A land-use category on which the plant cover is composed principally of grasses, grass-like plants (i.e., sedges and rushes), forbs, or shrubs suitable for grazing and browsing, and includes both pastures and native rangelands. This includes areas where practices such as clearing, burning, chaining, and/or chemicals are applied to maintain the grass vegetation. Savannas, some wetlands and deserts, in addition to tundra are considered Grassland. Woody plant communities of low forbs and shrubs, such as mesquite, chaparral, mountain shrub, and pinyon-juniper, are also classified as Grassland and Shrubland if they do not meet the criteria for Forest Land. Grassland includes land managed with agroforestry practices such as silvipasture and windbreaks, assuming the stand or woodlot does not meet the criteria for Forest Land.[65]
Forest Land	Land with at least 10 percent cover (or equivalent stocking) by live Trees of any size, including land that formerly had such Tree cover and that will be naturally or artificially regenerated. To qualify, the area must be at least 1 acre in size. Forest Land includes transition zones, such as areas between Forest and non-Forest Lands that have at least 10% cover (or equivalent stocking) with live Trees and forest areas adjacent to urban and built-up lands.[66]

[64] Adapted from: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/technical/nra/nri/?cid=nrcs143_014127

[65] Adapted from: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/technical/nra/nri/?cid=nrcs143_014127 Spatial analysis uses the unique definitions of Grassland and Shrubland, respectively, in the NLCD.

[66] http://acrcarbon.org/acr-program/standard/

Identified Agent	The known entity that is planning to convert a particular parcel of Grassland or Shrubland to Cropland (e.g., a particular local landowner).
Indirect N_2O Emissions	N_2O emissions that result from microbial nitrification and denitrification of Nitrogen that has first been removed from agricultural soils and animal waste management systems within the project boundary via volatilization, leaching, runoff, or harvest of crop biomass.[67, 68]
Land Conservation Agreement	An easement, covenant, deed restriction, or other legal agreement that may be employed to maintain the project land cover during the Project Crediting Period. The Land Conservation Agreement, as defined in this methodology, does not necessarily contain language pertaining to ownership of carbon or greenhouse gas emissions.
Participant Field	A particular parcel of Grassland or Shrubland where conversion to Cropland is planned by an identified agent or anticipated by an unidentified agent, analogous to the use of project activity in the *ACR Standard*.
Price Elasticity of Demand	A measure used in economics to show the responsiveness, or elasticity, of the quantity demanded of a good or service to a change in its price, ceteris paribus.
Price Elasticity of Supply	A measure used in economics to show the responsiveness, or elasticity, of the quantity supplied of a good or service to a change in its price.
Project Area	The collection of all participant fields where project activities are implemented.
Project Crediting Period	The length for which project activities are eligible to earn ERTs and the baseline determination remains valid.
Project Participant	A landowner or the manager of a Participant Field.
Project Proponent	An individual or entity that undertakes, develops, and/or owns a project. This may include the project investor, designer, and/or owner of the lands/facilities on which project activities are conducted. The Project Proponent and

[67] IPCC Good Practice Guidance and Uncertainty Management in National GHG Inventories; https://www.ipcc-nggip.iges.or.jp/public/gp/bgp/4_6_Indirect_N2O_Agriculture.pdf

[68] *ACR Standard*, https://acrcarbon.org/acr-program/standard/

	landowner/facility owner may be different entities. The Project Proponent is the ACR account holder.
Project Region	The larger region including and encompassing the entire Project Area. The Project Region may be an eco-region or geographic administrative unit.
Soil texture	The proportion of sand, silt and clay sized particles that make up the mineral fraction of the soil. It is a classification instrument used both in the field and laboratory to determine soil classes based on their physical texture.
Stratum	An area of land within which the value of a variable, and the processes leading to change in that variable, are relatively homogenous.
Succession	The process of change in the species structure of an ecological community over time.
Tree	A woody perennial plant, typically large, with a single well-defined stem carrying a more or less definite crown; sometimes defined as attaining a minimum diameter of 3 inches (7.6 cm) and a minimum height of 15 ft (4.6 m) at maturity. For FIA, any plant on the tree list in the current field manual is measured as a tree.[69]
Unidentified Agent	A particular entity that cannot be uniquely identified, but that belongs to a class of known conversion agents (e.g., farm corporations) who plan to convert Grassland or Shrubland to Cropland in the Project Area.

[69] https://www.nrs.fs.fed.us/fia/data-tools/state-reports/glossary/default.asp

Appendix A: Parameters

A.1 Parameters Defined by Methodology Equations

All parameters in A.1 can also be obtained as outputs from approved biogeochemical models.

PARAMETER	UNIT	DESCRIPTION	SOURCE	USED IN EQ.
BEy	$MTCO_2e$	Baseline emissions in year y, all field. y=0 at project start date		1
BEp,y	$MTCO_2e$	Baseline emissions from participant field p, in year y		1,2
$C_{AGB,BL_{p,y}}$	$MTCO_2e$	Carbon stock of above-ground biomass for Participant Field p in the baseline scenario in year y		2,3
$C_{AGB_{b,y=0}}$	$MTCO_2e$	Initial (year y=0) carbon stock of above-ground biomass for biomass type b		20, 22
$C_{AGB,PR\ p,y}$	$MTCO_2e$	Carbon stock of above-ground biomass for Participant Field p in the project scenario in year y		4, 19, 21
$C_{AGB_{grass},BL_{p,y}}$	$MTCO_2e$	Carbon stock of (remaining, pre-existing) above ground for Participant Field p in year y in the baseline scenario, as calculated from Section 6.2.1		3

