Draft revision to the approved baseline and monitoring methodology AM0047

"Production of biodiesel based on waste oils and/or waste fats from biogenic origin or from oil seeds cultivated in dedicated plantations for use as fuel"

I. SOURCE AND APPLICABILITY

Source

This methodology is based on:

- Case NM0180 "BIOLUX Benji Biodiesel Beijing Project", proposed by BIOLUX Benji Energy and Recycling Co. Ltd, whose baseline and monitoring methodology and project design document were prepared by Clemens Plöchl Carbon Consulting;
- Case NM0228 "AGRENCO Biodiesel Project in Alta Araguaia", proposed by Agrenco do Brasil S/A, whose baseline and monitoring methodology and project design document were prepared by Factor Consulting + Management AG and Geoklock Consultoria e Engenharia Ambiental Ltd;
- Case NM0233 "Palm Methyl Ester – Biodiesel Fuel (PME-BDF) production and use for transportation in Thailand" whose baseline and monitoring methodology and project design document were prepared by Japan Transport Cooperation Association and ALMEC Corporation.

For more information regarding the proposals and its consideration by the Executive Board please refer to cases NM0180, NM0233 and NM0228 on http://cdm.unfccc.int/goto/MPappmeth.

The methodology also refers to the latest version of the following tools[1]:

- "Tool for the demonstration and assessment of additionality";
- "Tool to calculate project emissions from electricity consumption";
- "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion".
- "Tool to determine project emissions from flaring gases containing methane"

~~This methodology also refers to the latest version of ACM0002 "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" and AMS I.D "Grid connected renewable electricity generation."~~

Selected approach from paragraph 48 of the CDM modalities and procedures

"Existing actual or historical emissions, as applicable"

Applicability

The methodology is applicable to project activities that reduce emissions through the production, sale and consumption of blends of petrodiesel with biodiesel to be used as fuel, where the biodiesel is produced from:

[1] Please refer to: http://cdm.unfccc.int/goto/MPappmeth

a) Waste cooking oil and/or waste fat from biogenic origin (henceforth referred to as "waste oil/fat"); or
b) Oil seeds cultivated in dedicated plantations on severely degraded land or on under-utilized agricultural land.

For the purpose of this methodology the following **definitions** apply:

- **Biogenic** means that the oils and/or fats originate from either vegetable or animal biomass, but not from mineral (fossil) sources;
- **Petrodiesel** is 100% fossil fuel diesel;
- **Biodiesel** is 100% trans-esterified biofuel diesel; and
- **Blended biodiesel** is defined as any blending fraction of petrodiesel with biodiesel greater than 0 and less than 100%;
- **Esterification** denotes the formation of an ester compound from carbonic acid and alcohol. Transesterification denotes the exchange of one alcohol in an ester against another (for example glycerol against methanol). In this methodology, "esterification" is used to denote both esterification and transesterification for simplicity;
- **Crop** is used in this methodology for both annual and perennial plants;
- **Dedicated plantations** are plantations that are newly established as part of the project activity for the purpose of supplying feedstock to the project plant;
- **Waste oil/fat***:* Is defined as a residue or waste stream from restaurants, agro and food industry, slaughterhouses or related commercial sectors.

The methodology ensures that the CERs can only be issued to the producer of the biodiesel and not to the consumer.

The following conditions apply to the methodology:

Feedstock inputs

a) If the feedstock is vegetable oils and / or fats from crops produced in dedicated plantations, volumes of biodiesel produced from feedstocks, which do not comply with the criteria for the dedicated plantations, are discounted in the calculation of emission reductions;
b) The alcohol used for esterification is methanol from **fossil fuel origin**. Volumes of biodiesel produced with alcohols other than methanol (for example, ethanol) are ~~discounted~~ not included in the quantity of biofuel claiming emissions reduction.[2]

Dedicated plantations (the following applicability conditions should be met **only if** the feedstock is vegetable oils and / or fats from crops produced in dedicated plantations).

a) The dedicated plantations are designed so as to avoid displacement of pre-project activities. To this end, the plantations are established on land which was, prior to project implementation:
    - Severely degraded land; OR
    - Under-utilized agricultural land.

[2] Such biodiesel is not included because the methodology does not provide procedures for estimating emissions in production of alcohol, other than methanol from **fossil fuel origin**, that may be used to produce biodiesel.

- Has been used for agricultural purposes, provided the project participants can demonstrate that no natural forests exists in the host country.[3]

b) Severely degraded land would, in absence of the project activity, not have been used for any other agricultural or forestry activity. One or more of the following indicators can be used to demonstrate that the land degraded:

   i. Vegetation degradation, e.g.,
      - Crown cover of pre-existing trees has decreased in the recent past for reasons other than sustainable harvesting activities;

   ii. Soil degradation, e.g.,
      - Soil erosion has increased in the recent past;
      - Soil organic matter content has decreased in the recent past.

   iii. Anthropogenic influences, e.g.,
      - There is a recent history of loss of soil and vegetation due to anthropogenic actions; and
      - Demonstration that there exist anthropogenic actions/activities that prevent possible occurrence of natural regeneration.

c) Plantations established on under-utilized agricultural land shall comprise one of the following activities:

   i. Introduction of a second crop per year on agricultural land previously lying idle for part of the year; OR

   ii. Liberation of under-utilized grazing land for conversion[4] to dedicated oil seed plantations, by increasing the livestock density on other existing grazing land in the project boundary. Livestock is not displaced to land areas outside the project boundary. Permanent losses in carbon stocks through over-utilization of the remaining grazing land must be prevented by respecting the maximum allowable livestock densities.

d) The site preparation does not cause longer-term net emissions from soil carbon. Carbon stocks in soil organic matter, litter and deadwood can be expected to decrease more due to soil erosion and human intervention or increase less in the absence of the project activity;

e) The land area of the dedicated plantations will be planted by direct planting and/or seeding;

f) After harvest, regeneration will occur either by direct planting, seeding or natural sprouting;

g) The project activity does not lead to an increase in livestock numbers in the project area. In case of dedicated plantations established on severely degraded land, no grazing will occur.

Biodiesel Plant and Product outputs

a) The petrodiesel, the biodiesel and their blends comply with national regulations (if existent), or with suitable international standards such as ASTM D6751, EN14214, or ANP42 24.11.2004;

b) The project activity involves construction and operation of a biodiesel plant for (trans-) esterification of animal and vegetable oils and fats;

c) Storage and treatment facilities of feedstocks and products of the plant are designed in a way to not result in any methane emissions. In particular, seed cake produced at the plant is either treated aerobically (e.g. returned to field directly, or after composting), or the methane resulting from

[3] This applicability condition addresses the issue that shifting agricultural production from the land area elsewhere may potentially result in deforestation. Natural forests include primary and secondary forests. Secondary forests are forest lands which have reverted to forests due to natural regeneration after a major disturbance such as fire, insect infestation, timber harvest or wind throw. To demonstrate that the no natural forests exist in the country, project participants may use forest statistics by the FAO or an official confirmation by the host country government.

[4] The conversion may be permanent, or temporary (e.g., rotation of oil crops and use as grazing land).

anaerobic treatment is completely captured and combusted (e.g. in a biodigester for energy generation). If waste water anaerobic treatment does not capture and combust the methane generated, methane emissions should be accounted as per this methodology;

d) The by-product glycerol is not disposed of or left to decay. It should be either incinerated or used as raw material for industrial consumption.

Consumption of biodiesel

a) The blended biodiesel is supplied to consumers within the host country whose existing stationary installations or vehicles, that actually combust the blend, are included in the project boundary.
b) The consumer (end-user) of blended biodiesel in the transport sector is a captive fleet.
c) The consumer and the producer of the blended biodiesel are bound by a contract that allows the producer to monitor the consumption of blended biodiesel and states that the consumer shall not claim CERs resulting from its consumption.
d) No major modifications in the consumer stationary installations or in the vehicles engines are deemed necessary to consume/combust the blended biodiesel. In case of stationary installations, the blending fraction can have any value between 0 and 100%. In case of vehicles use, the blending proportion must be low enough to ensure that the technical performance characteristics of the blended biodiesel do not differ significantly from those of pure petrodiesel. The default value for the maximum allowable blending proportion is 20% by volume (B20)[5]. If the project participants use a blending proportion more than 20%, they shall justify in the PDD that the technical performance characteristics of the blended biodiesel do not differ significantly from those of pure petrodiesel.
e) Blending is done by the producer, the consumer or a third party who is contractually bound to the producer to ensure that blending proportions and amounts are monitored and meet all regulatory requirements.

Activities for which CERs are claimed

a) Project participants claim CERs only for the CO_2 emissions from petrodiesel displaced by the biodiesel.
b) Project participants **do not** claim CERs for the following: (i) Net removal by sinks; (ii) Biodiesel consumed for non-energy purposes; (iii) Utilization of by-products such as glycerol; (iv) Avoidance of methane emissions from waste water treatment due to the reduction of waste oil in waste water.

[5] 2004 Biodiesel Handling and Use Guidelines, U.S. Department of Energy.

II. BASELINE METHODOLOGY

Project boundary

The spatial extent of the project boundary encompasses:

- Transportation of feedstock to the biodiesel plant. If the feedstock is vegetable oils and / or fats from crops produced in dedicated plantations, the transportation from the field to the crude vegetable oil production plant (off-site) should be included;
- Biodiesel production plant at the project site, comprising the esterification unit plus other installations on the site (e.g. storage, refining, blending, etc.); if the feedstock is vegetable oils and / or fats from crops produced in dedicated plantations, the crude vegetable oil production plant (on-site or off-site) should also be included;
- Transportation of biodiesel to the facility where the biodiesel is blended with petrodiesel;
- Facility where the biodiesel is blended with petrodiesel; (regardless of the ownership of the blending facility);
- Transportation of the blended biodiesel to the final consumer (end-user);
- Vehicles and existing stationary combustion installations where the blended biodiesel is consumed;
- If the feedstock is vegetable oils and / or fats from crops produced in dedicated plantations the geographic boundaries of the dedicated plantations including the grazing lands with increased livestock densities.

Relevant emission sources within this boundary include the following (see table below for details):

- Emissions from combustion of petrodiesel and biodiesel, taking into account the fossil carbon contained in methanol used in biodiesel production;
- Emissions from fuel and electricity consumed in the production of biodiesel;
- Emissions from the transport of feedstock to the biodiesel plant;
- Emissions from the transport of biodiesel to the facility where the biodiesel is blended with petrodiesel. These emissions are to be added to the project emissions only if the current distribution of the petrodiesel being displaced does not involve similar transport of fuel to a blend/distribution location.
- If the feedstock is vegetable oils and / or fats from crops produced in dedicated plantations and the complete land area of the dedicated plantations is included in the project boundary of one or several registered CDM A/R project activities, no further emission sources need to be included in the project boundary.[6] Otherwise project emission sources related to the production of the biomass shall also be considered.

Emissions associated with the production of methanol used for esterification are excluded from the project boundary, but are accounted for as leakage.

[6] The CDM Executive Board, at its 25th meeting, agreed that the emissions associated with an A/R activity should be accounted for in the A/R CDM project activity. In general, all project activities using biomass for energy should account for emissions associated with production of biomass. However, in the case that it can be demonstrated that for a project activity using biomass for energy, which uses biomass originating from a registered A/R project activity (i.e. through contractual agreement for procurement of biomass) it need not account for emissions related to biomass production.

Table 1: Summary of gases and sources included in the project boundary, and justification / explanation where gases and sources are not included.

	Source	Gas	Included?	Justification / Explanation
Baseline	Vehicles and stationary combustion sources consuming petrodiesel	CO_2	Yes	Main source of baseline emissions
		CH_4	No	Excluded for simplification. CH_4 and N_2O emissions are assumed to be very small. No systematic difference to project activity
		N_2O	No	
Project Activity	Transportation of feedstock to project site	CO_2	Yes	May be a significant emissions source
		CH_4	No	Excluded for simplification. CH_4 emissions are assumed to be very small.
		N_2O	No	Excluded for simplification. N_2O emissions are assumed to be very small.
	On site energy consumption at biodiesel production plant	CO_2	Yes	May be a significant emissions source
		CH_4	No	Excluded for simplification. CH_4 emissions are assumed to be very small.
		N_2O	No	Excluded for simplification. N_2O emissions are assumed to be very small.
	Transportation of biodiesel to blending facility	CO_2	Yes	May be a significant emissions source
		CH_4	No	Excluded for simplification. CH_4 emissions are assumed to be very small.
		N_2O	No	Excluded for simplification. N_2O emissions are assumed to be very small.
	Vehicles and stationary combustion sources consuming blended biodiesel	CO_2	Yes	Fossil carbon contained in methanol used for esterification. It is a significant source of emissions . Other biodiesel carbon is climate neutral.
		CH_4	No	Excluded for simplification. CH_4 and N_2O emissions are assumed to be very small. No systematic difference to baseline scenario
		N_2O	No	
	Anaerobic wastewater treatment in crude vegetable oil production, if applicable.	CO_2	No	Excluded for simplification. CO_2 emissions are assumed to be very small.
		CH_4	Yes	May be a significant emissions source
		N_2O	No	Excluded for simplification. N_2O emissions are assumed to be very small.

Project Activity (If the feedstock is vegetable oils and / or fats from crops produced in dedicated plantations)[7] [8]	Fossil fuel consumption during agriculture operations	CO_2	Yes	May be a significant emissions source
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.
	Electricity consumption during agriculture operations	CO_2	Yes[5]	May be a significant emissions source
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.

Procedure for the selection of the most plausible baseline scenario

The baseline scenario should be separately determined for the following elements:

- **Production of fuels (P)**: What would have happened at the production level in the absence of the CDM project activity?
- **Consumption (C):** Which fuel would have been consumed in the absence of the CDM project activity?

If the biodiesel is produced from waste oil/fat the following element should be taken into account:

- **Material (M)**: What would have happened to the material used as input for production of biofuel in the absence of the CDM project activity?

If the biodiesel is produced from oil seeds cultivated in dedicated plantations on severely degraded land or on under-utilized agricultural land the following element should be taken into account:

- **Land used for plantations (L):** What would be the land use in the absence of the CDM project activity?

For the **fuel production** level **(P)**, project participants shall identify the most likely baseline scenario among all realistic and credible alternatives(s), applying steps of the latest approved version of the "Tool for the demonstration and assessment of additionality". Step 3 should be used to assess which of these alternatives is to be excluded from further consideration (i.e. alternatives where barriers are prohibitive or which are clearly economically unattractive) and step 2 should be applied for all remaining alternatives. In case project proponent is a company already producing fuels other than biodiesel then only step 2 should be

[7] This emission source does not need to be included in the project boundary, if the complete land area of the dedicated plantation is included in the project boundary of one or several registered CDM A/R project activities. See footnote 6 for explanation.

[8] For specific types of crops produced there might be some other emissions sources, these are mentioned in the project emissions sections and are included in the project boundary if relevant for the specific project activity using this methodology.

applied for all options identified (barrier analysis is not allowed). Where more than one credible and plausible alternative scenario remains, project participants shall, as a conservative assumption, adopt the alternative that results in the lowest baseline emissions as the most likely baseline scenario.

At the production level the realistic and credible alternative(s) may include, *inter alia*:

P1 Continuation of current practices with no investment in biodiesel production capacity;
P2 The project activity implemented without the CDM; and
P3 Investment in any other alternative fuel replacing partially or totally the baseline fuel.

For the **consumption of fuel (C)**, the baseline should be determined as follows:

Step 1*: *Identify all realistic and credible alternatives for the fuel used by end consumers.

Project participants should at least consider the following alternatives with respect to the intended consumer of blended biodiesel:

C1 Continuation of petroleum diesel consumption;
C2 Consumption of biodiesel from other producers;
C3 Consumption of other single alternative fuel such as CNG or LPG, etc;
C4 Consumption of a mix of above alternative fuels;
C5 Consumption of biodiesel from the proposed project plant.

Step 2*: *Eliminate alternatives that are not complying with applicable laws and regulations

Eliminate alternatives that are not in compliance with all applicable legal and regulatory requirements. Apply Sub-step 1b of the latest version of the “Tool for the demonstration and assessment of additionality”.

Step 3*: *Eliminate alternatives that face prohibitive barriers

Scenarios that face prohibitive barriers (e.g technical barrier) should be eliminated by applying Step 3 of the latest version of the “Tool for the demonstration and assessment of additionality”.

