

The Purus Project

Full Monitoring Plans

A Tropical Forest Conservation Project in Acre, Brazil



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INTRODUCTION

The Purus Project (“Project”) is a payment for ecosystem services forest conservation project, otherwise known as a Reduced Emissions from Deforestation and Degradation (REDD+) project, on 34,702 hectares (i.e., approximately 85,714 acres) of privately-owned land in Acre, Brazil.¹

The Purus Project was successfully validated by SCS Global Services in January 2013 to the Verified Carbon Standard (VCS, Version 3.3) and to the Climate, Community and Biodiversity Standard (CCBS, Second Edition) with Gold Distinction.

The CCBS Project Design Document with supporting documentation can be accessed [here](#) and the VCS Project Description with supporting documentation can be accessed [here](#).

The three main Project Proponents of the Purus Project are CarbonCo, LLC (“CarbonCo”), Freitas International Group, LLC (“Freitas International Group or Carbon Securities”), and Moura e Rosa Empreendimentos Imobiliários LTDA (“Moura & Rosa” or “M&R”). CarbonCo, the wholly-owned subsidiary of Carbonfund.org Foundation, is responsible for getting the Project certified and for early-stage Project finance. Carbon Securities acts as a liaison between CarbonCo and Moura & Rosa, along with acting as a translator and assisting with logistics for site visits. Moura & Rosa is an Acre, Brazil-based organization created by the Landowners and is primarily responsible for day-to-day management of the Project and the implementation of activities to mitigate deforestation.

The ultimate project activities are to undertake a forest carbon inventory, model regional deforestation and land-use patterns, and mitigate deforestation pressures by utilizing payments for the Project’s ecosystem services, along with ongoing monitoring of the climate, community and biodiversity impacts of the Project. Social projects and activities to mitigate deforestation pressures range from engaging EMBRAPA (i.e., the Brazilian Agricultural Research Corporation) and SENAR (Serviço Nacional de Aprendizagem Rural) for agricultural extension training, to beginning patrols of potential deforestation sites in the early stages of the Project, to eventually building better houses and installing solar photovoltaic panels for the local communities to improve their livelihoods.

Please contact Brian McFarland of CarbonCo, LLC with any questions, comments or concerns regarding the Purus Project at 1-240-595-6883 or via email at BMcFarland@CarbonCoLLC.com.

¹ The Term REDD and REDD+ will be used interchangeably. REDD+ includes REDD along with forest conservation, sustainable forest management and the enhancement of carbon stocks. Thus, the Purus Project includes elements of forest conservation, sustainable forest management and reforestation.

CL3. CLIMATE IMPACT MONITORING

The Purus Project’s climate impact monitoring plan will be primarily conducted via aerial monitoring from a trike, by conducting participatory rural assessments throughout the Project Zone, as well as by reviewing satellite imagery provided by the State of Acre.

The climate impact monitoring plan identifies the types of measurements, required carbon pools, sampling method, and frequency of measurements. The climate impact monitoring plan also accounts for leakage and will continue for at least five years after all activity displacement or other leakage causing activities have taken place. Furthermore, the full climate impact monitoring plan, and its ongoing monitoring results, will be made publicly available on the internet and will also be made available to the local communities and the Purus Project’s other stakeholders.

Aerial Monitoring from a Trike

Wanderley Cesario Rosa, a Managing Director of Moura & Rosa, participated in training classes in Sao Paulo, Brazil on how to operate a trike in April 2012. Moura & Rosa then purchased a trike in May 2012, the trike was delivered to Moura & Rosa in June 2012, and aerial monitoring of deforestation throughout the Purus Project began in August 2012.



Example of Trikes, (Photo Credit: Trikes Brasil)²

The peak rainy season in Acre, which is the time period of the least threat of deforestation, is from November to April and Moura & Rosa will attempt to conduct aerial monitoring once per month depending on weather conditions and the resulting safety situation. The dry season in Acre, which is when the risk of deforestation is highest, is from May to November and Moura & Rosa will fly over the Purus Project at least once per month.

To complement this aerial monitoring via trike, climate impact monitoring will also be conducted by boat and by ground. Such terrestrial monitoring will takes place approximately every two weeks.

² Trikes Brasil. “Photo Gallery,” Available: <http://www.trikesbrasil.com.br/galeria-de-fotos.html>

The monitors will write down observations, document any community meetings, input this data into the monitoring template, and upload the document onto a shared DropBox account among the Project Proponents.

The monitoring template includes:

- Name of Monitor
- Date of Monitor
- Communities Visited
- Meeting Notes with Community
- Grievances and Concerns of Community
- Location and Date of Deforestation
- Responsible Actor for Deforestation
- Observations Pertaining to Deforestation
- Biodiversity Observed
- Other Notes Related to the Project

The main responsibilities of the patrollers are to establish a presence, identify and document any deforestation (i.e., including taking pictures), and then immediately report such deforestation to Moura & Rosa and the local project manager. Moura & Rosa will then immediately transfer this information to Carbon Securities and CarbonCo. Collectively, CarbonCo and Moura & Rosa will discuss the appropriate actions to counteract reported deforestation.

Verified Carbon Standard’s Monitoring Plan

The Purus Project’s CCBS climate impact monitoring plan, which will also utilize participatory rural assessments and satellite imagery, will be centered on the Verified Carbon Standard’s (VCS) monitoring plan. The complete VCS Project Description (VCS PD) can be accessed [here](#) and the following is a reprint of such monitoring plan:

Data and Parameters Available at Validation

Data and parameters calculated during the course of project development include those listed in this section.