PARAMETER	UNIT	DESCRIPTION	SOURCE	USED IN EQ.
$C_{AGB_{crop},BL_{p,y}}$	$MTCO_2e$	Carbon stock of aboveground crop biomass in Participant Field **p** in year **y** in the baseline scenario		5
$C_{AGB_{crop},BL_{b,y}}$	$MTCO_2e$	Carbon stock of aboveground crop biomass in Participant Field **p**, for crop type **b**, in year y in the baseline scenario		5, 6
$C_{BGB,BL_{p,y}}$	$MTCO_2e$	Carbon stock of belowground biomass in Participant Field **p** in year **y** in the baseline scenario		2,7
$C_{BGB_{crop},BL_{p,y}}$	$MTCO_2e$	Carbon stock of belowground crop biomass in Participant Field **p** in year **y** in the baseline scenario		7, 9
$C_{BGB_{grass},BL_{p,y}}$	$MTCO_2e$	Carbon stock of (remaining, pre-existing) belowground biomass from Participant Field **p** in year **y** in the baseline scenario		7, 8
$C_{BGB,PR_{p,y}}$	$MTCO_2e$	Carbon stock of below-ground biomass for Participant Field **p** in the project scenario in year **y**		8, 19, 22
$C_{SOC,BL_{p,y}}$	$MTCO_2e$	Carbon stock of soil organic carbon for Participant Field **p** in the baseline scenario in year **y**		2,10
$F_{BL/PR,ON_{p,y}}$	MT-N	Mass of organic **N** amendments applied to Participant Field **p** in the baseline/project scenario in year **y** adjusted for volatilization as NH_3 and NO_X		12, 14, 23, 25

PARAMETER	UNIT	DESCRIPTION	SOURCE	USED IN EQ.
$F_{BL/PR,SN_{p,y}}$	MT-N	Mass of synthetic fertilizer nitrogen applied to Participant Field **p** in the baseline/project scenario in year **y** adjusted for volatilization as NH_3 and NO_X		12, 13, 23, 24
$E_{BL/PR,N_2O_{p,y}} = E_{BL/PR,N_2Odirect_{p,y}}$	$MTCO_2e$	Total N_2O emissions from Participant Field **p** in the baseline/project scenario in year **y**. Indirect emissions are conservatively excluded		2, 12, 19, 23
$E_{(BL/PR),FF_{p,y}}$	$MTCO_2e$	Emissions due to the use of fossil fuels in agricultural management in the baseline/project scenario on Participant Field **p** in year **y**		2, 17, 19, 30
$EF_{t,y}$	d.u.	Emission factor for the fraction of soil organic carbon pool remaining **t** years since conversion to Cropland in year **y**		10, 11
$Nex_{l,p,y}$	kg N $(animal)^{-1}$ $(yr.)^{-1}$	Annual average **N** excretion per head of species/category **l**, Participant Field **p** in year **y**		26, 27
$E_{FERM_{p,y}}$	$MTCO_2e$	CH_4 emission from enteric fermentation due to livestock on Participant Field **p** in year **y**		28
PE_y	$MTCO_2e$	Total project emissions in year **y**		18
$PE_{p,y}$	$MTCO_2e$	Total project emissions from participant field **p** in year **y**		18, 19

A.2 Parameters Available at Validation

PARAMETER	UNIT	DESCRIPTION	SOURCE	USED IN EQ.
A_b	ha	Area of biomass/crop type **b**	Project Proponent	6, 21
$A_{p,i}$	ha	Area of Participant Field in soil strata **i**	Project Proponent	10
$C_{AGB_{b,y=0}}$	$MTCO_2e$	Initial (year **y**=0) carbon stock of aboveground biomass for Participant Field **p**	Measured, Modeled, values from literature	20, 22
$C_{SOC_{i,y=0}}$	$MTCO_2e\ (ha)^{-1}$	Total initial (year **y**=0) soil organic carbon stock in soil strata **i**, fixed for project duration	Measured, modeled, or literature. Where unavailable, default values from IPCC 2006 AFOLU GL, Table 2.3 may be used.	10
CF_b	MT C (MT dry matter)$^{-1}$	Carbon fraction of dry matter for biomass type **b**	Literature, Table 11.2 IPCC 2006 GL AFOLU	6, 21
D	years	Transition period for soil organic carbon, time period for transition between equilibrium SOC values, default value of 20	Measured, Modeled, literature, or default value of 20 years (IPCC 2006 AFOLU GL, Ch. 2).	11

PARAMETER	UNIT	DESCRIPTION	SOURCE	USED IN EQ.
$DM_{b,y=0}$	$MTCO_2e$	Average, annual, dry matter for biomass type **b** at project initiation (year **y**=0)	Measured, Modeled, literature	6, 21
$e^{(-0.77\times(y-t))}$	d.u.	The decay function for aboveground biomass following conversion	Kochsiek et al. 2009	4
$e^{(-1.41\times(y-t))}$	d.u.	The decay function for belowground biomass following conversion	Silver and Miya 2001	8
EF_f	$MTCO_2e$ (liter of fuel)$^{-1}$	Emission factor for the type of fossil fuel combusted in vehicle or equipment	For gasoline EF CO_2e = 8.89 kg CO_2e/gallon. For diesel EF CO_2e = 10.16 kg CO_2e/gallon. Source: EIA	17, 30
EF_l	kg-CH_4 head^{-1} grazing day^{-1}	Enteric CH_4 emission factor for livestock type **l**	Default value for Cattle in Cool Climate Zone: 1; default for Temperate or Warm Climate Zone: 2 Source: Chapter 10, Table 10.14, IPCC 2006 AFOLU GL	28, 29
EF_N	MT-N_2O-N (MT-N input)$^{-1}$	Emission Factor for emission from **N** inputs	0.0254 (2.54%) of applied synthetic fertilizer **N** and 0.02 (2%) of applied organic fertilizer **N** (Davidson, 2009)	12, 23

PARAMETER	UNIT	DESCRIPTION	SOURCE	USED IN EQ.
EF_{MNR}	MT-N_2O-N (MT-N input)$^{-1}$	Emission Factor for emission from manure inputs	Literature, Default values may be found Table 11.1, Chapter 11 IPCC 2006 AFOLU GL	23
$FC_{p,y}$	d.u	Proportion of Participant Field **p** that has been converted to Cropland in the baseline scenario for year **y**, d.u.	Project Proponent	10
$FC_{p,t,y}$	d.u.	The cumulative proportion of Participant Field **p** that has been converted to Cropland in year **t**, time of conversion, as of year **y** in the baseline scenario, determined based on rates and extents of conversion	Project Proponent	4, 8
$Frac_{ON}$	kg N volatilized (kg of N applied or deposited)$^{-1}$	Fraction of organic **N** applied to soils that volatilizes as NH_3 and NO_x	Default value of 0.20 Source: Chapter 11, Table 11.3, p. 11.24, IPCC 2006 AFOLU GL	14, 25
$Frac_{SN}$	kg N volatilized (kg of N applied or deposited)$^{-1}$	Fraction of synthetic **N** applied to soils that volatilizes as NH_3 and NO_x	Default value of 0.10 Source: Chapter 11, Table 11.3, p. 11.24, IPCC 2006 AFOLU GL	13, 24
GWP_{CH_4}	$MTCO_2e$	Global warming potential for CH_4	See *ACR Standard*	28