Step 4*: *Compare economic attractiveness of remaining alternatives

Compare the economic attractiveness for all the remaining alternatives by applying Step 2 of the latest version of the “Tool for the demonstration and assessment of additionality”. Provide all the assumptions in the CDM-PDD.

Include a sensitivity analysis applying Sub-step 2d of the latest version of the “Tool for the demonstration and assessment of additionality”. If the sensitivity analysis is conclusive (for a realistic range of assumptions), then the most cost effective scenario is the baseline scenario. In case the sensitivity analysis is not fully conclusive, select the baseline scenario alternative with least emissions among the alternatives that are the most economically attractive according to the investment analysis and the sensitivity analysis.

For the **material (M)** level, the previous steps 1 through 4 shall be taken. Project participants should at least consider the following alternatives.

M1 Use of material for production of biofuels (by the project proponent or by others);
M2 Use for material production of substances other than fuel;
M3 Incineration of material for the purpose of energy recovery;
M4 Incineration of material without energy recovery;
M5 Disposal of material in an anaerobic or aerobic manner.

For the **land use (L)** project participants should identify and describe in the CDM-PDD the key features of the project area, including, inter alia, the following elements:

- The applicable climate region according to the default IPCC classification, applying the guidance in Annex 3A.5 of Chapter 3, Volume 4, of the 2006 IPCC Guidelines;
- The relevant soil type according to World Reference Base for Soil Resources (WRB) or USDA soil classifications, following the decision trees in Annex 3A.5 of Chapter 3, Volume 4, of the 2006 IPCC Guidelines;
- The land-use type during the last 10 years before implementation of the project activity, including any changes in the land-use during that period;
- The land management practice(s) during the last 10 years before implementation of the project activity, including any changes in the management practice during that period;
- The vegetation type before the implementation of the project activity; and
- Land titles, GPS coordinates, or any other land description formally accepted by the host country.

The land-use type and management practices during the last 10 years before implementation for the project activity can be ascertained from regional land-use and land-use change statistics, land use records, or multiple satellite images.

For the **land use where the dedicated plantations are established (L)**, the baseline scenario should be determined as follows:

Step 1*: *Identify all realistic and credible alternatives for the land use.

Project participants should at least consider the following alternatives with respect to the baseline scenario for the use of the land where the dedicated plantations are established:

L1 Continuation of current land use, i.e.:
- For severely degraded land: Continued absence of agricultural and forestry activities;
- For under-utilized land: Agricultural land continues to lie idle for several months per year. Grazing land continues to be under-utilized (extensive grazing).

L2 Conversion to plantations of the oil crop.
L3 Conversion to another plantation (annual or perennial).

***Steps 2 – 4*:** Eliminate scenarios which are not in legal compliance or face prohibitive barriers or are not economically attractive, as described above for the fuel consumption scenarios.

The project participants should demonstrate that the most plausible scenario is continuation of current land use (L1), by assessing the attractiveness of the plausible alternative land uses in terms of benefits to the project participants, consulting with stakeholders for existing and future land use, and identifying barriers for alternative land uses. This can be done by demonstrating that similar lands in the vicinity are not planned to be used for alternative land uses other than L1. Show that apparent financial and/or other barriers, which prevent alternative land uses can be identified.

If the biodiesel is produced from waste oil/fat, this methodology is applicable for the baseline scenario which combines P1, C1, and any one of the M scenarios . For material scenarios M1, M2 and M3, possible leakage from the displacement of existing uses of waste oil/fat needs to be assessed, as stated in the leakage section.

If the biodiesel is produced from oil seeds, this methodology is applicable for the baseline scenario which combines P1, C1 and L1.

Additionality

The additionality of the project activity shall be demonstrated and assessed using the latest version of the *"Tool for the demonstration and assessment of additionality"* agreed by the CDM Executive Board, and available on the UNFCCC CDM web site.

Additionality is assessed only for the project activity ~~(i.e. the construction and operation of the biodiesel plant).~~ Additionality is established ex-ante for the duration of the crediting period, i.e. the relevant parameters are not subject to monitoring, and only need to be revalidated at the renewal of the crediting period.

Where Step 2 of the "Tool for the demonstration and assessment of additionality" (Investment Analysis) is used, the investment analysis shall include a sensitivity analysis of the biodiesel sales price, the feedstock costs and fuel costs.

Baseline emissions

Baseline emissions from displaced petrodiesel are determined using the following equation:

$$BE_y = BD_y \cdot CF_{PD} \cdot EF_{CO2,PD} \cdot NCV_{PD} \quad \textbf{(1)}$$

Where:

BE_y	=	Baseline emissions during the year y (tCO_2)
BD_y	=	Most conservative value among production of biodiesel ($P_{BD,y}$), consumption of biodiesel ($C_{BD,y}$) and consumption of blended biodiesel by the captive consumer times blending fraction ($C_{BBD,y}*f_{PJ,y}$). Only blended biodiesel complying with the applicability conditions shall be considered and that which is consumed by identified in-country consumers to substitute petrodiesel in the year y (tonnes). Biodiesel produced and consumed at the site (self-consumption) must be discounted in the calculation of the baseline emissions.
CF_{PD}	=	Conversion factor from biodiesel to petrodiesel (tonnes petrodiesel/tonnes biodiesel)
$EF_{CO2,PD}$	=	Carbon dioxide emissions factor for petrodiesel (tCO_2/GJ)
NCV_{PD}	=	Net calorific value of petrodiesel (GJ/tonne)

In determining emission coefficients, emission factors or net calorific values in this methodology, guidance by the 2000 IPCC Good Practice Guidance[9] should be followed. Project participants may either conduct regular measurements or they may use accurate and reliable local or national data where available. Where

[9] IPCC 2000, Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories

such data is not available, IPCC default emission factors[10] (country-specific, if available) may be used if they are deemed to reasonably represent local circumstances. All values should be chosen in a conservative manner and the choices should be justified.

The conversion factor (CF_{PD}) shall be calculated based on the respective net calorific values of biodiesel and petrodiesel, as shown in equation (2):

$$CF_{PD} = \frac{NCV_{BD}}{NCV_{PD}} \quad \textbf{(2)}$$

Where:

CF_{PD}	=	Conversion factor from biodiesel to petrodiesel (tonnes petrodiesel/tonnes biodiesel)
NCV_{BD}	=	Net calorific value of biodiesel (GJ/tonne)
NCV_{PD}	=	Net calorific value of petrodiesel (GJ/tonne)

Note: production of petrodiesel leads to emissions, which would occur in absence of project activity. These emissions are considered in the leakage section, as the production of the petrodiesel is not included in the project boundary.

Project Emissions

Project activity emissions include six components:

- CO_2 from consumption of fuels at the biodiesel production facility;
- CO_2 from consumption of electricity at the biodiesel production facility;
- CO_2 from combustion of fossil carbon contained in methanol that is chemically bound in the biodiesel during the esterification process, and released upon combustion;
- CO_2 from transport of both feedstock to the project site and biodiesel from the project site where the blending takes place. If the feedstock is vegetable oils and / or fats from crops produced in dedicated plantations, the transportation from the field to the crude vegetable oil production plant (off-site) should be included;
- If the biodiesel is produced from oil seeds cultivated in dedicated plantations on severely degraded land or on under-utilized agricultural land, following emissions are also included:
  - associated with the cultivation of lands to produce biomass (This source shall not be included if the total area of dedicated plantation is registered as one or several A/R CDM project activities);
  - emissions associated with the anaerobic waste water treatment to treat waste generated in crushing unit. These emissions will not be estimated if the methane resulting from the anaerobic waste water treatment is completely captured and combusted.

[10] IPCC 2006, Revised 2006 Guidelines for National Greenhouse Gas Inventories, Reference Manual

The petrodiesel fraction in the blend is excluded from the calculations.

$$PE_y = \sum_j PE_{fuel,j,y} + PE_{elec,y} + PE_{MeOH,y} + PE_{Tr,y} + PE_{W,y} + PE_{BC,y} \quad \textbf{(3)}$$

Where:

PE_y	=	Project emissions during the year *y* (tCO_2)
$PE_{fuel,j,y}$	=	Project emissions from combustion of fuels (i.e. for required steam) in biodiesel production in year *y* (tCO_2)
$PE_{elec,y}$	=	Project emissions from electricity consumption in the biodiesel plant in year *y* (tCO_2)
$PE_{MeOH,y}$	=	Project emissions from combustion of fossil fuel derived methanol in the biodiesel ester in year *y* (tCO_2)
$PE_{Tr,y}$	=	Project emissions from transport of both feedstock to the project site and biodiesel to the facility where the blending takes place in year *y* (tCO_2)
$PE_{w,y}$	=	Project emissions from waste water treatment in year y, if applicable (tCO_2e)
$PE_{BC,y}$	=	Project emissions associated with the cultivation of land to produce biomass in year *y* (tCO_2).

Emissions from fossil fuel consumption

This emission source should include CO_2 emissions from all fuel consumption that occurs at the site of the project plant (including upstream crude vegetable oil production plant) and that is attributable to the project activity.
The project emissions from fossil fuel combustion ($PE_{fuel,j,y} = PE_{FC,j,y}$) will be calculated following the latest version of "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion". For this purpose, the processes j in the tool corresponds to all fossil fuel combustion in the project plant (including upstream crude vegetable oil production plant) established as part of the project activity, as well as any other on-site fuel combustion for the purposes of the project activity.

Emissions from electricity consumption

Emissions from electricity consumption are calculated on the basis of measured electricity consumption at the biodiesel production site (including upstream crude vegetable oil production plant, if applicable).
The project emissions from electricity consumption ($PE_{Elec,y} = PE_{EC,y}$) will be calculated following the latest version of "Tool to calculate project emissions from electricity consumption". In case the electricity consumption is not measured then the electricity consumption shall be estimated as follows:

$$EC_{PJ,y} = \sum_i CP_{i,y} * 8760 \quad \textbf{(4)}$$

Where $CP_{i,y}$ is the rated capacity (in MW) of electrical equipment i used for project activity.

Emissions from fossil carbon content in methanol

This methodology limits the emission reduction claim to biodiesel produced using methanol produced from fossil fuel[11]. The emissions are estimated as shown in equation (5). The methanol consumption should be net of any water content. Methanol spilled and evaporated on the project site should be considered as consumption for estimating the emissions.

$$PE_{MeOH,y} = MC_{MeOH,y} \times EF_{C,MeOH} \times \frac{44}{12} \quad \textbf{(5)}$$

Where:

$PE_{MeOH,y}$	=	Project emissions from combustion of fossil fuel derived methanol in the biodiesel ester in year *y* (tCO_2)
$MC_{MeOH,y}$	=	Mass of methanol consumed in the biodiesel plant, including spills and evaporations in year *y* (tonnes)
$EF_{C,MeOH}$	=	Carbon emissions factor of methanol, based on molecular weight (tC/tMeOH) (= 12/32)
44/12	=	Molecular weight ratio to convert tonnes of carbon into tonnes of CO_2 (tCO_2/tC)

Transport Emissions

For transport emissions (to and from the biodiesel plant) project participants may choose between two different approaches to determine emissions: an approach based on distance and vehicle type (option 1) or on actual monitored vehicle fuel consumption (option 2).

Transport emissions include the following components:

- Transport of feedstock to the biodiesel plant, which includes the transportation from the field to the crude vegetable oil production plant (off-site);
- Transport of biodiesel from the plant to the blending facility.

Emissions from transport of biodiesel to the blending station are to be added to the project emissions only if the current distribution of the petrodiesel being displaced does not involve similar transport of fuel to a blend/distribution location.

<u>Option 1:</u>
Emissions are calculated on the basis of distance and the average truck load:

$$PE_{tr,y} = \left(\frac{FS_{tr,y}}{TL_{FS}} \times AVD_{FS} \times EF_{km,tr} \right) + \left(\frac{P_{BD,y}}{TL_{BD}} \times AVD_{BD} \times EF_{km,tr} \right) \quad \textbf{(6)}$$

Where:

$PE_{tr,y}$	=	Project emissions from transport of both feedstock to the project site and biodiesel to the facility where the blending takes place in year *y* (tCO_2)
$FS_{tr,y}$	=	Feedstock used for the production of biodiesel in year *y* (tonnes)
TL_{FS}	=	Average truck load for vehicles transporting feedstock (tonnes)
AVD_{FS}	=	Average distance travelled by vehicles transporting feedstock (km), including the

[11] Such biodiesel is not included because the methodology does not provide procedures for estimating emissions in production of alcohol, other than methanol from **fossil fuel origin**, that may be used to produce biodiesel.

transportation from the field to the crude vegetable oil production plant (if off-site) and including the return trip/s

$EF_{km,tr}$ = Carbon dioxide emissions factor for vehicles transporting feedstock or biodiesel (tCO_2/km)
$P_{BD,y}$ = Quantity of biodiesel from waste oil/fat or from oil seeds cultivated in dedicated plantations on severely degraded land or on under-utilized agricultural land that is used by host country consumers to substitute petrodiesel in the year *y* (tonnes)
TL_{BD} = Average truck load for vehicles transporting biodiesel (tonnes)
AVD_{BD} = Average distance travelled by vehicles transporting biodiesel to the blending plant (km), including return trip

Option 2:
Emissions are calculated based on the actual quantity of fossil fuel consumed for transportation.

$$PE_{tr,y} = \sum_i \left(FC_{FS,i,y} \times NCV_i \times EF_{CO2,i}\right) + \sum_i \left(FC_{BD,i,y} \times NCV_i \times EF_{CO2,i}\right) \quad \textbf{(7)}$$

Where:
$PE_{Tr,y}$ = Project emissions from transport of feedstock to the project site and biodiesel to the facility where the blending takes place in year *y* (tCO_2)
$FC_{FS,i,y}$ = Fuel consumption of type *i* for transporting feedstock in year *y* (tonnes) including the transportation from the field to the crude vegetable oil production plant (if off-site)
NCV_i = Net calorific value of fuel type *i* (GJ/tonne)
$EF_{CO2,I}$ = Carbon dioxide emissions factor for fuel type *i* (tCO_2/GJ)
$FC_{BD,i,y}$ = Fuel consumption of type *i* for transport biodiesel to blending plant in year *y* (tonnes)

Project emissions from waste water treatment

If the biodiesel is produced from oil seeds cultivated in dedicated plantations on severely degraded land or on under-utilized agricultural land, emissions associated with the anaerobic waste water treatment in the crude vegetable oil production plant should be estimated. These emissions will not be estimated if the methane resulting from the anaerobic waste water treatment is completely captured and combusted. These emissions will be estimated as follows:

$$PE_{CH4,w,y} = Q_{COD,y} \cdot P_{COD,y} \cdot B_0 \cdot MCF_p \quad \textbf{(8)}$$

Where:
$PE_{CH4,w,y}$ = Methane emissions from the waste water treatment in year y (tCH_4/y)
$Q_{COD,y}$ = Amount of waste waster treated anaerobically or released untreated from the crude vegetable oil production plant in year y (m3/y)
$P_{COD,y}$ = Chemical Oxygen Demand (COD) of wastewaster (tCOD/ m^3)
B_0 = Maximum methane producing capacity (t CH_4/t COD)
MCF_p = Methane conversion factor (fraction)

IPCC 2006 guidelines specifies the value for B_0 as 0.25 kg CH_4/kg COD. Taking into account the uncertainty of this estimate, project participants should use a value of 0.265 kg CH_4/kg COD as a conservative assumption for Bo.

In the case of all the CH_4 being emitted into the air directly, then

$$PE_{w,y} = PE_{CH4,w,y} \cdot GWP_{CH4} \quad \textbf{(9)}$$

If flaring occurs, the "Tool to determine project emissions from flaring gases containing methane" should be used to estimate project emissions from waste water treatment. In this case, $PE_{CH4,w,y}$ will be calculated ex-ante as per equation 8, and then monitored during the crediting period.

Project emissions associated with the cultivation of lands to produce biomass[12]

Note: if the oil seeds are sourced from plantation area that is registered as one or several CDM A/R project activities, then emissions from cultivation of biomass are not be accounted as project emissions.

If the biodiesel is produced from oil seeds cultivated in dedicated plantations on severely degraded land or on under-utilized agricultural land, emissions associated with the cultivation of lands to produce biomass should be estimated as per the following equation:

$$PE_{BC,y} = \sum_{j} PE_{Fuel,BC,j,y} + PE_{Elec,BC,y} \quad \textbf{(10)}$$

Where:

$PE_{BC,y}$	=	Project emissions from cultivating biomass in year *y* (tCO_2e/yr)
$PE_{Fuel,BC,j,y}$	=	Project emissions from fossil fuel consumption for agricultural operations in year *y* (tCO_2/yr). The project emissions from fossil fuel combustion ($PE_{fuel,BC,j,y} = PE_{FC,j,y}$) will be calculated following the latest version of *"Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"*. For this purpose, the processes *j* in the tool corresponds to all fossil fuel combustion in the agricultural operations that are part of the project activity.
$PE_{Elec,BC,,y}$	=	Project emissions from electricity consumption for agricultural operations in year y (tCO2/yr). The project emissions from electricity consumption ($PE_{Elec,BC,,y} = PE_{EC,y}$) will be calculated following the latest version of *"Tool to calculate project emissions from electricity consumption"*. In case the electricity consumption is not measured then the electricity consumption shall be estimated as follows: $EC_{PJ,y} = \sum_{i} CP_{BC,i,y} * 8760$, where $CP_{BC,i,y}$ is the rated capacity (in MW) of electrical equipment i used for agricultural operations.

Note: The following emissions may also occur in production of oil seeds and shall be estimated only for those project activities where they are applicable as per Table 2. These sources shall be summed up with the project emissions estimated using equation 10 above.

[12] Project Proponents are encouraged to submit procedures to allocate project emissions associated with the cultivation of lands to produce biomass among byproducts as a revision to this methodology for EB approval. It should be noted that, in the context of evaluation of methodologies, the procedure to allocate emissions based on mass has not been accepted.

Table 2: Cases for which relevant emission sources from the cultivation of biomass should be taken into account.

Emission Sources	# of Equations in Annex 1	Cases in which the emission sources should be considered
N_2O emissions from the application of fertilizers.	1, 2, 3	Should be estimated if **synthetic fertilizers or organic fertilizers** (e.g., animal manure, compost, sewage sludge, rendering waste) are applied at the plantation.
CO_2 emissions from urea application.	4	Should be estimated if **urea** is applied as a nitrogen source at the plantation.
CO_2 emissions from application of limestone and dolomite.	5	Should be estimated if **limestone or dolomite** is applied to the plantation to reduce soil acidity and improve plant growth.
Emissions from clearance of land prior to the establishment of the biomass plantation.	6, 7, 8,9	Should be estimated if the biodiesel is produced from oil seeds cultivated in dedicated plantations on under-utilized agricultural land. If it can be demonstrated that at maturity of the acreage, the total stock in above ground and below ground biomass is higher in the project case than in the baseline these emissions do not need to be estimated. For this, the project proponents should: • Estimate the above and below ground biomass in the baseline; • Estimate the above and below ground biomass with the project when the acreage reaches maturity. This should be done using specific data for the project activity.
CO_2 emissions resulting from changes in soil carbon stocks following land use changes or changes in the land management practices.	10, 11, 12, 13, 14	Should be estimated if land use change or change in land management practices is introduced with the cultivation of biomass under the project activity. If it can be demonstrated that at maturity of the acreage, the total stock in above ground and below ground biomass is higher in the project case than in the baseline this emissions don't need to be estimated. For this, the same procedure as above should be used.
CH_4 and N_2O emissions from the field burning of biomass.	15	Should be estimated if biomass from the plantation is to be burnt regularly during the crediting period (e.g. after harvest).
Direct N_2O emissions from land management at the plantation	16, 17, 18	Should be estimated when relevant, for example, drainage/management of organic soils is only applicable in the case of organic soils.
Emissions from the production of synthetic fertilizer that is used at the plantations	19	Should be estimated if synthetic fertilizers are applied at the plantation.

Leakage

This methodology distinguishes following categories of leakage:

- Emissions associated with the production of the methanol used for esterification;
- If the biodiesel is produced from waste oil/fat, displacement of existing uses of waste oil/fat that may result in increased demand for fossil fuels elsewhere;
- Leakage associated with the avoided production and transportation of petrodiesel.

$$LE_y = LE_{MeOH,y} + LE_{WOF,y} - LE_{PD,y} \quad \textbf{(11)}$$

Where:

LE_y = Leakage emissions in year y (tCO_2)
$LE_{MeOH,y}$ = Leakage emissions associated with production of methanol used in biodiesel production in year y (tCO_2)
$LE_{WOF,y}$ = Leakage emissions from displacement of existing utilization of waste oil/fat in year y (tCO_2). These emissions will only be estimated if the biodiesel is produced from waste oil/fat
$LE_{PD,y}$ = Leakage related to the avoided production and transportation of petrodiesel (tCO_2/yr)

Leakage from methanol production

Emissions from production of methanol that are used in the trans-esterification process to produce the biodiesel.

$$LE_{MeOH,y} = MC_{MeOH,y} \cdot EF_{MeOH,PC} \quad \textbf{(12)}$$

Where:

$LE_{MeOH,y}$ = Leakage emissions associated with production of methanol used in biodiesel production in year y (tCO_2)
$MC_{MeOH,y}$ = Mass of methanol consumed in the biodiesel plant, including spills and evaporation on site, in year y (tonnes)
$EF_{MeOH,PC}$ = Pre-combustion (i.e. upstream) emissions factor for methanol production (tCO_2/t MeOH).

Parameters	Value	References or Sources	Vintage	Spatial level	Monitored?	Comments
$EF_{MeOH,PC}$	Default : 1.95	Apple 1998: http://edj.net/sinor/SFR4-99art7.html and 2006 IPCC Guidelines		International	Yes	

Leakage from the displacement of existing uses of waste oil/fat

For material scenarios M1, M2 and M3, Project participants shall demonstrate that the use of the waste oil/fat by the project activity does not result in increased fossil fuel consumption elsewhere. For this purpose, project participants shall monitor the total supply of waste oil/fat used in the project plant.

Project participants shall demonstrate that there is a surplus of waste oil/fat in the region of the project activity, which is not currently recovered or used for any purpose. For the purpose of this methodology, "surplus" is defined as the quantity of available waste oil/fat produced in the region being at least 25% larger than the quantity of waste oil/fat that is recovered-(e.g. for energy generation or as feedstock), including the project plant.

Project participants shall clearly define the geographical boundary of the region and document it in the CDM-PDD. In defining the geographical boundary of the region, project participants should take into account the usual distances for waste oil/fat transport. In other words, if waste oil/fat is transported up to 50 km, the region may cover a radius of 50 km around the project activity. In any case, the region should cover a radius around the project activity of at least 20 km but not more than 200 km. Once defined, the region should not be changed during the crediting period(s).

Where project participants can not demonstrate that the total quantity of waste oil/fat used by the project activity does not result in increased fossil fuel use elsewhere, a leakage penalty shall be applied. The penalty is calculated as follows: For scenario M2, this applies where the most likely substitute, taking into account common practice of the region, is derived from fossil fuel.

$$LE_{WOF,y} = WOF_{L,y} \cdot NCV_{BD} \cdot EF_{CO2,L}$$ (for scenario M1 and M3) **(13)**

$$LE_{WOF,y} = COEF_{WOF,L} \cdot WOF_{L,y} \cdot NCV_L \cdot EF_{CO2,L}$$ (for scenario M2 where the substitute for substance is likely to be derived from fossil fuel) **(14)**

Where:

$LE_{WOF,y}$	=	Leakage emissions from displacement of existing utilization of waste oil/fat in year y (tCO_2)
$WOF_{L,y}$	=	Waste oil/fat that causes increased fossil fuel consumption elsewhere (tonnes)
NCV_{BD}	=	Net calorific value of biodiesel (GJ/tonne)
NCV_L	=	Net calorific value of the fossil fuel likely to substitute waste oil / fat (GJ/tonne)
$EF_{CO2,L}$	=	Carbon dioxide emissions factor of most carbon intensive fuel oil in the country (tCO_2/GJ)
$COEF_{WOF,l}$		Coefficient of substitution of fossil fuel to waste oil / fat to produce the substance previously produced by waste oil / fat

Determination of $WOF_{L,y}$

$$WOF_{L,y} = \begin{cases} \dfrac{(1.25 \times WOF_{D,y}) - WOF_{S,y}}{1.25} & if\,(1.25 \times WOF_{D,y}) > WOF_{S,y} \\ 0 & if\,(1.25 \times WOF_{D,y}) \leq WOF_{S,y} \end{cases} \quad \textbf{(15)}$$

with

$$WOF_{D,y} = WOF_{DS,y} + u_D$$
$$WOF_{S,y} = WOF_{SS,y} - u_S$$

Where:

$OF_{L,y}$ = Waste oil/fat that causes increased fossil fuel consumption elsewhere (tonnes)
$OF_{D,y}$ = Demand for waste oil/fat , including the project activity, in the defined region (tonnes), corrected for uncertainties associated with its determination
$OF_{S,y}$ = Supply of waste oil/fat in the defined region (tonnes), corrected for uncertainties associated with its determination
$WOF_{DS,y}$ = Statistical mean value obtained from surveys or other sources for the demand for waste oil/fat , including the project activity, in the defined region (tonnes),
$WOF_{SS,y}$ = Statistical mean value obtained from surveys or other sources for the supply of waste oil/fat in the defined region (tonnes)
u_D = Uncertainty for waste oil/fat demand (tonnes)
u_S = Uncertainty for waste oil/fat supply in the defined region (tonnes)

Methods to determine $WOF_{D,y}$, $WOF_{S,y}$ and the associated uncertainties are indicated in the monitoring methodology section below.

In the case that overall emission reductions from the project activity are negative in a given year because of the leakage penalty, CERs are not issued to project participants for the year concerned and in subsequent years, until emission reductions from subsequent years have compensated the quantity of negative emission reductions from the given year.

Leakage related to the avoided production and transportation of petrodiesel

The substitution of biodiesel for petrodiesel reduces indirect ("upstream") emissions associated with the production of petrodiesel. These include the following emission sources:

1. Extraction: operation of wells, energy for separation of associated gas, flare combustion, associated CO_2, CH_4 venting;
2. Long-distance transport: transport of crude oil to the refinery;
3. Oil refinery: energy consumption and fugitive emissions;
4. Regional Distribution: transport from refinery to local distributor.

These emissions are quantified based on the eligible production of biodiesel and the default emission factors provided in **table 3**. If available, reliable **local emission factors** from a peer-reviewed publication or a comparable source may be used instead of the default emission factor.

$$LE_{PD,y} = LE_{EXT,y} + LE_{LDTR,y} + LE_{REF,y} + \cdot LE_{RDTR,y} \quad \textbf{(16)}$$

Where:
$LE_{PD,y}$ = Leakage related to the avoided production and transportation of petrodiesel (tCO_2/yr)
$LE_{EXT,y}$ = Leakage related to extraction of crude oil (tCO_2/yr)
$LE_{LDTR,y}$ = Leakage related to long-distance transport of crude oil to the refinery(tCO_2/yr)
$LE_{REF,y}$ = Leakage related to oil refinery (tCO_2/yr)
$LE_{RDTR,y}$ = Leakage related to regional distribution: transport from refinery to local distributor(tCO_2/yr)

Leakage related to extraction of crude oil ($LE_{EXT,y}$)

$$LE_{EXT,y} = BD_y \cdot CF_{PD} \cdot EF_{EXT} \quad \textbf{(17)}$$

Where:

BD_y	=	Most conservative value among production of biodiesel ($P_{BD,y}$), consumption of biodiesel ($C_{BD,y}$) and consumption of blended biodiesel times blending fraction ($C_{BBD,y}*f_{\%}$) (t/yr)
CF_{PD}	=	Conversion factor from biodiesel to petrodiesel (tonnes petrodiesel/tonnes biodiesel)
EF_{EXT}	=	Emission factor for extraction of crude oil as per table 3 (tCO_2e/tpetrodiesel)

Leakage related to long-distance transport of crude oil to the refinery ($LE_{LDTR,y}$)

$$LE_{LDTR,y} = BD_y \cdot CF_{PD} \cdot EF_{LDTR} \quad \textbf{(18)}$$

Where:

BD_y	=	Most conservative value among production of biodiesel ($P_{BD,y}$), consumption of biodiesel ($C_{BD,y}$) and consumption of blended biodiesel times blending fraction ($C_{BBD,y}*f_{\%}$) (t/yr)
CF_{PD}	=	Conversion factor from biodiesel to petrodiesel (tonnes petrodiesel/tonnes biodiesel)
EF_{LDTR}	=	Emission factor for long-distance transport of crude oil to the refinery as per table 3 (tCO_2e/tpetrodiesel)

Leakage related to oil refinery ($LE_{REF,y}$)

$$LE_{REF,y} = BD_y \cdot CF_{PD} \cdot EF_{REF} \quad \textbf{(19)}$$

Where:

BD_y	=	Most conservative value among production of biodiesel ($P_{BD,y}$), consumption of biodiesel ($C_{BD,y}$) and consumption of blended biodiesel times blending fraction ($C_{BBD,y}*f_{\%}$) (t/yr)
CF_{PD}	=	Conversion factor from biodiesel to petrodiesel (tonnes petrodiesel/tonnes biodiesel)
EF_{REF}	=	Emission factor related to oil refinery as per table 3 (tCO_2e/tpetrodiesel)

Leakage related to regional distribution transport from refinery to local distributor ($LE_{RDTR,y}$)

$$LE_{RDTR,y} = BD_y \cdot CF_{PD} \cdot EF_{RDTR} \quad \textbf{(20)}$$

Where:

BD_y	=	Most conservative value among production of biodiesel ($P_{BD,y}$), consumption of biodiesel ($C_{BD,y}$) and consumption of blended biodiesel times blending fraction ($C_{BBD,y}*f_{\%}$) (t/yr)
CF_{PD}	=	Conversion factor from biodiesel to petrodiesel (tonnes petrodiesel/tonnes biodiesel)
EF_{RDTR}	=	Emission factor for regional distribution transport from refinery to local distributor as per table 3 (tCO_2e/tpetrodiesel)

Table 3:Default emission factors by sources (Source: Swiss Ecoinventory of Energy Systems (1995), Vol. 1, p.245.)

Source	CO_2	CH_4	CO_2+CH_4	Parameter
Extraction	0.166	0.073	0.238	EF_{EXT}
Oil refinery	0.065	0.005	0.070	EF_{REF}
Long-distance transport	0.109	0.005	0.114	EF_{LDTR}
Regional distribution	0.065	0.005	0.070	EF_{RDTR}
Total	0.436	0.091	**0.527**	
Units	ton CO_2e/tpetrodiesel			

Emission reductions

Regulations requiring minimum fractions of biodiesel can reduce the amount of biodiesel that is eligible for CERs. In this case, both the baseline emissions and project emissions should be adjusted. This translates into a proportional reduction of emission reductions. Therefore, the following equation applies:

$$ER_y = \left(BE_y - PE_y - LE_y\right) \cdot q_{reg,y} \quad \textbf{(21)}$$

Where:

ER_y	=	Emission reductions in year *y* (tCO_2/yr)
BE_y	=	Baseline emissions in year *y* (tCO_2/yr)
PE_y	=	Project emissions in year *y* (tCO_2/yr)
LE_y	=	Leakage emissions in year *y* (tCO_2/yr)
$q_{reg,y}$	=	Fraction of biodiesel that is additional to regulatory requirements (%)

Note: In many cases emissions from production of petrodiesel, adjusted for emission from production of methanol and displacement of waste oil/fat, may be greater than that from cultivation of biomass for biodiesel production. In such situations leakage as emissions from production of biomass are ignored.