PARAMETER	UNIT	DESCRIPTION	SOURCE	USED IN EQ.
GWP_{N_2O}	$MTCO_2e$	Global warming potential for N_2O	See *ACR Standard*	12, 23
Y_m	d.u.	Methane conversion factor, per cent of gross energy in feed converted to methane	Suggested Default for Cattle or Buffalo-grazing: 6.5%; Lambs (<1-year-old): 4.5%; and Mature Sheep: 6.5% Source: Chapter 4, Tables 10.12 and 10.13, IPCC 2006 AFOLU GL	29
P		Total number of participant fields, **p**	Project Proponent	
t	years	Time since conversion of Grassland to Cropland in the baseline scenario	Project Proponent	
R_b	d.u.	Root carbon-to-shoot carbon ratio of (crop) biomass type **b**; default value 4.2 for temperate grassland, 4.5 for cool temperate grassland and 1.8 for shrubland	Literature, Craine et al. 2005, Mokany et al 2006; or IPCC 2006 AFOLU GL	9, 22
$\frac{44}{12}$		Ratio of molar mass of CO_2 to **C**	NA	6, 21

PARAMETER	UNIT	DESCRIPTION	SOURCE	USED IN EQ.
$\frac{44}{28}$		Ratio of molar mass of N_2O to **N**	NA	12

A.3 Parameters Monitored

PARAMETER	UNIT	DESCRIPTION	SOURCE	USED IN EQ.
B		Total number of crop/biomass types **b**		
$DM_{BL,b,y}$	MT dry matter $(ha)^{-1}$	Annualized average dry matter in the baseline for crop type **b** in year **y**	Harvest Index: ratio of economic product dry mass to plant aboveground dry mass. Alternatively, Values from literature, where none are available use of Harvest Index applied to crop yield guides for the Project Region may be used, or the IPCC default value of 5.0 MT C $(ha)^{-1}$ for annual crops following one year after conversion (IPCC 2006 AFOLU GL, Table 5.9)	6
$F_{PRP_{p,y}}$	MT-N	Mass of manure and urine **N** deposited by grazing animals	Producer records, or a university extension or other production report containing grazing	23

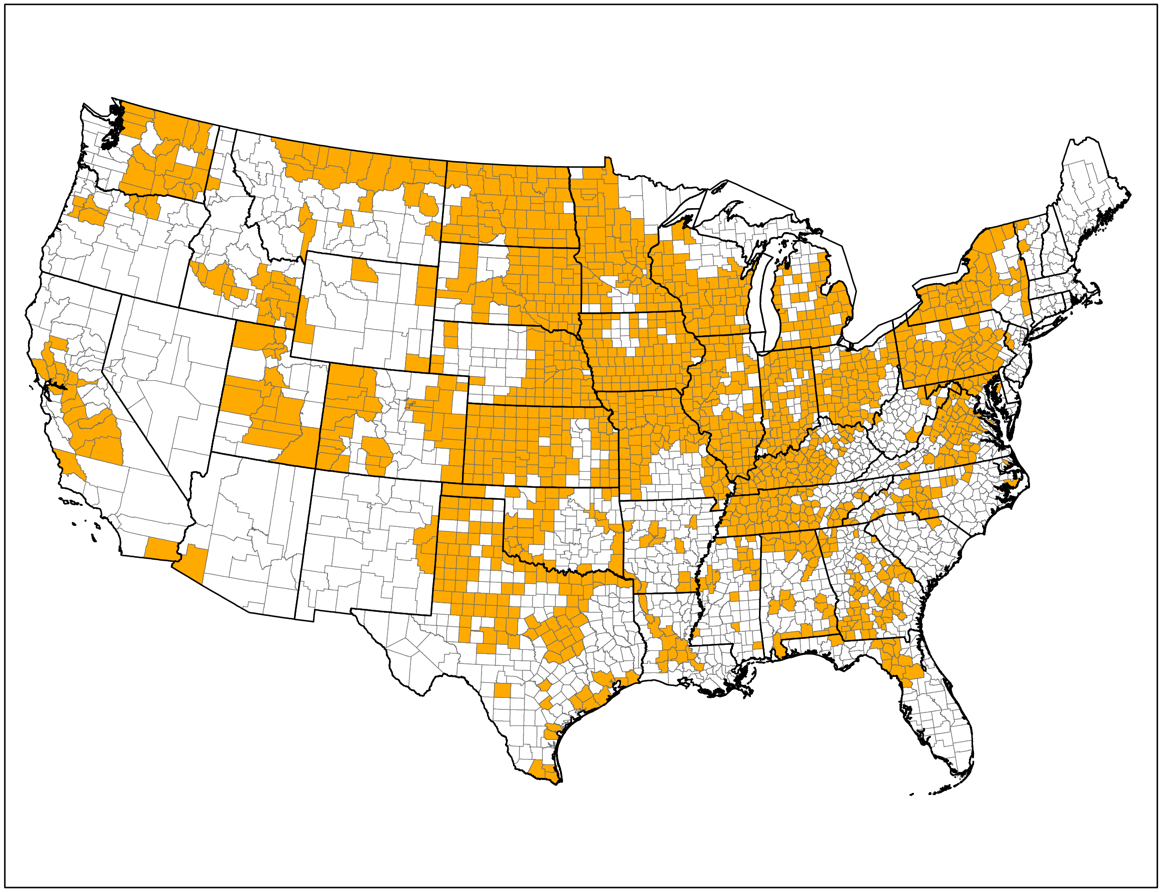
PARAMETER	UNIT	DESCRIPTION	SOURCE	USED IN EQ.
		on pasture, range and paddock	animal population multiplied by per animal manure and urine **N** deposition.	
$FSOC_{LU}$	d.u.	Fraction of soil organic carbon pool remaining after transition period, accounting for land use factors	Literature, model, measured, or IPCC defaults Table 5.5 AFOLU GL 2006	11
$FSOC_{MG}$	d.u.	Fraction of soil organic carbon pool remaining after transition period, accounting for management factors	Literature, model, measured, or IPCC defaults Table 5.5 AFOLU GL 2006	11
$FSOC_{IN}$	d.u.	Fraction of soil organic carbon pool remaining after transition period, accounting for input of organic matter	Literature, model, measured, or IPCC defaults Table 5.5 AFOLU GL 2006	11
$FF_{BL/PR_{p,v,j,y}}$	liters	Volume of fossil fuel consumed in the baseline/project scenario on Participant Field **p** in vehicle/equipment type **v** with fuel type **j** during year **y**	Expert opinion or extension/agency report (baseline) or producer report (project) that contains vehicle/equipment hours and fuel needed per unit of use.	17, 30