If $\left(-LE_y\right) > PE_{BC,y}$ then:

$$ER_y = (BE_y \cdot -(PE_y - PE_{BC,y})) * q_{reg,y} \quad \textbf{(22)}$$

Where all the biodiesel from the project activity is consumed with the same blending ratio, $q_{reg,y}$ is determined according to Equation 23. Where the biodiesel is consumed in different blending ratios, $q_{reg,y}$ is determined according to Equation 24.

$$q_{reg,y} = \left(1 - \frac{f_{BL,y}}{f_{PJ,y}}\right) \quad \textbf{(23)}$$

Where:

$f_{BL,y}$	=	Fraction of biodiesel in the blended diesel in the baseline scenario in year y (%), determined in accordance with Table 3
$f_{PJ,y}$	=	Fraction of biodiesel in the blended diesel in the project scenario in year y (%)

$$q_{reg,y} = \frac{\sum_i C_{BBD,i,y} \cdot \left(1 - \frac{f_{BL,y}}{f_{PJ,i,y}}\right)}{\sum_i C_{BBD,i,y}} \tag{24}$$

Where:

$C_{BBD,i,y}$	=	Consumption of blended biodiesel with blending ratio i, in year y (t/yr)
$f_{BL,y}$	=	Fraction of biodiesel in the blended diesel in the baseline scenario in year y (%), determined in accordance with Table 3
$f_{PJ,i,y}$	=	Fraction of biodiesel in the blended diesel from the project activity, with blending ratio i, in year y (%)

The blending ratio in the baseline scenario $f_{BL,y}$ is determined in accordance with Table 3. If there are no binding regulations requiring a minimum share of biodiesel to be blended into petrodiesel, $f_{BL,y}$ will be zero. If binding regulations require a minimum blending ratio, $f_{BL,y}$ shall be assumed as equal to the mandatory blending ratio applicable in the respective year $f_{reg,y}$, unless the project participants can demonstrate that the current average blending ratio in the country $f_{ave,y}$ was below 90% of $f_{reg,y}$. In the latter case, $f_{BL,y}$ may be assumed as zero. Such demonstration shall be based on the most recent data available from reliable, independent sources.

Accounting for mandatory blending in this way can lead to negative CERs if the blending ratio achieved by the project participants $f_{PJ,y}$ is below the mandatory level $f_{reg,y}$ (see Case 2.a in Table 4). If the total amount of CERs in a given year is negative, the debit shall be carried over into the next year.

Project participants must use only pure petrodiesel for blending, and not any diesel pre-blended with biodiesel from other sources. Volumes of blended diesel not complying with this requirement shall be discounted in the calculation of the baseline emissions.

In undertaking this analysis, the EB guidance on national policy/regulation as per Annex 3 of the Board's twenty-second meeting report need to be taken into account.

Table 4: Rules for determining baseline blending ratio $f_{BL,y}$

Case	Sub-Case	Blending Ratio in Project Activity $f_{PJ,y}$	
		$100\% \geq f_{PJ,y} > f_{reg,y}$	$f_{reg,y} \geq f_{PJ,y}$
1. No binding regulation requiring blending	--	$f_{BL,y} = 0$	
2. Binding regulation requires minimum blending ratio $f_{reg,y}$	2.a) Average compliance is 90% or higher ($f_{ave,y} \geq 0.9 \times f_{reg,y}$)	$f_{BL,y} = f_{reg,y}$	$f_{BL,y} = f_{reg,y}$ $\rightarrow$ *zero CERs*
	2.b) Average compliance is below 90% ($f_{ave,y} < 0.9 \times f_{reg,y}$)	$f_{BL,y} = 0$	$f_{BL,y} = 0$

Changes required for methodology implementation in 2nd and 3rd crediting periods

Compliance with the applicability conditions, baseline scenario (i.e. baseline fuels) and additionality all need to be fully revalidated upon renewal of the crediting period.

Data and parameters not monitored

ID Number:	1
Parameter:	DBI_a
Data unit:	kg dry matter/d
Description:	Daily biomass intake by animal type a.
Source of data:	Use accurate and reliable local or national data where available. Where such data is not available, use default values provided in AR-AM0004, Version 01, Table 3 or latest revision thereof.
Measurement procedures (if any):	
Any comment:	

Baseline Emissions

ID Number:	2
Parameter:	NCV_{PD}
Data unit:	GJ/tonne
Description:	Net calorific value of petrodiesel
Source of data:	2006 IPCC Guidelines for GHG Inventories.
Measurement procedures (if any):	
Any comment:	

ID Number:	3
Parameter:	$EF_{CO2,PD}$
Data unit:	tCO_2/GJ
Description:	Carbon dioxide emissions factor for petrodiesel
Source of data:	Default value may be derived from 2006 IPCC Guidelines, or from national statistics, if available.
Measurement procedures (if any):	
Any comment:	Local or national data should be preferred. Default values from the IPCC may be used alternatively.

Project Emissions

ID Number:	4
Parameter:	MCF_p
Data unit:	%
Description:	Methane conversion factor (fraction)
Source of data:	The source of data should be the following, in order of preference: project specific data, country specific data or IPCC default values. As per guidance from the Board, IPCC default values should be used only when country or project specific data are not available or difficult to obtain.

Measurement procedures (if any):	
Any comment:	Preferably local specific value should be used. In absence of local values, MCF_p default values can be obtained from table 6.3, chapter 6, volume 4 from IPCC 2006 guidelines.

Leakage

ID Number:	5
Parameter:	EF_{MeOH_PC}
Data unit:	tCO_2/t methanol
Description:	Specific emission per tonne of produced methanol
Source of data:	Apple 1998: http://edj.net/sinor/SFR4-99art7.html and 2006 IPCC Guidelines.
Measurement procedures (if any):	1.95 tCO_2/tonne produced methanol
Any comment:	Based on 30 GJ/tonne energy requirement and average of IPCC emissions factors for natural gas and diesel oil.

ID Number:	6
Parameter:	NCV_L
Data unit:	GJ/tonne
Description:	Net calorific value of the fossil fuel likely to substitute waste oil / fat
Source of data:	2006 IPCC Guidelines for GHG Inventories.
Measurement procedures (if any):	
Any comment:	Identification of the fossil fuel shall be made taking into account common practice

ID Number:	7
Data / Parameter:	$EF_{CO2,L}$
Data unit:	tCO_2 /GJ
Description:	Carbon dioxide emission factor of the most carbon intensive fuel oil in the country
Source of data:	Reliable official data (e.g. official statistics and government publication publications).
Measurement procedures (if any):	
Monitoring frequency:	Annually
Any comment:	Local or national data should be preferred. Default values from the 2006 IPCC Guidelines may be used alternatively and should be chosen in a conservative manner.

ID Number:	8
Data / Parameter:	$COEF_{WOF,l}$
Data unit:	Dimensionless
Description:	Carbon dioxide emission factor of the most carbon intensive fuel oil in the country
Source of data:	Reliable official or industry data (e.g. official statistics, government and industry publication publications). If such data are not existent, a default of 1 is taken.
Measurement procedures (if any):	
Monitoring frequency:	Annually
Any comment:	Local or national data should be preferred. Identification of the fossil fuel shall be made taking into account common practice

ID Number:	9
Parameter:	EF_{EXP}, EF_{EXT}, EF_{LDTR}, EF_{REF}, EF_{RDTR}
Data unit:	tCO_2e/t petrodiesel
Description:	Emission factors for production and transportation of petrodiesel
Source of data:	Default value, or reliable **local emission factor** derived from a peer-reviewed publication or a comparable source
Value to be applied:	Default values as per Table 3.
Any comment:	

III. MONITORING METHODOLOGY

Monitoring procedures

Describe and specify in the draft CDM-PDD all monitoring procedures, including the type of measurement instrumentation used, the responsibilities for monitoring and QA/QC procedures that will be applied. Where the methodology provides different options (e.g. use of default values or on-site measurements), specify which option will be used. All meters and instruments should be calibrated regularly as per industry practices.

Biodiesel production must apply national industry standards on QA/QC or, if there are no national QA/QC standards yet, apply industry standards from mature biodiesel production markets such as in Brazil, Europe or US.

Specific CDM related monitoring procedures

The quality manual necessary under the above mentioned QA/QC standards shall include a section describing the elements of the CDM related monitoring procedures and how to assure and control their quality. A quality management representative from the project participant shall ensure that the monitoring procedures are established and that they meet the requirements as specified in this methodology.

Monitoring the plant inputs and outputs required for calculating leakage, baseline and project emissions shall be based on a complete documented mass balance, adjusted for stock changes, covering:

- Amounts of waste oil/fat purchased and processed, if applicable;
- Amounts of feedstock from dedicated plantations purchased and processed; if applicable;
- Amounts of catalysts purchased, processed and recovered;
- Amounts of methanol purchased and processed;
- Amounts of glycerol produced and incinerated and/or sold for utilization;
- Amounts of blended biodiesel delivered to consumers and consumed.

This mass balance shall be based on a combination of purchase/sales records and records of measurements, in accordance with the measuring instruments available at the plant and stationary consumers or fuelling stations of the captive fleet owner in case of use in transport sector. The mass balance serves as a QA/QC instrument to crosscheck results of monitoring parameters as defined in the following section.

The following procedure shall be used to verify the actual amount of biodiesel from waste oil/fat that is consumed by the end user for displacement of petrodiesel and its correspondence with the produced amount of biodiesel from waste oil/fat:

- If the biodiesel is produced from waste oil/fat, the produced amount of biodiesel from waste oil/fat is recorded by a periodically calibrated metering system;
- If the biodiesel is produced from oil seeds cultivated in dedicated plantations on severely degraded land or on under-utilized agricultural land, the produced amount of biodiesel from feedstock from dedicated plantations is recorded by a periodically calibrated metering system;
- The amount of biodiesel produced from waste oil/fat or from feedstock from dedicated plantations transported to the storage of the blender is recorded by a calibrated metering system at the point of filling the (road) tankers and at the point of delivery at the blender site;

- During the process of creating the biodiesel blend at the blending station, the blending operation shall be monitored to assure adequate mixing of the products in the specified proportions. This includes measuring and recording the volumes and blend levels as verified through bills of lading, meter printouts or other auditable records of both the biodiesel and diesel fuel, which comprise the blended biodiesel;
- Contractually the biodiesel producer has to monitor consumption by the consumer as follows:
  - The receiving amount of blended biodiesel in the gas station or final distributor has to be recorded by a calibrated metering system and the storage fill level is recorded by a calibrated filling level indicator;
  - The amount of the blended biodiesel filled into the installation or vehicle where combustion takes place must be recorded by a calibrated metering system;
  - If blending is done by a third party contractual arrangement shall be made, that the same monitoring procedure as described above can be applied.

If the biodiesel is produced from oil seeds cultivated in dedicated plantations on severely degraded land or on under-utilized agricultural land the following specific guidance should be taken into account:

- If feedstock is pre-processed off-site, the energy consumption of the corresponding facilities shall be included in the monitoring. This applies, for example, for crude vegetable oil production plant (oil mills) located in between the plantations and the biodiesel plant;
- For dedicated plantations involving introduction of a second crop on land where previously only one crop was planted and harvested per year, emissions attributable to the *baseline crop* may be excluded from the monitoring. In particular, energy consumption and fertilizers applied to the baseline crop in each year of the crediting period may be excluded. Justification must be provided to the DOE that this does not cause any leakage of emissions attributable to the project activity;
- For dedicated plantations established on under-utilized grazing land, increased use of fertilizer and energy (if any) on the remaining grazing land must be monitored and accounted for in the calculation of project emissions;
- Monitoring compliance with the applicability conditions.

For plantations established on under-utilized agricultural land the following specific rules apply:

- A database specifying the locations of the dedicated plantations must be established and periodically updated. The location from where feedstock originates must be identified for all amounts of feedstock processed by the biodiesel plant for which CERs are claimed. The DOE shall verify that the land is underutilized and would not have been used, if the new parcel of land is added after registration of the project activity;
- Where a second crop is introduced onto land previously lying idle for part of the year, “idle” is defined as follows:
  - In the three years prior to implementation of the project, only one crop was planted and harvested per year. In between the time of harvesting and the next planting, there was no planting nor harvest of any other crop; OR
  - In between the time of harvesting and the next planting, only grass was planted for either harvest as animal feed or on-site grazing. In this case, the amount of biomass residues (other than oil) produced by the dedicated plantations and suitable as animal feed, in tonnes of dry matter per year, must be equal or exceed the amount of grass dry matter which was produced prior to the project activity.

- Where the density of livestock is increased in order to liberate under-utilized grazing land for conversion to dedicated plantations, monitoring involves the following:
  - Scope: The monitoring covers both the former grazing land converted to oil seed plantations, and the remaining grazing land where the livestock is concentrated. These land areas are collectively referred to below as "grazing land". They are comprehensively identified, and treated separately from other plantation land (i.e. formerly degraded land, and land where second crop is introduced) for monitoring compliance with this applicability condition;
  - Sampling: Aggregate monitoring results for the total grazing land may be extrapolated from the results of sampled land parcels. The sampled parcels shall be of uniform size (e.g. 1 ha), be selected randomly and provide for representative monitoring results;
  - Control that the project activity does not result in a displacement of livestock to areas outside the project boundary: The total number of livestock of each species a on the grazing land (Na,y) is monitored. Where the livestock numbers decrease below the levels observed prior to implementation of the project (Na,0), the amount of biodiesel produced from these areas is discounted pro rata in the CER calculation unless the project participants provide evidence that the decrease in livestock numbers is not a consequence of the project activity and hence would also have occurred in the baseline scenario (for example, decrease due to diseases).13;
  - Control that the grazing land is not over-utilized: The actual biomass consumption by the livestock on each sampled parcel of grazing land BCGrazing,p,y (including the dedicated plantations on converted grazing land, if some grazing still occurs) is calculated in accordance with Equation (42) below. Likewise, the maximum allowable biomass consumption BCGrazing,p,max on the sampled land parcel is calculated based on the same equation, using local data on maximum allowable numbers of livestock per area (Na,max) and maximum allowable grazing days per year (da,max). The maximum allowable biomass consumption must be defined so as to conservatively prevent material, permanent losses in carbon stocks on the grazing land. In the calculation of the CERs for the biodiesel produced on under-utilized grazing land, a discount is applied pro rata the share of sampled land parcels where the actual biomass consumption by livestock is found to exceed the maximum allowable consumption (i.e., BCGrazing,p,y > BCGrazing,p,max).14

$$BC_{Grazing,p,y} = \sum_{a=1}^{A} DBI_a \cdot N_{a,p,y} \cdot d_{a,p,y} \cdot 0.001 \qquad \textbf{(25)}$$

Where:

$BC_{Grazing,p,y}$	=	Biomass consumption by livestock on sampled land parcel p (t dry matter /yr)
a	=	Animal type index (A = total number of animal types) (--)
DBI_a	=	Daily biomass intake by animal type a (kg dry matter /d). If no local data are available, use default values provided in AR-AM0004, Version 01, Table 3 (p.23) or latest revision thereof
$N_{a,p,y}$	=	Number of animals of type a observed on sampled land parcel p
$d_{a,p,y}$	=	Number of days during which the animals of type a are present on sampled land parcel p (d/yr)

[13] For the purpose of comparing $N_{a,y}$ and $N_{a,0}$, different livestock species shall be weighted based on their respective average daily food intake.

[14] For example, if the maximum allowable biomass consumption is exceeded on 10% of the sampled parcels, 10% of the biodiesel produced on under-utilized grazing land would be discounted.

Data Archiving

All data need to be archived electronically until two years after end of the crediting period.

Data and parameters monitored

Applicability Conditions

Data / Parameter:	$f_{PJ,y}$ and $f_{PJ,i,y}$
Data unit:	%
Description:	Fraction of biodiesel in the blended diesel in the project scenario in year y and fraction of biodiesel in the blended diesel from the project activity, with blending ratio i, in year y
Source of data:	Records from blending operations.
Measurement procedures (if any):	Recording volumes or flows with calibrated meters
Monitoring frequency:	Every produced blend must be monitored.
QA/QC procedures:	During the process of creating the blended biodiesel at the blending station, the blending operation shall be monitored to assure adequate mixing of the products in the correct proportions. For automotive purposes the blending ratio must not exceed 20%. This includes measuring and recording the volumes and blend levels as verified through bills of lading, meter printouts or other auditable records of both the biodiesel and diesel fuel, which comprise the blend.
Any comment:	See "BQ-9000 Quality Assurance Program Requirements for the Biodiesel industry" for further information.

Data / Parameter:	$f_{reg,y}$
Data unit:	%
Description:	Fraction of biodiesel in the blended diesel bound by regulation in year y.
Source of data:	regulations in the Host Country.
Measurement procedures (if any):	
Monitoring frequency:	Annually.
QA/QC procedures:	

Data / Parameter:	Various parameters; Compliance of biodiesel produced with national regulations
Data unit:	Various data units
Description:	Compliance of produced biodiesel with national regulation, biofuel properties
Source of data:	Various measurements based on national or international standards.
Measurement procedures (if any):	Various methods of measurement and uncertainty analysis.
Monitoring frequency:	According to national regulation, at least annually.
QA/QC procedures:	According to national or international standards.