PARAMETER	UNIT	DESCRIPTION	SOURCE	USED IN EQ.
$GD_{p,l,y}$	days	Grazing days per livestock type **l** on Participant Field **p** in year **y**	University extension, producer, or other production report containing average grazing days per livestock type **l** in the project region.	27, 28
GE	MJ head^{-1} day^{-1}	Gross energy intake	Literature, government reports, or expert opinion.	29
$M_{BL/PR,SN_{p,j,y}}$	MT	Mass of synthetic fertilizer type **j** applied to Participant Field **p** in year **y**	County-level producer surveys conducted by a government agricultural agency(ies) or university extension offices, or the expert opinion of an university extension personnel working in the region and systems of interest, personnel of a governmental agriculture agency field office (e.g., USDA's RMA, FSA, NRCS) with jurisdiction in the Project Region, or Cropland management plans approved by a lending agency.	13, 24
$M_{BL/PR,ON_{p,k,y}}$	MT	Mass of organic **N** amendment type **k** applied to Participant Field **p** in year **y**	County-level producer surveys conducted by a government agricultural agency(ies) or university extension offices, or the expert opinion of an university extension personnel working in the region and systems of interest, personnel of a governmental agriculture agency field office (e.g., USDA's RMA, FSA, NRCS) with jurisdiction in the Project Region, or	14, 25

PARAMETER	UNIT	DESCRIPTION	SOURCE	USED IN EQ.
			Cropland management plans approved by a lending agency.	
$N_{BL/PR,ON_k}$	MT-N (MT input)$^{-1}$	Nitrogen content of organic **N** amendment type **k**	Producer of nitrogen if a commercially produced product. Otherwise IPCC defaults or values from the literature.	14, 25
$N_{BL/PR,SN_j}$	MT-N (MT input)$^{-1}$	Nitrogen content of synthetic fertilizer type **j**	Producer of fertilizer	13, 24
N_{rate_l}	kg N (1,000 kg animal mass)$^{-1}$ day^{-1}	**N** excretion rate	Default values may be found in Table 10.19, Chapter 10 IPCC 2006 AFOLU GL	27
$P_{p,l}$	number of head	Population of livestock type **l**	Where the Project Proponent can demonstrate that any positive change in enteric methane would be *de minimus* then it is not required that livestock populations must be monitored at the level of the Participant Field. This could be done by identifying the maximum stocking rate observed in the Project Region and calculating the difference in enteric methane emission between the baseline and maximum stocking rate.	26, 28

PARAMETER	UNIT	DESCRIPTION	SOURCE	USED IN EQ.
TAM_l	kg animal^{-1}	Typical animal mass for livestock category l	Literature, government reports, or expert opinion.	27
L		Total number of livestock types in project scenario	Project Proponent	26, 28
J		Total number of synthetic N inputs, j	Project Proponent	13, 24
K		Total number of organic N amendments, k	Project Proponent	14, 25
V		Total number of vehicles, v	Project Proponent	17, 30
F		Total number of fossil fuels, f	Project Proponent	17, 30

Appendix B: County Map for Unidentified Agent of Conversion



Project fields/parcels located in the counties highlighted in orange have a baseline scenario of cropland for unidentified agents of conversion and surpass the practice-based performance standard for demonstrating additionality. Project fields/parcels in white counties must determine the baseline land-use scenario and demonstrate additionality according to sections 3.1.1.2 and 3.2.2.2 respectively.

STATE	COUNTY
AL	Baldwin County
	Barbour County
	Bullock County
	Calhoun County
	Cherokee County
	Colbert County
	Covington County
	Cullman County
	Dallas County
	DeKalb County
	Escambia County
	Etowah County
	Franklin County
	Geneva County
	Henry County
	Houston County
	Jackson County
	Lauderdale County
	Lawrence County
	Limestone County
	Macon County
	Madison County
	Marengo County
	Marshall County
	Morgan County
	Perry County
	Talladega County
AR	Ashley County
	Chicot County
	Conway County
	Crawford County
	Drew County
	Jackson County
	Lafayette County
	Little River County
	Lonoke County
	Miller County
	Perry County
	Pope County
	Yell County
AZ	Yuma County
CA	Amador County
	Contra Costa County
	Fresno County
	Glenn County
	Imperial County
	Kings County
	Lake County
	Madera County
	Merced County
	Napa County
	Sacramento County
	San Joaquin County
	San Luis Obispo County
	Solano County
	Sonoma County
	Stanislaus County
	Tulare County
	Yolo County
CO	Adams County
	Alamosa County
	Arapahoe County
	Baca County
	Cheyenne County
	Conejos County
	Delta County
	Denver County
	Dolores County
	Eagle County
	Elbert County
	Garfield County
	Kiowa County
	Kit Carson County
	La Plata County
	Lincoln County
	Logan County
	Mesa County
	Moffat County
	Montezuma County
	Montrose County
	Morgan County
	Phillips County
	Pitkin County
	Prowers County
	Rio Blanco County
	Rio Grande County
	Routt County
	Saguache County
	San Miguel County
	Washington County
FL	Alachua County
	Citrus County
	Columbia County
	Dixie County
	Gilchrist County
	Hamilton County
	Jackson County
	Lafayette County
	Levy County
	Madison County
	Marion County
	Suwannee County
GA	Appling County
	Atkinson County
	Bacon County