Data / Parameter:	$MP_{Glyc,y}$
Data unit:	Tonnes (t)
Description:	Amount of byproduct glycerol produced during plant operation
Source of data:	Measured (volumetric or weighed) values.
Measurement procedures (if any):	Volumetric flow meter including a volume integrator or load cell to measure the weight of produced glycerol.
Monitoring frequency:	All quantity of produced glycerol must be monitored.
QA/QC procedures:	Volumetric flow meter and integrator calibrated periodically Load cell calibrated periodically. Measured amounts to be crosschecked against mass balance of the biodiesel production unit.

Data / Parameter:	$MU_{Glyc,y}$
Data unit:	Tonnes (t)
Description:	Amount of byproduct glycerol sold or used.
Source of data:	Sales data and internal records in case of use inside the plant.
Measurement procedures (if any):	---
Monitoring frequency:	All produced glycerol must be tracked via sales data or internal records or its mode of disposal checked by DOE (incl. visual inspection of facilities and record of incineration or disposal if any).
QA/QC procedures:	DOE to check the produced glycerol was marketed.

Data / Parameter:	$N_{a,p,y}$
Data unit:	-
Description:	Number of animals of type a observed on sampled land parcel p
Source of data:	Measured
Measurement procedures (if any):	Counting of animals of type a on sampled land parcel p
Monitoring frequency:	At least annually; more often in case of significant intra-annual fluctuations
QA/QC procedures:	Cross-check with farmers' livestock inventory data

Data / Parameter:	$d_{a,p,y}$
Data unit:	d/yr
Description:	Number of days during which the animals of type a are present on sampled land parcel p
Source of data:	Measured / counted
Measurement procedures (if any):	
Monitoring frequency:	Annually
QA/QC procedures:	Cross-check with farmers livestock inventory data

Baseline Emissions

Data / Parameter:	BD_y
Data unit:	Tonnes
Description:	Most conservative value among production of biodiesel ($P_{BD,y}$), consumption of biodiesel ($C_{BD,y}$) and consumption of blended biodiesel times blending fraction ($C_{BBD,y}*f_{pj,y}$). The biodiesel from waste oil/fat alone or from crops cultivated on dedicated plantations which comply with the applicability conditions, and that consumed by identified in-country consumers to substitute petrodiesel in the year *y* (tonnes) shall be considered for claiming CERs. Volumes of biodiesel produced with alcohols other than methanol (for example, ethanol) are not included in the quantity of biofuel claiming emissions reduction. Further, volumes of biodiesel produced from non-fossil fuel methanol are not included in the quantity of biofuel claiming emissions reduction.
Source of data:	Metering system at production site
Measurement procedures (if any):	Use calibrated measurement equipment that is maintained regularly and checked for proper functioning.
Monitoring frequency:	All produced biodiesel must be metered.
QA/QC procedures:	Cross check production and consumption data with sales records.
Any comment:	Measured for reference purposes to ensure consumption of biodiesel does not exceed production of biodiesel.

Data / Parameter:	$P_{BD,y}$
Data unit:	Tonnes
Description:	Quantity of produced biodiesel from waste oil/fat or from the feedstock from dedicated plantations that is used by host country consumers to substitute for petrodiesel.
Source of data:	Metering system at production site.
Measurement procedures (if any):	Use calibrated measurement equipment that is maintained regularly and checked for proper functioning.
Monitoring frequency:	All produced biodiesel must be metered.
QA/QC procedures:	Cross check production and consumption data with sales records.
Any comment:	Measured for reference purposes to ensure consumption of biodiesel does not exceed production of biodiesel.

Data / Parameter:	$C_{BD,y}$
Data unit:	Tonnes
Description:	Quantity of biodiesel from waste oil/fat or feedstock from dedicated plantations consumed by host country consumers to substitute for petrodiesel.
Source of data:	Metering system at consumer site.
Measurement procedures (if any):	Use calibrated measurement equipment that is maintained regularly and checked for proper functioning.
Monitoring frequency:	Continuous recording of filling consumers´ stationary combustion installations or vehicles.
QA/QC procedures:	Cross check production and consumption data with sales records.
Any comment:	Consumption of biodiesel will be determined as the consumption of blended biodiesel times the blending fraction of the respective blend.

Data / Parameter:	$C_{BBD,y}$
Data unit:	Tonnes
Description:	Quantity of blended biodiesel from waste oil/fat or from feedstock from dedicated plantations consumed by host country consumers to substitute for petrodiesel.
Source of data:	Metering system at fuelling stations.
Measurement procedures (if any):	Use calibrated measurement equipment that is maintained regularly and checked for proper functioning.
Monitoring frequency:	Continuous recording of filling consumers´ stationary combustion installations or vehicles.
QA/QC procedures:	Cross check production and consumption data with sales records.
Any comment:	

Data / Parameter:	NCV_{BD}
Data unit:	GJ/tonne
Description:	Net calorific value of biodiesel.
Source of data:	Laboratory analysis.
Measurement procedures (if any):	Measured according to relevant national or international standards regulating determination of NCV by calibrated equipment.
Monitoring frequency:	Annually.
QA/QC procedures:	Check consistency of measurements and local / national data with default values by the IPCC. If the values differ significantly from IPCC default values, possibly collect additional information or conduct measurements.
Any comment:	Analysis has to be carried out by accredited laboratory. A sample is representative if uncertainty of the NCV does not exceed ±5% at 95% confidence level.

Project emissions

Data / parameter:	$PE_{fuel,j,y}$
Data unit:	tCO_{2e}
Description:	Project emissions from fossil fuel combustion in process *j* during the year *y*
Source of data:	Calculated as per the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion". When using the tool $PE_{fuel,j,y} = PE_{FC,j,y}$.
Measurement procedures (if any):	As per the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"
Monitoring frequency:	As per the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"
QA/QC procedures:	As per the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"
Any comment:	-

Data / parameter:	$PE_{Elec,y}$
Data unit:	tCO_2
Description:	Emissions from consumption of electricity in the project case in year y.
Source of data:	Calculated as per the "Tool to calculate project emissions from electricity consumption". When using the tool $PE_{Elec,y} = PE_{EC,y}$.
Measurement procedures (if any):	As per the "Tool to calculate project emissions from electricity consumption"
Monitoring frequency:	As per the "Tool to calculate project emissions from electricity consumption"
QA/QC procedures:	As per the "Tool to calculate project emissions from electricity consumption"
Any comment:	-

Data / Parameter:	$CP_{i,y}$
Data unit:	MW
Description:	Rated capacity of electrical equipment i used for project activity in year y
Source of data:	Equipment at site
Measurement procedures (if any):	
Monitoring frequency:	Annually
QA/QC procedures:	
Any comment:	This parameter is used in case the electricity consumption is not measured

Data / parameter:	$PE_{Fuel,BC,j,y}$
Data unit:	tCO_{2e}
Description:	Project emissions from fossil fuel consumption for **agricultural operations** in year *y*.
Source of data:	Calculated as per the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion". When using the tool $PE_{Fuel,BC,j,y} = PE_{FC,j,y}$.
Measurement procedures (if any):	As per the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"
Monitoring frequency:	As per the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"
QA/QC procedures:	As per the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"
Any comment:	-

Data / parameter:	$PE_{Elec,BC,,y}$
Data unit:	tCO_2
Description:	Project emissions from electricity consumption for **agricultural operations** in year y
Source of data:	Calculated as per the "Tool to calculate project emissions from electricity consumption". When using the tool $PE_{Elec,BC,y} = PE_{EC,y}$.
Measurement procedures (if any):	As per the "Tool to calculate project emissions from electricity consumption"
Monitoring frequency:	As per the "Tool to calculate project emissions from electricity consumption"
QA/QC procedures:	As per the "Tool to calculate project emissions from electricity consumption"
Any comment:	-

Data / Parameter:	$CP_{BC,i,y}$
Data unit:	MW
Description:	Rated capacity of electrical equipment i used for **agricultural operations** in year y.
Source of data:	Equipment at site
Measurement procedures (if any):	
Monitoring frequency:	Annually
QA/QC procedures:	
Any comment:	This parameter is used in case the electricity consumption is not measured

Data / Parameter:	$MC_{MeOH,y}$
Data unit:	Tonnes
Description:	Mass of methanol consumed in the biodiesel plant.
Source of data:	Mass meters.
Measurement procedures (if any):	Use calibrated measurement equipment that is maintained regularly and checked for proper functioning.
Monitoring frequency:	Continuously.
QA/QC procedures:	Crosscheck against methanol purchase receipts and calculated stochiometric requirements.
Any comment:	Adjust for stock changes when comparing purchase data with consumption data; also used for leakage calculations. Use most conservative values. Any spills on-site and evaporation are accounted as consumption. Please note that data should also report the source of methanol - from fossil fuel or non-fossil fuel sources. As per the applicability only Biofuel produced using fossil fuel based methanol can be credited.

Data / Parameter:	$FS_{tr,y}$
Data unit:	Tonnes
Description:	Feedstock used for the production of biodiesel
Source of data:	Plant record, Records of truck operators
Measurement procedures (if any):	Mass or volumetric (including quantity integrator) meters (e.g. load cell).
Monitoring frequency:	Every feedstock (waste oil/fat, oil seeds, oil from oil seeds) must be monitored.
QA/QC procedures:	Crosscheck data provided by trucks delivering the feedstock with measured feedstock inputs at plant. Use most conservative values.
Any comment:	

Data / Parameter:	AVD_{FS}
Data unit:	Km
Description:	Average distance travelled by vehicles transporting feedstock (km), including the transportation from the field to the crude vegetable oil production plant (if off-site) and including the return trip/s
Source of data:	Records of truck operator
Measurement procedures (if any):	Vehicle odometer

Monitoring frequency:	Annually
QA/QC procedures:	Check consistency of distance records provided by the truck operators by comparing recorded distances with other information from other sources (e.g. maps).
Any comment:	If feedstock is supplied from different sites, this parameter should correspond to the mean value of km travelled by trucks that supply the biodiesel plant

Data / Parameter:	AVD_{BD}
Data unit:	Km
Description:	Average distance travelled by vehicles transporting biodiesel to the blending plant, including return trip
Source of data:	Records of truck operator
Measurement procedures (if any):	Vehicle odometer
Monitoring frequency:	Annually
QA/QC procedures:	Check consistency of distance records provided by the truckers by comparing recorded distances with other information from other sources (e.g. maps).
Any comment:	If biodiesel is transported to different blending sites, this parameter should correspond to the mean value of km travelled by trucks that transport the biodiesel.

Data / Parameter:	TL_{FS}
Data unit:	Tonnes
Description:	Average truck load for vehicles transporting feedstock
Source of data:	Records of truck operator; plant records, vehicle manufacturer information
Measurement procedures (if any):	
Monitoring frequency:	Annually
QA/QC procedures:	Cross check against vehicle manufacturer’s capacity rating
Any comment:	

Data / Parameter:	TL_{BD}
Data unit:	Tonnes
Description:	Average truck load for vehicles transporting biodiesel
Source of data:	Records of truck operator; Plant records, vehicle manufacturer information
Measurement procedures (if any):	
Monitoring frequency:	Annually
QA/QC procedures:	Cross check against vehicle manufacturer’s capacity rating
Any comment:	

Data / Parameter:	$EF_{km,tr}$
Data unit:	tCO_2 /km
Description:	Carbon dioxide emission factor for vehicles transporting feedstock and biodiesel.
Source of data:	Measurements or local / national data should be preferred. Default values from the IPCC may be used alternatively.
Measurement procedures (if any):	
Monitoring frequency:	Annually
QA/QC procedures:	Check consistency of measurements and local / national data with default values from IPCC. If the values differ significantly from IPCC default values, possibly collect additional information or conduct measurements.
Any comment:	Local or national data should be preferred. Default values from the IPCC may be used alternatively and should be chosen in a conservative manner.

Data / Parameter:	$FC_{FS,i,y}$
Data unit:	Tonnes
Description:	Fuel consumption of fuel type i for transportation feedstock. Including the transportation from the field to the crude vegetable oil production plant (if off-site).
Source of data:	Truck operator records
Measurement procedures (if any):	
Monitoring frequency:	All consumed fuel must be metered.
QA/QC procedures:	Crosscheck fuel purchase data with average consumption for the type of vehicle provided by the manufacturer.
Any comment:	Fuel purchase data must be adjusted for stock changes. Subscript i denotes different fuel types.

Data / Parameter:	$FC_{BD,i,y}$
Data unit:	Tonnes
Description:	Fuel consumption of fuel type i for transportation of biodiesel to blending plant.
Source of data:	Truck operator records
Measurement procedures (if any):	
Monitoring frequency:	All consumed fuel must be metered
QA/QC procedures:	Crosscheck fuel purchase data with average consumption for the type of vehicle provided by the manufacturer.
Any comment:	Fuel purchase data must be adjusted for stock changes. Subscript i denotes different fuel types.

Data / Parameter:	$Q_{COD,y}$
Data unit:	m^3/yr
Description:	Amount of wastewaster treated anaerobically or released untreated from the the crude vegetable oil production plant in year y
Source of data:	Measured value by flow meter
Measurement procedures (if any):	-

Monitoring frequency:	Monthly aggregated annually
QA/QC procedures:	The monitoring instruments will be subject to regular maintenance and testing to ensure accuracy
Any comment:	If the wastewater is treated aerobically, emissions are assumed to be zero, and hence this parameter does not need to be monitored

Data / Parameter:	$P_{COD,y}$
Data unit:	$tCOD/m^3$
Description:	Chemical Oxygen Demand (COD) of wasteswaster
Source of data:	Measured value by purity meter
Measurement procedures (if any):	-
Monitoring frequency:	Monthly and averaged annually
QA/QC procedures:	The monitoring instruments will be subject to regular maintenance and testing to ensure accuracy
Any comment:	If the wastewater is treated aerobically, emissions are assumed to be zero, and hence this parameter does not need to be monitored

Leakage

Data / Parameter:	$WOF_{DS,y}$
Data unit:	Tonnes
Description:	Formal and informal market demand for waste oil/fat , including the project activity, in the defined region. Statistical mean value obtained from surveys or other sources for the demand for waste oil/fat , including the project activity, in the defined region (tonnes).
Source of data:	Demand by the project activity is known. Other demand can be determined by: reliable official data from authorities; scientific publications; market data from waste collection companies and companies utilizing waste oil/fat ; third party statistically representative surveys that shall include a list of potential uses of waste oil/fats, interviews with collection companies or companies using waste oil/fats, etc.
Measurement procedures (if any):	--
Monitoring frequency:	Annually
QA/QC procedures:	The calculated demand for waste oil/fat shall be based on at least 2 of the above mentioned data sources and associated uncertainties. The most conservative result considering the most conservative uncertainty limit should be adopted.
Any comment:	

Data / Parameter:	$WOF_{SS,y}$
Data unit:	Tonnes
Description:	Supply for waste oil/fat in the defined region. Statistical mean value obtained from surveys or other sources for the supply of waste oil/fat in the defined region (tonnes).
Source of data:	Reliable official data from authorities; scientific publications; market data from

	waste collection companies; third party statistically representative survey that shall include oil consumption data, information about fat absorption data of cooked food, etc; compare with data from other countries.
Measurement procedures (if any):	--
Monitoring frequency:	Annually
QA/QC procedures:	The calculated supply for waste oil/fat shall be based on at least 2 of the above mentioned data sources and associated uncertainties. The most conservative result considering the most conservative uncertainty limit should be adopted.
Any comment:	

Data / Parameter:	u_D
Data unit:	Tonnes
Description:	Uncertainty for waste oil/fat demand.
Source of data:	Demand by the project activity is known. Other demand can be determined by: reliable official data from authorities; scientific publications; market data from waste collection companies and companies utilizing waste oil/fat ; third party statistically representative surveys that shall include a list of potential uses of waste oil/fats, interviews with collection companies or companies using waste oil/fats, etc.
Measurement procedures (if any):	--
Monitoring frequency:	Annually
QA/QC procedures:	The calculated demand for waste oil/fat shall be based on at least 2 of the above mentioned data sources and associated uncertainties. The most conservative result considering the most conservative uncertainty limit should be adopted.
Any comment:	Surveys must be realized with a 95% confidence interval. This confidence interval corresponds to the guidelines issued by the EB in its 22nd meeting Annex 2 (EB 22 report Annex 2, D, page 3): "Methodologies employing sampling to derive parameters in estimating emissions reductions shall quantify these parameter uncertainties at the 95% confidence level".