STATE	COUNTY
	Baker County
	Bartow County
	Berrien County
	Bleckley County
	Brooks County
	Burke County
	Calhoun County
	Chattooga County
	Coffee County
	Colquitt County
	Crawford County
	Crisp County
	Decatur County
	Dodge County
	Dougherty County
	Early County
	Floyd County
	Gordon County
	Hart County
	Houston County
	Irwin County
	Jeff Davis County
	Jefferson County
	Jenkins County
	Johnson County
	Lamar County
	Lanier County
	Lee County
	Macon County
	Miller County
	Mitchell County
	Monroe County
	Montgomery County
	Morgan County
	Murray County
	Peach County
	Pierce County
	Polk County
	Putnam County
	Richmond County
	Screven County
	Seminole County
	Spalding County
	Sumter County
	Taylor County
	Telfair County
	Terrell County
	Thomas County
	Toombs County
	Treutlen County
	Walker County
	Walton County
	Warren County
	Washington County
	Wheeler County
	White County
	Worth County
IA	Adair County
	Adams County
	Allamakee County
	Appanoose County
	Audubon County
	Benton County
	Black Hawk County
	Butler County
	Carroll County
	Cass County
	Cedar County
	Cherokee County
	Chickasaw County
	Clarke County
	Clay County
	Clayton County
	Clinton County
	Crawford County
	Dallas County
	Davis County
	Decatur County
	Delaware County
	Des Moines County
	Dickinson County
	Dubuque County
	Emmet County
	Fayette County
	Floyd County
	Franklin County
	Fremont County
	Greene County
	Grundy County
	Guthrie County
	Hancock County
	Hardin County
	Harrison County
	Henry County
	Howard County
	Ida County
	Iowa County
	Jackson County
	Jasper County
	Jefferson County
	Johnson County
	Jones County
	Keokuk County
	Lee County
	Linn County
	Louisa County
	Lucas County
	Lyon County

STATE	COUNTY
	Madison County
	Mahaska County
	Marion County
	Marshall County
	Mills County
	Mitchell County
	Monona County
	Monroe County
	Montgomery County
	Muscatine County
	O'Brien County
	Osceola County
	Page County
	Plymouth County
	Polk County
	Pottawattamie County
	Poweshiek County
	Ringgold County
	Sac County
	Shelby County
	Sioux County
	Story County
	Tama County
	Taylor County
	Union County
	Van Buren County
	Wapello County
	Warren County
	Washington County
	Wayne County
	Winnebago County
	Winneshiek County
	Woodbury County
	Wright County
ID	Ada County
	Bannock County
	Bear Lake County
	Bingham County
	Bonneville County
	Butte County
	Camas County
	Canyon County
	Caribou County
	Elmore County
	Gooding County
	Jefferson County
	Latah County
	Lincoln County
	Madison County
	Oneida County
	Power County
IL	Adams County
	Alexander County
	Bond County
	Boone County
	Brown County
	Bureau County
	Calhoun County
	Carroll County
	Cass County
	Christian County
	Clay County
	Clinton County
	Coles County
	Crawford County
	Cumberland County
	DeKalb County
	Douglas County
	Edgar County
	Edwards County
	Effingham County
	Fayette County
	Ford County
	Franklin County
	Fulton County
	Gallatin County
	Greene County
	Hamilton County
	Hancock County
	Hardin County
	Henderson County
	Henry County
	Jackson County
	Jasper County
	Jefferson County
	Jersey County
	Jo Daviess County
	Johnson County
	Kane County
	Kankakee County
	Kendall County
	Knox County
	Lawrence County
	Lee County
	Livingston County
	Macoupin County
	Madison County
	Marion County
	Marshall County
	Mason County
	Massac County
	McDonough County
	McHenry County
	McLean County
	Menard County
	Mercer County
	Monroe County
	Montgomery County

STATE	COUNTY
	Morgan County
	Ogle County
	Peoria County
	Perry County
	Pike County
	Pope County
	Pulaski County
	Putnam County
	Randolph County
	Richland County
	Rock Island County
	Saint Clair County
	Saline County
	Schuyler County
	Scott County
	Shelby County
	Stark County
	Stephenson County
	Tazewell County
	Union County
	Vermilion County
	Wabash County
	Warren County
	Washington County
	Wayne County
	White County
	Whiteside County
	Will County
	Williamson County
	Winnebago County
IN	Adams County
	Allen County
	Benton County
	Blackford County
	Boone County
	Brown County
	Carroll County
	Cass County
	Clark County
	Clay County
	Crawford County
	Daviess County
	Decatur County
	DeKalb County
	Delaware County
	Dubois County
	Elkhart County
	Fayette County
	Floyd County
	Fountain County
	Franklin County
	Fulton County
	Gibson County
	Greene County
	Hamilton County
	Harrison County
	Hendricks County
	Henry County
	Huntington County
	Jackson County
	Jasper County
	Jay County
	Jefferson County
	Jennings County
	Knox County
	Kosciusko County
	LaGrange County
	LaPorte County
	Lawrence County
	Madison County
	Marshall County
	Martin County
	Miami County
	Monroe County
	Montgomery County
	Morgan County
	Newton County
	Noble County
	Orange County
	Owen County
	Perry County
	Pike County
	Porter County
	Pulaski County
	Putnam County
	Randolph County
	Ripley County
	Rush County
	Saint Joseph County
	Scott County
	Spencer County
	Starke County
	Steuben County
	Tippecanoe County
	Union County
	Vermillion County
	Vigo County
	Warren County
	Warrick County
	Washington County
	Wayne County
	White County
	Whitley County
KS	Allen County
	Atchison County
	Barton County
	Bourbon County
	Brown County

STATE	COUNTY
	Butler County
	Cherokee County
	Cheyenne County
	Clay County
	Cloud County
	Comanche County
	Crawford County
	Decatur County
	Dickinson County
	Doniphan County
	Douglas County
	Edwards County
	Ellis County
	Finney County
	Ford County
	Franklin County
	Gove County
	Graham County
	Grant County
	Gray County
	Greeley County
	Hamilton County
	Harper County
	Harvey County
	Haskell County
	Hodgeman County
	Jackson County
	Jefferson County
	Jewell County
	Johnson County
	Kearny County
	Kingman County
	Kiowa County
	Labette County
	Lane County
	Leavenworth County

STATE	COUNTY
	Lincoln County
	Linn County
	Logan County
	Marion County
	Marshall County
	McPherson County
	Meade County
	Miami County
	Mitchell County
	Montgomery County
	Morton County
	Nemaha County
	Neosho County
	Ness County
	Norton County
	Osage County
	Osborne County
	Ottawa County
	Pawnee County
	Phillips County
	Pratt County
	Rawlins County
	Reno County
	Republic County
	Rice County
	Rooks County
	Rush County
	Russell County
	Saline County
	Scott County
	Sedgwick County
	Seward County
	Shawnee County
	Sheridan County
	Sherman County
	Smith County

STATE	COUNTY
	Stafford County
	Stanton County
	Stevens County
	Sumner County
	Thomas County
	Trego County
	Wallace County
	Washington County
	Wichita County
	Wilson County
KY	Adair County
	Allen County
	Ballard County
	Barren County
	Bath County
	Bourbon County
	Boyle County
	Breckinridge County
	Bullitt County
	Butler County
	Caldwell County
	Calloway County
	Carlisle County
	Carroll County
	Casey County
	Christian County
	Clark County
	Clinton County
	Crittenden County
	Cumberland County
	Daviess County
	Edmonson County
	Estill County
	Fleming County
	Franklin County
	Fulton County

STATE	COUNTY
	Graves County
	Grayson County
	Green County
	Greenup County
	Hancock County
	Hardin County
	Hart County
	Henderson County
	Henry County
	Hickman County
	Hopkins County
	Larue County
	Lewis County
	Lincoln County
	Livingston County
	Logan County
	Lyon County
	Marion County
	Marshall County
	Mason County
	McCracken County
	McLean County
	Meade County
	Mercer County
	Metcalfe County
	Monroe County
	Muhlenberg County
	Nelson County
	Ohio County
	Powell County
	Pulaski County
	Rockcastle County
	Rowan County
	Russell County
	Scott County
	Shelby County
	Simpson County
	Spencer County
	Taylor County
	Todd County
	Trigg County
	Trimble County
	Union County
	Warren County
	Washington County
	Wayne County
	Webster County
LA	Allen Parish
	Avoyelles Parish
	Bossier Parish
	Evangeline Parish
	Grant Parish
	Iberville Parish
	Jefferson Davis Parish
	Natchitoches Parish
	Pointe Coupee Parish
	Rapides Parish
	Red River Parish
	Saint Landry Parish
MD	Allegany County
	Baltimore County
	Carroll County
	Cecil County
	Frederick County
	Garrett County
	Harford County
	Howard County
	Montgomery County
	Queen Anne's County
	Washington County
MI	Alcona County
	Allegan County
	Alpena County
	Arenac County
	Barry County
	Bay County
	Berrien County
	Branch County
	Calhoun County
	Cass County
	Clinton County
	Eaton County
	Genesee County
	Gladwin County
	Grand Traverse County
	Hillsdale County
	Huron County
	Ingham County
	Ionia County
	Iosco County
	Isabella County
	Jackson County
	Lapeer County
	Leelanau County
	Lenawee County
	Livingston County
	Macomb County
	Manistee County
	Mason County
	Mecosta County
	Missaukee County
	Muskegon County
	Oceana County
	Ogemaw County
	Oscoda County
	Ottawa County
	Saginaw County

STATE	COUNTY
	Saint Clair County
	Saint Joseph County
	Sanilac County
	Shiawassee County
	Tuscola County
	Washtenaw County
	Wayne County
MN	Aitkin County
	Anoka County
	Becker County
	Beltrami County
	Benton County
	Big Stone County
	Carver County
	Cass County
	Chippewa County
	Chisago County
	Clay County
	Clearwater County
	Cottonwood County
	Crow Wing County
	Dakota County
	Dodge County
	Douglas County
	Fillmore County
	Freeborn County
	Goodhue County
	Grant County
	Hennepin County
	Houston County
	Hubbard County
	Isanti County
	Jackson County
	Kanabec County
	Kandiyohi County
	Lac qui Parle County
	Lake of the Woods County
	Le Sueur County
	Lincoln County
	Lyon County
	Mahnomen County
	Marshall County
	McLeod County
	Meeker County
	Mille Lacs County
	Morrison County
	Mower County
	Murray County
	Norman County
	Olmsted County
	Otter Tail County
	Pennington County
	Pine County
	Pipestone County
	Polk County
	Pope County
	Red Lake County
	Redwood County
	Rice County
	Roseau County
	Scott County
	Sherburne County
	Sibley County
	Stearns County
	Steele County
	Stevens County
	Swift County
	Todd County
	Traverse County
	Wabasha County
	Wadena County
	Washington County
	Wilkin County
	Winona County
	Wright County
	Yellow Medicine County
MO	Adair County
	Andrew County
	Atchison County
	Audrain County
	Barry County
	Barton County
	Bates County
	Benton County
	Bollinger County
	Boone County
	Buchanan County
	Butler County
	Caldwell County
	Callaway County
	Cape Girardeau County
	Carroll County
	Cass County
	Cedar County
	Chariton County
	Clark County
	Clay County
	Clinton County
	Cole County
	Cooper County
	Dade County
	Daviess County
	DeKalb County
	Dunklin County
	Franklin County
	Gasconade County
	Gentry County
	Greene County

STATE	COUNTY
	Grundy County
	Harrison County
	Henry County
	Hickory County
	Holt County
	Howard County
	Jackson County
	Jasper County
	Johnson County
	Knox County
	Lafayette County
	Lawrence County
	Lewis County
	Lincoln County
	Linn County
	Livingston County
	Macon County
	Madison County
	Marion County
	Mercer County
	Moniteau County
	Monroe County
	Montgomery County
	Morgan County
	New Madrid County
	Newton County
	Nodaway County
	Perry County
	Pettis County
	Pike County
	Platte County
	Polk County
	Putnam County
	Ralls County
	Randolph County
	Ray County
	Saint Charles County
	Saint Clair County
	Saint Francois County
	Saint Louis County
	Sainte Genevieve County
	Saline County
	Schuyler County
	Scotland County
	Scott County
	Shelby County
	Stoddard County
	Sullivan County
	Vernon County
	Warren County
	Wayne County
	Worth County
MS	Adams County
	Alcorn County
	Benton County
	Calhoun County
	Chickasaw County
	Clay County
	Covington County
	DeSoto County
	George County
	Humphreys County
	Leake County
	Lee County
	Leflore County
	Lowndes County
	Monroe County
	Noxubee County
	Pontotoc County
	Sunflower County
	Union County
	Washington County
MT	Blaine County
	Broadwater County
	Chouteau County
	Daniels County
	Dawson County
	Fallon County
	Gallatin County
	Glacier County
	Golden Valley County
	Hill County
	Liberty County
	McCone County
	Petroleum County
	Phillips County
	Pondera County
	Roosevelt County
	Sheridan County
	Teton County
	Toole County
	Valley County
NC	Alamance County
	Anson County
	Burke County
	Cabarrus County
	Catawba County
	Cherokee County
	Clay County
	Cleveland County
	Davidson County
	Davie County
	Durham County
	Franklin County
	Gaston County
	Henderson County
	Hyde County