Data / Parameter:	u_S
Data unit:	Tonnes
Description:	Uncertainty for waste oil/fat demand.
Source of data:	Supply of waste oil/fat in the region defined by the project can be determined by: reliable official data from authorities; scientific publications; market data from waste collection companies and companies utilizing waste oil/fat ; third party statistically representative surveys that shall include a list of potential uses of waste oil/fats, interviews with collection companies or companies using waste oil/fats, etc.
Measurement procedures (if any):	--
Monitoring frequency:	Annually
QA/QC procedures:	The calculated supply for waste oil/fat shall be based on at least 2 of the above mentioned data sources and associated uncertainties. The most conservative result considering the most conservative uncertainty limit should be adopted.

Any comment:	Surveys must be realized with a 95% confidence interval. This confidence interval corresponds to the guidelines issued by the EB in its 22nd meeting Annex 2 (EB 22 report Annex 2, D, page 3): "Methodologies employing sampling to derive parameters in estimating emissions reductions shall quantify these parameter uncertainties at the 95% confidence level".

Annex 1: Project emissions associated with the cultivation of lands to produce biomass

Definitions

Above-ground biomass: Is all biomass of living vegetation, both woody and herbaceous, above the soil including stems, stumps, branches, bark, seeds, and foliage (2006 IPCC Guidelines, Volume 4, Chapter 1, Table 1.1);

Below-ground biomass: is all biomass of live roots (2006 IPCC Guidelines, Volume 4, Chapter 1, Table 1.1);

Organic soils : Are found in wetlands or have been drained and converted to other land-use types (2006 IPCC Guidelines, Volume 4, Chapter 3, Annex 3A5). Organic soils are defined as soils where criteria 1 and 2 or criteria 1 and 3 apply:

1. Thickness of organic horizon greater than or equal to 10 cm. A horizon of less than 20 cm must have 12 percent or more organic carbon when mixed to a depth of 20 cm;
2. Soils that are never saturated with water for more than a few days must contain more than 20 percent organic carbon by weight (i.e., about 35 percent organic matter);
3. Soils are subject to water saturation episodes and have either:
    a) At least 12 percent organic carbon by weight (i.e., about 20 percent organic matter) if the soil has no clay; or
    b) At least 18 percent organic carbon by weight (i.e., about 30 percent organic matter) if the soil has 60% or more clay; or
    c) An intermediate, proportional amount of organic carbon for intermediate amounts of clay.

Mineral soil. Is a soil that is not classified as an organic soil according to the definition provided above. Mineral soils typically have relatively low amounts of organic matter, occur under moderate to well drained conditions, and predominate in most ecosystems except wetlands;

Forest Land. This category includes all land with woody vegetation consistent with thresholds used to define Forest Land, as communicated by the DNA of the host country to UNFCCC. It also includes systems with a vegetation structure that currently fall below, but in situ could potentially reach the threshold values used by a country to define the Forest Land category;

Cropland. This category includes cropped land, including rice fields, and agro-forestry systems where the vegetation structure falls below the thresholds used for the Forest Land category;

Grassland. This category includes rangelands and pasture land that are not considered Cropland. It also includes systems with woody vegetation and other non-grass vegetation such as herbs and brushes that fall below the threshold values used in the Forest Land category. The category also includes all grassland from wild lands to recreational areas as well as agricultural and silvi-pastural systems, consistent with national definitions;

Wetlands. This category includes areas of peat extraction and land that is covered or saturated by water for all or part of the year (e.g. peatlands) and that does not fall into the Forest Land, Cropland, Grassland or Settlements categories. It includes reservoirs as a managed sub-division and natural rivers and lakes as unmanaged sub-divisions;

Project area. The total land area where biomass is cultivated under the CDM project activity.

N_2OEmissions from the application of fertilizers

$$PE_{N2O-N,Fer,y} = F_{N,y} \times EF_{N2O-N,dir} \times GWP_{N2O} \times \frac{44}{28} \quad (1)$$

Where:

$PE_{N2O-N,Fer,y}$	=	Direct N_2O-N emissions from land management at the plantation in year *y* (tCO_2e/yr)
$F_{N,y}$	=	Amount of synthetic fertilizer nitrogen and organic fertilizer nitrogen from animal manure, sewage, compost or other organic amendments applied at the plantation in year *y* (t N/yr). Where $F_{N,y} = F_{ON,y} + F_{SN,y}$
$EF_{N2O-N,dir}$	=	Emission factor for direct nitrous oxide emissions from N inputs (Default Value 0.01 t N_2O-N/t N)

The amount of organic fertilizer N applied at the plantation ($F_{ON,y}$) is calculated based on the quantity of organic fertilizer applied and the N content in the organic fertilizer, as follows:

$$F_{ON,y} = \sum_{p} M_{OF,p,y} \times w_{N,p,y} \quad (2)$$

Where:

$F_{ON,y}$	=	Amount of organic fertilizer nitrogen from animal manure, sewage, compost or other organic amendments applied at the plantation in year *y* (t N/yr)
$M_{OF,p,y}$	=	Amount of organic fertilizer *p* applied at the plantation in year *y* (tonnes)
$w_{N,p,y}$	=	Weight fraction of nitrogen in organic fertilizer type *p* (t N / t organic fertilizer)
p	=	Organic fertilizer types (animal manure, sewage, compost or other organic amendments) applied at the plantation in year *y*

The amount of synthetic fertilizer N applied at the plantation ($F_{SN,y}$) is calculated based on the quantity of synthetic fertilizer applied and the N content in the synthetic fertilizer, as follows:

$$F_{SN,y} = \sum_{q} M_{SF,q,y} \times w_{N,q,y} \quad (3)$$

Where:

$F_{SN,y}$	=	Amount of synthetic fertilizer nitrogen applied at the plantation in year *y* (t N/yr)
$M_{SF,q,y}$	=	Amount of synthetic fertilizer *q* applied at the plantation in year *y* (t synthetic fertilizer/yr)
$w_{N,q,y}$	=	Weight fraction of nitrogen in synthetic fertilizer type *q* (t N /t synthetic fertilizer)
q	=	Synthetic fertilizer types applied at the plantation in year *y*

Data and parameters not monitored

Parameter:	$\mathbf{EF_{N2O\text{-}N,dir}}$
Data unit:	kg N_2O-N/kg N input
Description:	Emissions factor for direct N_2O emissions from N inputs
Source of data:	2006 IPCC Guidelines, Vol. 4, Ch. 11. Table 11.1
Value to be applied:	0.01
Any comment:	

Parameter:	GWP_{N2O}
Data unit:	tCO_2e/tN_2O
Description:	Global Warming Potential of nitrous oxide valid for the commitment period
Source of data:	IPCC 1996
Value to be applied:	310 for the first commitment period
Any comment:	

Data and parameters monitored

Data / Parameter:	$M_{OF,p,y}$
Data unit:	tonnes of organic fertilizer / year
Description:	Amount of organic fertilizer *p* applied at the plantation in year *y* where *p* are the organic fertilizer types (animal manure, sewage, compost or other organic amendments) applied at the plantation in year *y*
Source of data:	On-site records and measurements
Measurement procedures (if any):	Measure the quantities of any animal manure, sewage, compost or other organic amendments applied as fertilizers to the plantation
Monitoring frequency:	Continuously
QA/QC procedures:	
Any comment:	

Data / Parameter:	$w_{N,p,y}$
Data unit:	tN/t organic fertilizer
Description:	Weight fraction of nitrogen in organic fertilizer type *p* where *p* are the organic fertilizer types (animal manure, sewage, compost or other organic amendments) applied at the plantation in year *y*
Source of data:	Sample measurements by project participants
Measurement procedures (if any):	Where applicable, measure the quantities and nitrogen content of any animal manure, sewage, compost or other organic amendments applied as fertilizers to the dedicated plantation.
Monitoring frequency:	Regularly
QA/QC procedures:	
Any comment:	

Data / Parameter:	$M_{SF,q,y}$
Data unit:	tonnes of synthetic fertilizer / year
Description:	Amount of synthetic fertilizer *q* applied at the plantation in year *y* where *q* are the synthetic fertilizer types applied at the plantation in year *y*
Source of data:	On-site records by project participants
Measurement procedures (if any):	
Monitoring frequency:	Continuously
QA/QC procedures:	Cross-check records of applied quantities with purchase receipts
Any comment:	

Data / Parameter:	$w_{N,q,y}$
Data unit:	tN/t synthetic fertilizer
Description:	Weight fraction of nitrogen in synthetic fertilizer type *q* where *q* are the synthetic fertilizer types applied at the plantation in year *y*
Source of data:	Specifications by the fertilizer manufacturer
Measurement procedures (if any):	-
Monitoring frequency:	Continuously
QA/QC procedures:	
Any comment:	

CO_2 emissions from urea application

Adding urea to soils leads to a loss of CO_2 that was fixed in the industrial production process. Urea ($CO(NH_2)_2$) is converted into ammonium, hydroxyl ion and bicarbonate in the presence of water and urease enzymes in the soil. The bicarbonate evolves into CO_2 and water. CO_2 emissions from urea application are calculated as follows:

$$PE_{urea,y} = M_{urea,y} \times EF_{CO2,urea} \times \frac{44}{12} \quad \textbf{(4)}$$

Where:

$PE_{urea,y}$	=	Project emissions from urea application at the plantation in year *y* (tCO_2/yr)
$M_{urea,y}$	=	Quantity of urea applied at the plantation in year y (tonnes urea / yr)
$EF_{CO2,urea}$	=	CO_2 emission factor for urea application (Default Value 0.2 tCO_2/turea)

Data and parameters not monitored

Parameter:	**$EF_{CO2,urea}$**
Data unit:	t CO_2/t of urea
Description:	CO_2 emission factor for urea application
Source of data:	2006 IPCC Guidelines for National GHG Inventories, Vol. 5, Ch. 11, Page 11.32
Value to be applied:	0.2
Any comment:	

Data and parameters monitored

Data / Parameter:	$M_{urea,y}$
Data unit:	tonnes of urea per year
Description:	Quantity of urea applied at the plantation in year *y*
Source of data:	Records by project participants
Measurement procedures (if any):	-
Monitoring frequency:	Continuously
QA/QC procedures:	Cross-check records of applied quantities with purchase receipts
Any comment:	

CO_2 emissions from application of limestone and dolomite

Adding carbonates to soils in the form of lime (e.g., calcic limestone ($CaCO_3$) or dolomite ($CaMg(CO_3)_2$) leads to CO_2 emissions as the limes dissolve and release bicarbonate, which evolves into CO_2 and water. The Tier 1 approach from the 2006 IPCC Guidelines for National GHG Inventories is used to estimate these emissions. CO_2 emissions from liming at the plantation are estimated as follows:

$$PE_{lime,y} = \left(M_{limestone,y} \times EF_{limestone} + M_{dolomite,y} \times EF_{dolomite}\right) \times \frac{44}{12} \quad \textbf{(5)}$$

Where:

$PE_{lime,y}$	=	Project emissions from application of limestone and dolomite at the plantation in year *y* (tCO_2/yr)
$M_{limestone,y}$	=	Quantity of calcic limestone ($CaCO_3$) applied at the plantation in year *y* ($tCaCO_3$**/yr)**
$M_{dolomite,y}$	=	Quantity of dolomite ($CaMg(CO_3)_2$) applied at the plantation in year *y* (t Ca Mg$(CO_3)_2$**/yr)**
$EF_{limestone}$	=	Carbon emission factor for calcic limestone ($CaCO_3$) application (Default Value 0.12 tC/t$CaCO_3$)
$EF_{dolomite}$	=	Carbon emission factor for dolomite ($CaMg(CO_3)_2$) application (Default Value 0.13 tC/t$CaMg(CO_3)_2$)

Data and parameters not monitored

Parameter:	$EF_{limestone}$
Data unit:	$tC/tCaCO_3$
Description:	Carbon emission factor for calcic limestone ($CaCO_3$) application
Source of data:	2006 IPCC Guidelines, Vol. 4, Ch. 11 Section 11.3.1
Value to be applied:	0.12
Any comment:	

Parameter:	$\mathbf{EF_{dolomite}}$
Data unit:	$tC/tCaMg(CO_3)_2)$
Description:	Carbon emission factor for dolomite ($CaMg(CO_3)_2$) application
Source of data:	2006 IPCC Guidelines, Vol. 4, Ch. 11 Section 11.3.1
Value to be applied:	0.13
Any comment:	

Data and parameters monitored

Data / parameter:	$M_{\mathbf{Limestone,y}}$
Data unit:	$tCaCO_3$**/year**
Description:	Quantity of calcic limestone ($CaCO_3$) applied at the plantation in year *y*
Source of data:	Records by project participants
Measurement procedures (if any):	
Monitoring frequency:	Annually
QA/QC procedures:	Cross-check records of applied quantities with purchase receipts
Any comment:	

Data / Parameter:	$M_{\mathbf{Dolomite,y}}$
Data unit:	$tCaMg(CO_3)_2$**/year**
Description:	Quantity of dolomite ($CaMg(CO_3)_2$) applied at the plantation in year *y*
Source of data:	Records by project participants
Measurement procedures (if any):	
Monitoring frequency:	Annually
QA/QC procedures:	Cross-check records of applied quantities with purchase receipts
Any comment:	

Identification and stratification of the project area

Project participants should identify and transparently document the project area (i.e. the land area where biomass is cultivated under the CDM project activity) in the CDM-PDD, delineating the project area with GPS data.

Project participants should identify and describe in the CDM-PDD the key features of the project area, including, inter alia, the following elements:

- The applicable climate region according to the default IPCC classification, applying the guidance in Annex 3A.5 of Chapter 3, Volume 4, of the 2006 IPCC Guidelines;
- The relevant soil type according to World Reference Base for Soil Resources (WRB) or USDA soil classifications, following the decision trees in Annex 3A.5 of Chapter 3, Volume 4, of the 2006 IPCC Guidelines;
- ~~The land-use type during the last 10 years before implementation of the project activity, including any changes in the land-use during that period;~~
- ~~The land management practice(s) during the last 10 years before implementation of the project activity, including any changes in the management practice during that period;~~
- The vegetation type before the implementation of the project activity;
- Whether and how any land clearance is undertaken (e.g. harvesting, burning, etc);
- The land-use type (forest or cropland) under the project activity;
- The land management practices that are applied under the project activity.

If one or several of the above-mentioned features differ within the project area, project participants should stratify the land area in different strata *s* according to the features above. The land area of each stratum ($A_{PJ,s}$) should be clearly delineated in the CDM-PDD, using GPS data, and the features of each stratum should be transparently documented. Project participants may use geographical information systems (GIS) for that purpose.

Emissions from clearance of land prior to the establishment of the biomass plantation

Emissions from clearance of land prior to the establishment of the biomass plantation include CO_2 emissions resulting from losses of biomass stocks (above-ground and below-ground) and, in case of slash and burn, CH_4 and N_2O emissions from burning the biomass. ~~This emission from loss of biomass can be estimated to be zero, if it can be demonstrated that the project activity will lead to increase in biomass. Further, if project activity is plantation which meets the definition of forest, then the plantation is not registered as a CDM afforestation/reforestation project activity.~~

$$PE_{CL} = PE_{CL,CO2} + PE_{CL,non-CO2} \quad (6)$$

Where:

PE_{CL}	=	Project emissions from clearance of land prior to the establishment of the biomass plantation (tCO_2e)
$PE_{CL,CO2}$	=	Project emissions of CO_2 from losses of biomass stocks (above-ground and below-ground) as a result of clearance of land prior to the establishment of the biomass plantation (tCO_2/yr)
$PE_{CL,non-CO2}$	=	Project emissions of CH_4 and N_2O from burning biomass stocks prior to the establishment of the biomass plantation (tCO_2/yr)

All emissions from clearance of land prior to the establishment of the biomass plantation should be accounted in the first year of the first crediting period.