STATE	COUNTY
	Iredell County
	Lincoln County
	Mecklenburg County
	Mitchell County
	Orange County
	Pasquotank County
	Randolph County
	Rowan County
	Stanly County
	Surry County
	Transylvania County
	Union County
	Warren County
	Wilkes County
	Yadkin County
ND	Adams County
	Barnes County
	Benson County
	Billings County
	Bottineau County
	Bowman County
	Burke County
	Burleigh County
	Cass County
	Cavalier County
	Dickey County
	Divide County
	Dunn County
	Eddy County
	Emmons County
	Foster County
	Grand Forks County
	Grant County
	Griggs County
	Hettinger County
	Kidder County
	LaMoure County
	Logan County
	McHenry County
	McIntosh County
	McLean County
	Mercer County
	Morton County
	Mountrail County
	Nelson County
	Oliver County
	Pembina County
	Pierce County
	Ramsey County
	Ransom County
	Renville County
	Richland County
	Rolette County
	Sargent County
	Sheridan County
	Slope County
	Stark County
	Steele County
	Stutsman County
	Towner County
	Walsh County
	Ward County
	Wells County
	Williams County
NE	Adams County
	Antelope County
	Banner County
	Boone County
	Box Butte County
	Boyd County
	Buffalo County
	Burt County
	Butler County
	Cass County
	Cedar County
	Clay County
	Colfax County
	Cuming County
	Dakota County
	Dawes County
	Dixon County
	Dodge County
	Fillmore County
	Franklin County
	Furnas County
	Gage County
	Gosper County
	Greeley County
	Hall County
	Hamilton County
	Harlan County
	Holt County
	Howard County
	Jefferson County
	Johnson County
	Kearney County
	Kimball County
	Knox County
	Lancaster County
	Madison County
	Merrick County
	Nance County
	Nemaha County
	Nuckolls County
	Otoe County
	Pawnee County
	Perkins County
	Phelps County

STATE	COUNTY
	Pierce County
	Platte County
	Polk County
	Red Willow County
	Richardson County
	Saline County
	Sarpy County
	Saunders County
	Seward County
	Sherman County
	Stanton County
	Thayer County
	Thurston County
	Valley County
	Washington County
	Wayne County
	Webster County
	Wheeler County
	York County
NJ	Hunterdon County
	Warren County
NM	Curry County
	Quay County
	Roosevelt County
NY	Albany County
	Allegany County
	Broome County
	Cattaraugus County
	Cayuga County
	Chautauqua County
	Chemung County
	Chenango County
	Clinton County
	Columbia County
	Cortland County
	Dutchess County
	Erie County
	Franklin County
	Genesee County
	Herkimer County
	Jefferson County
	Lewis County
	Livingston County
	Madison County
	Monroe County
	Montgomery County
	Niagara County
	Oneida County
	Onondaga County
	Ontario County
	Orleans County
	Oswego County
	Otsego County
	Rensselaer County
	Saint Lawrence County
	Saratoga County
	Schoharie County
	Schuyler County
	Seneca County
	Steuben County
	Tioga County
	Tompkins County
	Washington County
	Wayne County
	Wyoming County
	Yates County
OH	Adams County
	Allen County
	Ashland County
	Ashtabula County
	Athens County
	Auglaize County
	Brown County
	Butler County
	Champaign County
	Clark County
	Clermont County
	Clinton County
	Columbiana County
	Coshocton County
	Crawford County
	Darke County
	Defiance County
	Delaware County
	Fairfield County
	Fayette County
	Franklin County
	Fulton County
	Gallia County
	Greene County
	Hardin County
	Highland County
	Hocking County
	Holmes County
	Huron County
	Jackson County
	Knox County
	Licking County
	Logan County
	Lorain County
	Madison County
	Mahoning County
	Marion County
	Medina County
	Mercer County
	Montgomery County
	Morgan County

STATE	COUNTY
	Morrow County
	Muskingum County
	Perry County
	Pickaway County
	Pike County
	Portage County
	Preble County
	Richland County
	Ross County
	Sandusky County
	Scioto County
	Seneca County
	Shelby County
	Stark County
	Trumbull County
	Tuscarawas County
	Union County
	Warren County
	Wayne County
	Williams County
	Wyandot County
OK	Alfalfa County
	Beckham County
	Blaine County
	Bryan County
	Caddo County
	Canadian County
	Cimarron County
	Cotton County
	Craig County
	Custer County
	Garfield County
	Grant County
	Greer County
	Harmon County
	Harper County
	Jackson County
	Jefferson County
	Kay County
	Kingfisher County
	Kiowa County
	Le Flore County
	Major County
	McCurtain County
	Muskogee County
	Ottawa County
	Roger Mills County
	Sequoyah County
	Texas County
	Tillman County
	Tulsa County
	Wagoner County
	Washita County
OR	Benton County
	Gilliam County
	Linn County
	Marion County
	Morrow County
	Polk County
	Sherman County
PA	Adams County
	Allegheny County
	Armstrong County
	Beaver County
	Bedford County
	Berks County
	Blair County
	Bradford County
	Butler County
	Cambria County
	Carbon County
	Centre County
	Chester County
	Clarion County
	Clearfield County
	Clinton County
	Columbia County
	Crawford County
	Cumberland County
	Dauphin County
	Erie County
	Fayette County
	Franklin County
	Fulton County
	Greene County
	Huntingdon County
	Indiana County
	Jefferson County
	Juniata County
	Lancaster County
	Lawrence County
	Lebanon County
	Lehigh County
	Luzerne County
	Lycoming County
	Mercer County
	Mifflin County
	Monroe County
	Montour County
	Northumberland County
	Perry County
	Potter County
	Schuylkill County
	Snyder County
	Somerset County
	Sullivan County
	Union County

STATE	COUNTY
	Venango County
	Warren County
	Washington County
	Westmoreland County
	York County
SC	Cherokee County
	Chesterfield County
SD	Aurora County
	Beadle County
	Bennett County
	Bon Homme County
	Brookings County
	Brown County
	Brule County
	Buffalo County
	Campbell County
	Charles Mix County
	Clark County
	Clay County
	Codington County
	Davison County
	Day County
	Deuel County
	Douglas County
	Edmunds County
	Faulk County
	Grant County
	Gregory County
	Haakon County
	Hamlin County
	Hand County
	Hanson County
	Hughes County
	Hutchinson County
	Hyde County
	Jackson County
	Jerauld County
	Jones County
	Kingsbury County
	Lake County
	Lincoln County
	Lyman County
	Marshall County
	McCook County
	McPherson County
	Meade County
	Miner County
	Minnehaha County
	Moody County
	Pennington County
	Perkins County
	Potter County
	Roberts County
	Sanborn County
	Spink County
	Stanley County
	Sully County
	Tripp County
	Turner County
	Union County
	Walworth County
	Yankton County
TN	Bedford County
	Benton County
	Bledsoe County
	Blount County
	Bradley County
	Cannon County
	Carroll County
	Cheatham County
	Chester County
	Clay County
	Cocke County
	Coffee County
	Crockett County
	Davidson County
	Decatur County
	DeKalb County
	Dickson County
	Dyer County
	Fayette County
	Franklin County
	Gibson County
	Giles County
	Grundy County
	Hamblen County
	Hardeman County
	Hardin County
	Haywood County
	Henderson County
	Henry County
	Hickman County
	Houston County
	Humphreys County
	Jackson County
	Jefferson County
	Lauderdale County
	Lawrence County
	Lewis County
	Lincoln County
	Loudon County
	Macon County
	Madison County
	Marion County
	Marshall County
	Maury County
	McMinn County

STATE	COUNTY
	McNairy County
	Meigs County
	Monroe County
	Montgomery County
	Obion County
	Perry County
	Polk County
	Robertson County
	Rutherford County
	Sequatchie County
	Smith County
	Stewart County
	Sumner County
	Tipton County
	Trousdale County
	Warren County
	Wayne County
	Weakley County
	White County
	Williamson County
TX	Archer County
	Armstrong County
	Bailey County
	Bell County
	Borden County
	Bosque County
	Bowie County
	Brazoria County
	Callahan County
	Cameron County
	Carson County
	Castro County
	Chambers County
	Childress County
	Clay County
	Cochran County

STATE	COUNTY
	Coleman County
	Collin County
	Collingsworth County
	Comanche County
	Concho County
	Cooke County
	Coryell County
	Cottle County
	Crosby County
	Dallam County
	Dallas County
	Dawson County
	Deaf Smith County
	Delta County
	Denton County
	Ellis County
	Falls County
	Fannin County
	Fisher County
	Floyd County
	Gaines County
	Glasscock County
	Gray County
	Grayson County
	Guadalupe County
	Hale County
	Hall County
	Hamilton County
	Hansford County
	Hardeman County
	Harris County
	Hartley County
	Haskell County
	Hidalgo County
	Hill County
	Hockley County

STATE	COUNTY
	Howard County
	Hunt County
	Jackson County
	Jefferson County
	Johnson County
	Jones County
	Karnes County
	Kaufman County
	Lamar County
	Lamb County
	Limestone County
	Lubbock County
	Lynn County
	Martin County
	Matagorda County
	McCulloch County
	McLennan County
	Milam County
	Mills County
	Mitchell County
	Montague County
	Moore County
	Navarro County
	Nolan County
	Nueces County
	Ochiltree County
	Parmer County
	Randall County
	Reagan County
	Red River County
	Robertson County
	Rockwall County
	Runnels County
	San Patricio County
	Schleicher County
	Scurry County

STATE	COUNTY
	Sherman County
	Swisher County
	Taylor County
	Terry County
	Throckmorton County
	Tom Green County
	Uvalde County
	Wharton County
	Wheeler County
	Wichita County
	Wilbarger County
	Willacy County
	Williamson County
	Yoakum County
UT	Box Elder County
	Cache County
	Davis County
	Emery County
	Garfield County
	Juab County
	Millard County
	Morgan County
	Piute County
	San Juan County
	Sanpete County
	Sevier County
	Utah County
	Wayne County
	Weber County
VA	Albemarle County
	Amelia County
	Appomattox County
	Augusta County
	Bath County
	Brunswick County
	Buckingham County
	Campbell County
	Caroline County
	Charlotte County
	Clarke County
	Culpeper County
	Cumberland County
	Dinwiddie County
	Fauquier County
	Fluvanna County
	Franklin County
	Frederick County
	Goochland County
	Greene County
	Halifax County
	Hanover County
	King George County
	King William County
	Loudoun County
	Louisa County
	Lunenburg County
	Madison County
	Mecklenburg County
	Nelson County
	Nottoway County
	Orange County
	Page County
	Pittsylvania County
	Powhatan County
	Rappahannock County
	Richmond County
	Rockbridge County
	Rockingham County
	Shenandoah County
	Spotsylvania County
	Stafford County
	Wythe County
VT	Addison County
	Franklin County
	Grand Isle County
WA	Adams County
	Benton County
	Columbia County
	Douglas County
	Ferry County
	Franklin County
	Garfield County
	Grant County
	Kittitas County
	Klickitat County
	Okanogan County
	Skagit County
	Snohomish County
	Spokane County
	Stevens County
	Walla Walla County
	Whatcom County
	Whitman County
	Yakima County
WI	Adams County
	Ashland County
	Barron County
	Bayfield County
	Brown County
	Buffalo County
	Burnett County
	Calumet County
	Chippewa County
	Clark County
	Columbia County
	Crawford County

STATE	COUNTY
	Dane County
	Dodge County
	Door County
	Dunn County
	Eau Claire County
	Fond du Lac County
	Grant County
	Green County
	Green Lake County
	Iowa County
	Jackson County
	Jefferson County
	Juneau County
	Kenosha County
	Kewaunee County
	La Crosse County
	Lafayette County
	Manitowoc County
	Marquette County
	Monroe County
	Oconto County
	Outagamie County
	Ozaukee County
	Pepin County
	Pierce County
	Polk County
	Portage County
	Racine County
	Richland County
	Rock County
	Rusk County
	Saint Croix County
	Sauk County
	Shawano County
	Sheboygan County
	Trempealeau County
	Vernon County
	Walworth County
	Washburn County
	Washington County
	Waupaca County
	Waushara County
	Winnebago County
	Wood County
WV	Berkeley County
	Greenbrier County
	Hardy County
	Jefferson County
	Mason County
	Mineral County
	Preston County
	Tucker County
WY	Big Horn County
	Crook County
	Laramie County
	Lincoln County
	Weston County

Appendix C: References

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