CO₂ emissions from losses of biomass stocks

Project emissions from losses of biomass stocks are calculated based on the difference of the biomass stock before and immediately after clearance of lands, as follows:

$$PE_{CL,CO2} = \sum_{s} \left(B_{BEFORE,s} - B_{PJ,s}\right) \times A_{PJ,s} \times CF \times \frac{44}{12} \quad (7)$$

with

$$B_{BEFORE,s} = B_{AG,BEFORE,s} \times \left(1 + R_{BEFORE,s}\right) \quad (8)$$

Where:

$PE_{CL,CO2}$	=	Project emissions of CO_2 from losses of biomass stocks (above-ground and below-ground) as a result of clearance of land prior to the establishment of the biomass plantation (tCO_2/yr)
$B_{BEFORE,s}$	=	Average biomass stocks (above ground and below ground) per hectare on stratum *s* of the projects area before the clearance of the land (tonnes of dry matter / ha)
$B_{PJ,s}$	=	Average biomass stocks (above ground and below ground) per hectare on stratum *s* of the project area immediately after the start of the project activity (i.e. after the clearance of the land and after seeding/planting) (tonnes of dry matter / ha)
$A_{PJ,s}$	=	Size of the land area of stratum *s* (ha)
CF	=	Carbon fraction in the dry matter of the biomass (Default value 0.47 t C / tones of dry matter)
$B_{AG,BEFORE,s}$	=	Average above-ground biomass stocks per hectare on stratum *s* of the project area before the clearance of the land (tonnes of dry matter / ha)
$R_{BEFORE,s}$	=	Ratio of below-ground biomass to above-ground biomass for the biomass stocks on stratum *s* of the project area before the clearance of the land. IPCC default values will be used, see guidance below.
s	=	All strata in which the project area is stratified

CH₄ and N₂O emissions from burning biomass as part of clearance of lands

In case of burning of biomass as part of the clearance of lands, CH_4 and N_2O emissions from biomass burning should be estimated as follows:

$$PE_{CL,non\text{-}CO2} = \sum_{s_{CL,B}} A_{PJ,s_{CL,B}} \times M_{B,s_{CL,B}} \times C_{f,s_{CL,B}} \times \left(EF_{N2O,CL} \times GWP_{N2O} + EF_{CH4,CL} \times GWP_{CH4}\right) \quad (9)$$

Where:

$PE_{CL,non\text{-}CO2}$	=	Project emissions of CH_4 and N_2O from burning biomass stocks prior to the establishment of the biomass plantation (tCO_2/yr)
$A_{PJ,s_{CL,B}}$	=	Size of the land area of stratum $s_{CL,B}$ (ha)
$M_{B,s_{CL,B}}$	=	Average mass of biomass available for burning on stratum $s_{CL,B}$ of the project area (t dry matter/ha)

$C_{f,s_{CL,B}}$ = Combustion factor, accounting for the proportion of biomass that is actually burnt on stratum $s_{CL,B}$ of the project area (dimensionless)
$EF_{N2O,CL}$ = N_2O emission factor for burning of biomass prior to the establishment of the biomass plantation (tN_2O/tonne of dry matter). Default values are provided below.
GWP_{N2O} = Global Warming Potential of nitrous oxide valid for the commitment period (tCO_2e/tN_2O)
$EF_{CH4,CL}$ = CH_4 emission factor for burning of biomass prior to the establishment of the biomass plantation (tCH_4/tonne of dry matter). Default values are provided below.
GWP_{CH4} = Global Warming Potential of methane valid for the commitment period (tCO_2e/tCH_4)
$s_{CL,B}$ = Strata of the project area where biomass is burnt as part of land clearance prior to the establishment of the biomass plantation

Note that the term $\left(M_{B,s_{CL,B}} \times C_{f,s_{CL,B}}\right)$ corresponds to the term $\left(B_{BEFORE,s} - B_{PJ,s}\right)$ if land clearance is only undertaken by burning the existing vegetation (and not by harvesting). If part of the existing vegetation is harvested or used for other purposes, the term $\left(M_{B,s_{CL,B}} \times C_{f,s_{CL,B}}\right)$ should be smaller than the term $\left(B_{BEFORE,s} - B_{PJ,s}\right)$.

Data and parameters not monitored

Parameter:	GWP_{CH4}
Data unit:	tCO_2e/tCH_4
Description:	Global Warming Potential of methane valid for the commitment period
Source of data:	IPCC 1996
Value to be applied:	21 for the first commitment period
Any comment:	

Parameter:	$B_{AG,BEFORE,s}$
Data unit:	tonnes of dry matter / ha
Description:	Average above-ground biomass stocks per hectare on stratum *s* of the project area before the clearance of the land where *s* are all strata in which the project area is stratified
Source of data:	Choose between the following two approaches: • Use the upper end of the range of IPCC default values for the above-ground biomass of the relevant forest type and ecological zone, as contained in Tables 4.7 and 4.8 of Volume 4, Chapter 4 of the 2006 IPCC Guidelines. If the land area has a different cover than those categories provided in these tables, choose a similar forest type that represents a conservative estimate. If the table only provides one single value and not a range for the above-ground biomass, project participants should apply the range of similar categories; • Representative sampling of the above-ground biomass on the land area by project participants
Measurement procedures (if any):	In case of measurements, project participants should use appropriate procedures from the 2006 IPCC Guidelines to estimate $B_{AG,BEFORE,s}$
Any comment:	

Parameter:	$R_{BEFORE,s}$
Data unit:	-
Description:	Ratio of below-ground biomass to above-ground biomass for the biomass stocks on stratum *s* of the project area before the clearance of the land where *s* are all strata in which the project area is stratified
Source of data:	Use the applicable IPCC default value from Table 4.4 of Volume 4, Chapter 4 of the 2006 IPCC Guidelines
Measurement procedures (if any):	-
Any comment:	

Parameter:	CF
Data unit:	t C / tonnes of dry matter
Description:	Carbon fraction in the dry matter of the biomass
Source of data:	Default value, 2006 IPCC Guidelines, Volume 4, Chapter 4, Table 4.3
Value to be applied:	0.47
Any comment:	

Data / parameter:	$EF_{CH4,CL}$
Data unit:	tCH_4/tonne of dry matter
Description:	CH_4 emission factor for burning of biomass prior to the establishment of the biomass plantation
Source of data:	2006 IPCC Guidelines, Volume 4, Chapter 2, Table 2.5, as provided below
Value to be applied:	see table below
Any comment:	

Category	**Emission factor ($t\ CH_4$ / t dry matter)**
Savanna and grassland	0.0023
Agricultural residues	0.0027
Tropical forest	0.0068
Other forest than tropical forest	0.0047

Data / parameter:	$EF_{N2O,CL}$
Data unit:	tN_2O/tonne of dry matter
Description:	N_2O emission factor for burning of biomass prior to the establishment of the biomass plantation
Source of data:	2006 IPCC Guidelines, Volume 4, Chapter 2, Table 2.5, as provided below
Value to be applied:	see table below
Any comment:	

Category	**Emission factor ($t\ N_2O$/ t dry matter)**
Savanna and grassland	0.00021
Agricultural residues	0.00007
Tropical forest	0.00020
Other forest than tropical forest	0.00026

Data / parameter:	$\mathbf{M_{B,s_{CL,B}}}$
Data unit:	t dry matter/ha
Description:	Average mass of biomass available for burning on stratum $s_{CL,B}$ of the project area where $s_{CL,B}$ are the strata of the project area where biomass is burnt as part of land clearance prior to the establishment of the biomass plantation
Source of data:	Project participants may either conduct representative sample measurements, according to relevant guidance in the 2006 IPCC Guidelines, or use the most appropriate default value for the term $M_{B,s_{CL,B}} \times C_{f,s_{CL,B}}$, as provided in the 2006 IPCC Guidelines, Volume 4, Chapter 2, Table 2.4, adjusted for one standard error as a conservative approach.[15]
Measurement procedures (if any):	
Any comment:	

Data / parameter:	$\mathbf{C_{f,s_{CL,B}}}$
Data unit:	-
Description:	Combustion factor, accounting for the proportion of biomass that is actually burnt on stratum $s_{CL,B}$ of the project area where $s_{CL,B}$ are the strata of the project area where biomass is burnt as part of land clearance prior to the establishment of the biomass plantation
Source of data:	Project participants may either conduct representative sample measurements, according to relevant guidance in the 2006 IPCC Guidelines, or use the most appropriate default value for the term $M_{B,s_{CL,B}} \times C_{f,s_{CL,B}}$, as provided in the 2006 IPCC Guidelines, Volume 4, Chapter 2, Table 2.4, adjusted for one standard error as a conservative approach.
Measurement procedures (if any):	
Any comment:	

Data and parameters monitored

Data / Parameter:	$B_{PJ,s}$
Data unit:	tonnes of dry matter / ha
Description:	Average biomass stocks (above-ground and below-ground) per hectare on stratum *s* of the project area immediately after the start of the project activity (i.e. after the clearance of the land and after seeding/planting) where *s* are all strata in which the project area is stratified
Source of data:	Project participants may either assume a value of 0 or undertake sampling
Measurement procedures (if any):	

[15] For example, in case of post logging slash burn in a boreal forest a default value of 114.4 = 69.6 + 44.8 tons of dry matter per hectare should be chosen for the term $M_{B,s_{CL,B}} \times C_{f,s_{CL,B}}$.

Monitoring frequency:	Once after the start of the project activity
QA/QC procedures:	
Any comment:	

CO_2 emissions resulting from changes in soil carbon stocks following land use changes or changes in the land management practices ($PE_{CO2,soil,y}$)

CO_2 emissions from decreases of carbon stocks in soil carbon pools as a result of land use changes or changes in management practices should be estimated, using the IPCC Tier 1/2 approaches in the 2006 Guidelines for National GHG Inventories. In cases where carbon stocks in soil carbon pools increase as a result of the project activity, these increases should not be accounted as emission reductions and $PE_{CO2,soil,y}$ should be assumed as zero.

The approach to estimate carbon stock changes in soil organic carbon pools is different for organic and mineral soils. Changes in inorganic soil carbon are neglected. Project emissions may include emissions from mineral and organic soils within the project area:

$$PE_{CO2,soil,y} = PE_{CO2,MS,y} + PE_{CO2,OS,y} \tag{10}$$

Where:

$PE_{CO2,soil,y}$	=	Project emissions of CO_2 in year *y* resulting from changes in soil carbon stocks following a land use change or a change in the land management practices (tCO_2/yr)
$PE_{CO2,MS,y}$	=	Project emissions of CO_2 in year *y* resulting from changes in soil carbon stocks of mineral soils following a land use change or a change in the land management practices (tCO_2/yr)
$PE_{CO2,OS,y}$	=	Project emissions of CO_2 in year *y* resulting from changes in soil carbon stocks of organic soils following a land use change or a change in the land management practices (tCO_2/yr)

CO_2 emissions from mineral soils

For mineral soils, the IPCC Tier 1 method is used to estimate soil carbon emissions. Consistent with the IPCC Tier 1 approach, it is assumed that soil carbon stocks were in an equilibrium before the implementation of the project activity (or would have reached an equilibrium in the absence of the project activity) and change in a linear fashion during a transition period to a new equilibrium as result of the change in the land use or land management practice.

Annual CO_2 emissions from soil carbon stock changes are calculated based on the difference between the soil organic carbon stock before and after implementation of the project activity and the duration of the transition period (i.e. the time dependence of the stock change factors *T*), as follows:

$$PE_{CO2,MS,y} = \sum_{s_{MS}} \frac{SOC_{historic,s_{MS}} - SOC_{PJ,s_{MS}}}{T} \times A_{PJ,s_{MS}} \times \frac{44}{12} \tag{11}$$

Where:

$PE_{CO2,MS,y}$	=	Project emissions of CO_2 in year *y* resulting from changes in soil carbon stocks of mineral soils following a land use change or a change in the land management practices (tCO_2/yr)

$SOC_{historic,s_{MS}}$ = Soil organic carbon stock with the land use and land management practices on stratum s_{MS} before the implementation of the project activity (tC/ha)

$SOC_{PJ,s_{MS}}$ = Soil organic carbon stock with the land use and land management practices on stratum s_{MS} under the project activity (tC/ha)

$A_{PJ,s_{MS}}$ = Size of the land area of stratum s_{MS} (ha)

T = Time dependence of the stock change factors (years). In case of a renewable crediting period: 20 years. In case of a single crediting period: 10 years.

s_{MS} = Strata of the project area with mineral soils

The soil organic carbon stock is calculated based on reference soil organic carbon stock value of stratum s_{MS} ($SOC_{REF,s_{MS}}$) for the relevant soil type and climate region and stock change factors (F_{LU}, F_{MG} and F_I) that reflect that land-use type, the land management practices and any carbon input in the soil, as follows:

$$SOC_{historic,s_{MS}} = SOC_{REF,s_{MS}} \times F_{LU,historic,s_{MS}} \times F_{MG,historic,s_{MS}} \times F_{I,historic,s_{MS}} \quad \textbf{(12)}$$

and

$$SOC_{PJ,s_{MS}} = SOC_{REF,s_{MS}} \times F_{LU,PJ,s_{MS}} \times F_{MG,PJ,s_{MS}} \times F_{I,PJ,s_{MS}} \quad \textbf{(13)}$$

Where:

$SOC_{historic,s_{MS}}$ = Soil organic carbon stock with the land use and land management practices on stratum s_{MS} before the implementation of the project activity (tC/ha)

$SOC_{PJ,s_{MS}}$ = Soil organic carbon stock with the land use and land management practices on stratum s_{MS} under the project activity (tC/ha)

$SOC_{REF,s_{MS}}$ = Reference soil organic carbon stock value for stratum s_{MS} (tC/ha). IPCC default values will be used, see guidance below

$F_{LU,historic,s_{MS}}$ = Stock change factor for the historic land-use system on stratum s_{MS}

$F_{LU,PJ,s_{MS}}$ = Stock change factor for the land-use system on stratum s_{MS} under the project activity

$F_{MG,historic,s_{MS}}$ = Stock change factor for the historic land management regime on stratum s_{MS}

$F_{MG,PJ,s_{MS}}$ = Stock change factor for the land management regime on stratum s_{MS} under the project activity

$F_{I,historic,s_{MS}}$ = Stock change factor for input of organic matter on stratum s_{MS} for the historical situation

$F_{I,PJ,s_{MS}}$ = Stock change factor for input of organic matter on stratum s_{MS} under the project activity

s_{MS} = Strata of the project activity with mineral soils

CO_2 emissions from organic soils

For organic soils, the land area is multiplied with an annual emission factor that estimates the losses of carbon following drainage. Annual project emissions are calculated as follows:

$$PE_{CO2,OS,y} = \sum_{s_{OS}} A_{PJ,s_{OS}} \times EF_{organic,s_{OS}} \times \frac{44}{12} \quad \textbf{(14)}$$

Where:

$PE_{CO2,OS,y}$	=	Project emissions of CO_2 in year y resulting from changes in soil carbon stocks of organic soils following a land use change or a change in the land management practices (tCO_2/yr)
$A_{PJ,s_{OS}}$	=	Size of the land area of stratum s_{OS} (ha)
$EF_{organic,s_{OS}}$	=	Emission factor for carbon soil losses for organic soils on stratum s_{OS} (tonnes C per ha and year). IPCC default values will be used, see guidance below.
s_{OS}	=	Strata of the project area with organic soils

Data and parameters not monitored

Parameter:	**T**
Data unit:	years
Description:	Time dependence of the stock change factors
Source of data:	-
Value to be applied:	In case of a renewable crediting period: 20 years (commonly used value) In case of a single crediting period: 10 years
Any comment:	

Parameter:	$SOC_{REF,s_{MS}}$
Data unit:	tC/ha
Description:	Reference soil organic carbon stock value for stratum s_{MS} where s_{MS} are the strata of the project area with mineral soils
Source of data:	Select the applicable value for the soil type identified from the 2006 IPCC Guidelines, Vol. 4, Ch. 2, Table 2.3
Value to be applied:	
Any comment:	

Parameter:	$\mathbf{F_{LU,historic,sMS}}$, $\mathbf{F_{MG,historic,sMS}}$, $\mathbf{F_{I,historic,sMS}}$
Data unit:	dimensionless
Description:	Stock change factor on stratum s_{MS} for the historic land-use system ($\mathbf{F_{LU,historic,sMS}}$), for the historic management regime ($\mathbf{F_{MG,historic,sMS}}$) and for input of organic matter for the historical situation ($\mathbf{F_{I,historic,sMS}}$)
Source of data:	If available, reliable, well documented and reasonably representative for the project area, regional or national stock change factors should be used. If such data is not available, the following default values from the 2006 IPCC Guidelines should be used: Forest land: Use 1.0 for all factors Cropland: Vol. 4, Ch. 5, Table 5.5 Grassland: Vol.4, Ch. 6, Table 6.2
Value to be applied:	
Any comment:	

Parameter:	$F_{LU,PJ,sMS}$, $F_{MG,PJ,sMS}$, $F_{I,PJ,sMS}$
Data unit:	dimensionless
Description:	Stock change factor for the land-use system on stratum s_{MS} under the project activity, Stock change factor for the historic land management regime on stratum s_{MS} and Stock change factor for input of organic matter on stratum s_{MS} for the historical situation.
Source of data:	If available, reliable, well documented and reasonably representative for the project area, regional or national stock change factors should be used. If such data is not available, the following default values from the 2006 IPCC Guidelines should be used: Forest land: Use 1.0 for all factors Cropland: Vol. 4, Ch. 5, Table 5.5 Grassland: Vol.4, Ch. 6, Table 6.2
Value to be applied:	
Any comment:	

Parameter:	$EF_{organic,sOS}$
Data unit:	tonnes C per hectare and year
Description:	Emission factor for carbon soil losses for organic soils on stratum s_{OS}
Source of data:	2006 IPCC Guidelines, Vol. 4, Ch. 5, Table 5.6
Value to be applied:	Select the suitable default value as follows: The plantation is cropland: Vol. 4, Ch. 5, Table 5.6 The plantation is forest land: Vol. 4, Ch. 4, Table 4.6
Any comment:	

CH_4 and N_2O emissions from the field burning of biomass

Biomass from the plantation may be burnt regularly during the crediting period (e.g. after harvest). In these cases, CH_4 and N_2O emissions should be calculated for each time that field burning is occurring, as follows:

$$PE_{FB,y} = \sum_{s_{FB}} A_{PJ,s_{FB}} \cdot M_{B,s_{FB}} \cdot C_{f,s_{FB}} \cdot \left(EF_{N2O,FB} \cdot GWP_{N2O} + EF_{CH4,FB} \cdot GWP_{CH4}\right) \quad \textbf{(15)}$$

Where:

$PE_{FB,y}$	=	Project emissions from field burning of biomass at the plantation site in year *y* (tCO_2e/yr)
$A_{PJ,s_{FB}}$	=	Size of the land area of stratum s_{FB} (ha)
$M_{B,s_{FB}}$	=	Average mass of biomass available for burning on stratum s_{FB} (t dry matter/ha)
$C_{f,s_{FB}}$	=	Combustion factor, accounting for the proportion of biomass that is actually burnt on stratum s_{FB} (dimensionless)
$EF_{N2O,FB}$	=	N_2O emission factor for field burning of biomass (tN_2O/tonne of dry matter). IPCC default values will be used, see guidance below.
GWP_{N2O}	=	Global Warming Potential of nitrous oxide valid for the commitment period (tCO_2e/tN_2O)

$EF_{CH4,FB}$ = CH_4 emission factor for field burning of biomass (tCH_4/tonne of dry matter). IPCC default values will be used, see guidance below.

GWP_{CH4} = Global Warming Potential of methane valid for the commitment period (tCO_2e/tCH_4)

s_{FB} = Strata of the project area where biomass is burnt in year y[16]

Data and parameters not monitored

Parameter:	$EF_{N2O,FB}$
Data unit:	tN_2O/t dry matter of biomass
Description:	N_2O emission factor for field burning of biomass
Source of data:	Select the most suitable value to the type of biomass from the 2006 IPCC Guidelines, Vol. 4, Ch. 2, Table 2.5
Value to be applied:	
Any comment:	

Parameter:	$EF_{CH4,FB}$
Data unit:	tCH_4/t dry matter of biomass
Description:	CH_4 emission factor for field burning of biomass
Source of data:	Select the most suitable value to the type of biomass from the 2006 IPCC Guidelines, Vol. 4, Ch. 2, Table 2.5
Value to be applied:	
Any comment:	

Data and parameters monitored

Data / Parameter:	$\mathbf{M_{B,s_{FB}}}$
Data unit:	ton dry matter per hectare
Description:	Average mass of biomass available for burning on stratum s_{FB} where s_{FB} are the strata of the project area where biomass is burnt in year y
Source of data:	Sample measurements by project participants
Measurement procedures (if any):	
Monitoring frequency:	Each time field burning takes place
QA/QC procedures:	
Any comment:	

Data / Parameter:	$\mathbf{C_{f,s_{FB}}}$
Data unit:	-
Description:	Combustion factor, accounting for the proportion of biomass that is actually

[16] If biomass on a stratum is burnt two or more times in the year, emissions from this stratum should be accounted each time burning is occuring.

	burnt on stratum s_{FB} where s_{FB} are the strata of the project area where biomass is burnt in year y
Source of data:	Sample measurements by project participants or assume a default value of 1
Measurement procedures (if any):	Measure the remaining biomass after field burning (if any)
Monitoring frequency:	Each time field burning takes place
QA/QC procedures:	
Any comment:	

Direct N_2O emissions from land management at the plantation ($PE_{N2O\text{-}N,dir,y}$)

N_2O emissions from land management at the plantation can occur from the following activities:

- N in crop residues (above-ground and below-ground);
- N mineralization associated with loss of soil organic matter resulting from change of land use or a change of management practices of mineral soils (applicable in case of mineral soils);
- Drainage/management of organic soils (applicable in case of organic soils).

Some emission sources may not be relevant for certain project types. Project participants should document and justify in the CDM-PDD which of these activities may occur in the context of the proposed project activity.

Direct soil N_2O emissions are calculated as follows:

$$PE_{N2O-N,dir,y} = \left\{ \begin{array}{l} \left(\sum_{s_{CR}} F_{CR,s_{CR},y} \right) \times EF_{N2O-N,dir} + \\ \sum_{s_{MS}} \left[F_{SOM,s_{MS},y} \times EF_{N2O-N,dir} \right] + \sum_{s_{OS}} \left[A_{PJ,s_{OS},y} \times EF_{N2O,N,OS} \right] \end{array} \right\} \times GWP_{N2O} \times \frac{44}{28} \quad (16)$$

Where:

$PE_{N2O\text{-}N,dir,y}$	=	Direct N_2O-N emissions from land management at the plantation in year y (tN_2O-N/yr)
$EF_{N2O\text{-}N,dir}$	=	Emission factor for direct nitrous oxide emissions from N inputs (Default Value 0.01 t N_2O-N/t N)
$F_{CR,s_{CR},y}$	=	Amount of N in crop residues (above ground and below ground), including N-fixing crops, returned to the soil on stratum s_{CR} in year y (t N/yr)
$F_{SOM,s_{MS},y}$	=	Amount of N in the mineral soil that is mineralized on stratum s_{MS} in year y in association with loss of soil carbon from soil organic matter as a result of a land use change or a change in the land management practice (t N/yr)
$A_{PJ,s_{OS},y}$	=	Size of the land area of stratum s_{OS} (ha)
$EF_{N2O,N,OS}$	=	Emission factor for direct nitrous oxide emissions from drained/managed organic soils (t N_2O-N per ha and year). Default values are provided below.
s_{CR}	=	Strata of the project area where crops residues, including N-fixing crops, are returned

		to the soil
s_{MS}	=	Strata of the project area with mineral soils
s_{OS}	=	Strata of the project area with organic soils

The amount of N in crops residues returned to the soil ($F_{CR,s_{CR},y}$) is calculated for each stratum s_{CR} as follows:

$$F_{CR,s_{CR},y} = \sum_c M_{c,s_{CR},y} \times \left[R_{AG,c} \times w_{N,AG,c} \times \left(1 - Frac_{REMOVE,c,y}\right) \times \left(1 - f_{burnt,s_{CR},c,y} \times \left(1 - C_{f,c}\right)\right) + R_{BG,c} \times w_{N,BG,c}\right] \quad (17)$$

Where:

$F_{CR,s_{CR},y}$	=	Amount of N in crop residues (above ground and below ground), including N-fixing crops, returned to the soil on stratum s_{CR} in year y (t N/yr)
$M_{c,s_{CR},y}$	=	Quantity of crop type c that is harvested on stratum s_{CR} in year y (t dry matter)
$f_{burnt,s_{CR},c,y}$	=	Fraction of the area of stratum s_{CR}, cultivated with crop type c, that is burnt in year y
$C_{f,c}$	=	Combustion factor, accounting for the proportion of the crop residues from crop type c that are actually combusted when undertaking field burning
$R_{AG,c}$	=	Ratio of above-ground residue of crop type c to harvested yield for crop type c
$w_{N,AG,c}$	=	N content in the above-ground residues of crop type c (t N/t dry matter)
$Frac_{REMOVE,c,y}$	=	Fraction of above-ground biomass residues of crop type c that are removed from the plantation in year y
$R_{BG,c}$	=	Ratio of below-ground residue of crop type c to harvested yield for crop type c
$w_{N,BG,c}$	=	N content in the below-ground residues of crop type c (t N/t dry matter)
c	=	Crop types harvested on stratum s_{CR} in year y
s_{CR}	=	Strata of the project area where crops residues, including N-fixing crops, are returned to the soil

When soil C is lost through oxidation as a result of a land use change or a change in land management practices, this loss will be accompanied by a simultaneous mineralization of N. This N is regarded as an additional source of N available for conversion to N_2O. This quantity of N ($F_{SOM,sMS,y}$) is estimated for each stratum s_{MS} as follows:

$$F_{SOM,s_{MS},y} = \frac{SOC_{historic,s_{MS}} - SOC_{PJ,s_{MS}}}{T} \times \frac{1}{R} \times A_{PJ,s_{MS}} \quad (18)$$

Where:

$F_{SOM,s_{MS},y}$	=	Amount of N in the mineral soil that is mineralized on stratum s_{MS} in year y in association with loss of soil carbon from soil organic matter as a result of a land use change or a change in the land management practice (t N/yr)
$SOC_{historic,s_{MS}}$	=	Soil organic carbon stock with the land use and land management practices on stratum s_{MS} before the implementation of the project activity (tC/ha)
$SOC_{PJ,s_{MS}}$	=	Soil organic carbon stock with the land use and land management practices on stratum s_{MS} under the project activity (tC/ha)

T	=	Time dependence of the stock change factors (years)
R	=	C:N ratio of the soil organic matter
$A_{PJ,s_{MS}}$	=	Size of the land area of stratum s_{MS} (ha)

Data and parameters not monitored

Parameter:	$EF_{N2O,N,OS}$
Data unit:	t N_2O-N per ha and year
Description:	Emission factor for direct nitrous oxide emissions from drained/managed organic soils
Source of data:	2006 IPCC Guidelines, Vol. 4, Ch. 11. Table 11.1, as provided below
Value to be applied:	see table below
Any comment:	

Applicable climate and soil type	**Emission factor (tN_2O-N/(ha year))**
Temperate organic crop and grassland soils	8
Tropical organic crop and grassland soil	16
Temperate and boreal organic nutrient rich forest soils	0.6
Temperate and boreal organic nutrient poor forest soils	0.1
Tropical organic forest soils	8

Data / parameter:	R
Data unit:	-
Description:	C:N ratio of the soil organic matter
Source of data:	If reliable and well documented country-specific or regional data are available, such data should be used. If such data is not available, project participants should assume, consistent with the 2006 IPCC Guidelines, a default value of 15 for situations involving land-use change from forest land or grassland to cropland and a default value of 10 for situations involving management changes on cropland.
Measurement procedures (if any):	-
Any comment:	

Data and parameters monitored

Data / parameter:	$\mathbf{M_{c,s_{CR},y}}$
Data unit:	t dry matter
Description:	Quantity of crop type *c* that is harvested on stratum s_{CR} in year *y* where • *c* are the crop types harvested on stratum s_{CR} in year *y*, and • s_{CR} are the strata of the project area where crops residues, including N-fixing crops, are returned to the soil where *c* are the crop types harvested on stratum s_{CR} in year *y*
Source of data:	Records by project proponents
Measurement procedures (if any):	

Monitoring frequency:	Continuously
QA/QC procedures:	
Any comment:	

Data / parameter:	$\mathbf{f}_{burnt,s_{CR},c,y}$
Data unit:	-
Description:	Fraction of the area of stratum s_{CR}, cultivated with crop type *c*, that is burnt in year *y* where: • *c* are the crop types harvested on stratum s_{CR} in year *y*; and • s_{CR} are the strata of the project area where crops residues, including N-fixing crops, are returned to the soil
Source of data:	Records by project proponents
Measurement procedures (if any):	
Monitoring frequency:	Each time field burning is taking place
QA/QC procedures:	
Any comment:	

Data / parameter:	$R_{AG,c}$
Data unit:	-
Description:	Ratio of above-ground residue of crop type *c* to harvested yield for crop type *c*
Source of data:	Records by project proponents
Measurement procedures (if any):	
Monitoring frequency:	
QA/QC procedures:	
Any comment:	

Data / parameter:	$Frac_{REMOVE,c,y}$
Data unit:	-
Description:	Fraction of above-ground biomass residues of crop type c that are removed from the plantation in year *y* where: • *c* are the crop types harvested on stratum s_{CR} in year *y*, and • s_{CR} are the strata of the project area where crops residues, including N-fixing crops, are returned to the soil where *c* are the crop types harvested on stratum s_{CR} in year *y*
Source of data:	Records by project proponents
Measurement procedures (if any):	
Monitoring frequency:	Continuously
QA/QC procedures:	
Any comment:	

Emissions from the production of synthetic fertilizer that is used at the plantations ($PE_{FP,y}$)

The GHG emissions from the production of synthetic fertilizer are estimated for each synthetic fertilizer type *f* by multiplying an emission factor with the monitored quantity of fertilizer applied at the plantations during year *y*, as follows:

$$PE_{FP,y} = \sum_{f} \left(EF_{CO2e,FP,f} \cdot M_{SF,q,y} \right) \quad \textbf{(19)}$$

Where:

$PE_{FP,y}$	=	Project emissions related to the production of synthetic fertilizer that is used at the dedicated plantations in year *y* (tCO_2e/yr)
$EF_{CO2e,FP,f}$	=	Emission factor for GHG emissions associated with the production of fertilizer type *f* (tCO_2e/kg fertilizer). Default value is provided below.
$M_{SF,q,y}$	=	Amount of synthetic fertilizer *q* applied at the plantation in year *y* where *q* are the synthetic fertilizer types applied at the plantation in year *y*(tn fertilizer/yr)

Data and parameters not monitored

Data / Parameter:	$EF_{CO2e,FP,f}$
Data unit:	tCO_2e/tfertilizer
Description:	Emissions factor for GHG emissions associated with the production of fertilizer type *f*
Source of data:	Use default values as provided in the Tables below.
Value to be applied:	See tables below
Any comment:	Source: Calculated based on Wood and Cowie (2004) and Swaminathan (2004)

N Fertilizer Type	**Emission factor (tCO_2/tN)**
Urea	1.7
Ammonium nitrate	7.1
Ammonium sulfate	2.0
Calcium nitrate	11.7
Ammonium Phosphate	2.7
Liquid urea/ammonium nitrate	4.9

P Fertilizer Type	**Emission factor ($tCO2/tP_2O_5$)**
Phosphate rock	2.0
Ammonium phosphate	0.3
Tripple super phosphate	0.5
Single super phosphate	0.2

K Fertilizer Type	**Emission factor (tCO_2/tK_2O)**
Potassium chloride	0.4
Potassium sulphate	0.3

The following data shall be updated at the renewal of the crediting period, based on any future revision or amendment of the 2006 IPCC Guidelines:

- Emissions factor for direct N_2O emissions from N inputs ($EF_{N2O\text{-}N,dir}$);
- Emissions factor for atmospheric deposition of N on soils and water surfaces ($EF_{N2O,ATD}$);
- Emissions factor for N_2O emissions from N leaching and runoff ($EF_{N2O\text{-}N,L}$);
- Fraction of organic N fertilizer that volatilizes as NH_3 and NO_X ($Frac_{GASM}$);
- Fraction of synthetic and organic fertilizer N that is lost through leaching and runoff ($Frac_{LEACH}$);
- Fraction of synthetic fertilizer N that volatilizes as NH_3 and NO_X ($Frac_{GASF}$)N_2O emission factor for field burning of biomass ($EF_{N2O,BB}$);
- CH_4 emission factor for field burning of biomass ($EF_{CH4,BB}$).

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