Data Unit / Parameter:	$\Delta C_{BSL,PA,unplanned}$
Data unit:	t CO ₂ -e
Description:	Net CO ₂ emissions in the baseline from unplanned deforestation in the project area
Source of data:	Derived in Section 3.1 of VCS PD
Value applied:	Set at start of baseline period
Justification of choice of data or description of measurement methods and procedures applied:	Derived and justified in Section 3 of PVCS D in which baseline is set
Any comment:	

Data Unit / Parameter:	$\Delta C_{BSL,LK,unplanned}$
Data unit:	t CO ₂ -e
Description:	Net CO ₂ emissions in the baseline from unplanned deforestation in the leakage belt
Source of data:	Derived in Section 3.1 and 3.2 of VCS PD
Value applied:	Set at start of baseline period
Justification of choice of data or description of measurement methods and procedures applied:	Derived and justified in Section 3 of VCS PD in which baseline is set
Any comment:	

Data Unit / Parameter:	CF
Data unit:	t C t ⁻¹ d.m.
Description:	Carbon fraction of biomass
Source of data:	IPCC 2006GL
Value applied:	0.47
Justification of choice of data or description of measurement methods and procedures applied:	Global default
Any comment:	
Data Unit / Parameter:	C_{OLB}
Data unit:	t CO ₂ -e ha ⁻¹
Description:	Area-weighted average aboveground tree carbon stock for forests available for unplanned deforestation outside the Leakage Belt
Source of data:	Derived from source data found in FAO. 2009. Global Forest Resources Assessment 2010, Brazil Country Report. Forestry Department, Food and Agriculture Organization of the United Nations, Rome.
Value applied:	372.3 t CO ₂ -e ha ⁻¹
Justification of choice of data or description of measurement methods and procedures applied:	Derived above in Section 3.3 of the VCS PD
Any comment:	

Data Unit / Parameter:	ΔC_{PLB}
Data unit:	t CO ₂ -e ha ⁻¹
Description:	Area weighted average aboveground tree carbon stock for forests available for unplanned deforestation

	inside the Leakage Belt
Source of data:	Stock estimates of strata represented in the project area were derived from measurements from the forest carbon inventory of the project area, in addition to data from Salimon et al. for one unsampled forest strata. Salimon et al. 2011. Estimating state-wide biomass carbon stocks for a REDD plan in Acre, Brazil. Forest Ecology and Management 262: 555-560.
Value applied:	351 t CO ₂ e ha-1
Justification of choice of data or description of measurement methods and procedures applied:	Derived above in Section 3 of the VCS PD
Any comment:	

Data and Parameters Monitored

Details on data and parameters monitored are provided below. Note that:

- “value applied” is left blank because all parameters in this section are monitored
- “monitoring equipment” is left blank to provide flexibility in measurement and monitoring approach, essential for any longterm monitoring, reporting and verification (MRV) plan
- Where a parameter is calculated from a methodology equation (i.e. not raw data), the methodology module and equation number is specified and “Description of measurement methods and procedures to be applied” and “QA/QC procedures to be applied” are appropriately left blank
- To avoid repetition and maintain an economical use of space in the summary tables, “Description of measurement methods and procedures to be applied” and “QA/QC procedures to be applied” for monitored (not calculated) parameters reference detailed accounts of procedures provided in the monitoring plan description below.

Data Unit / Parameter:	$\Delta C_{P,Def,i,t}$
Data unit:	t CO ₂ -e
Description:	Net carbon stock change as a result of deforestation in the project case in the project area in stratum <i>i</i> at time <i>t</i>
Source of data:	Calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	Every ≤ 5 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	

Calculation method:	Equation 3, VMD0015
Any comment:	

Data Unit / Parameter:	$\Delta C_{P,DefLB,i,t}$
Data unit:	t CO ₂ -e
Description:	Net carbon stock change as a result of deforestation in the project case in the leakage belt in stratum <i>i</i> at time <i>t</i>
Source of data:	Calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	Every ≤ 5 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	Equation 4, VMD0015
Any comment:	

Data Unit / Parameter:	$\Delta C_{P,DistPA,i,t}$
Data unit:	t CO ₂ -e
Description:	Net carbon stock change as a result of natural disturbance in the project case in the project area in stratum <i>i</i> at time <i>t</i>
Source of data:	Calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	Every ≤ 5 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	Equation 20, VMD0015
Any comment:	

Data Unit / Parameter:	$A_{DefPA,u,i,t}$
Data unit:	Ha
Description:	Area of recorded deforestation in the project area

	stratum i converted to land use u at time t
Source of data:	Monitored at each monitoring/verification event through the use of classified satellite imagery
Description of measurement methods and procedures to be applied:	Detailed procedures are provided below under monitoring plan description.
Frequency of monitoring/recording:	Every ≤ 5 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description
Calculation method:	
Any comment:	

Data Unit / Parameter:	$A_{DefLB,u,i,t}$
Data unit:	Ha
Description:	Area of recorded deforestation in the leakage belt stratum i converted to land use u at time t
Source of data:	Monitored at each monitoring/verification event through the use of classified satellite imagery
Description of measurement methods and procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Frequency of monitoring/recording:	Every ≤ 5 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description
Calculation method:	
Any comment:	

Data Unit / Parameter:	$A_{DistPA,q,i,t}$
Data unit:	ha
Description:	Area impacted by natural disturbance in post-natural disturbance stratum q in stratum i , at time t
Source of data:	Monitored at each monitoring/verification event through the use of classified satellite imagery
Description of measurement methods and procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Frequency of monitoring/recording:	Every ≤ 5 years

Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description
Calculation method:	
Any comment:	

Data Unit / Parameter:	$C_{BSL,i}$
Data unit:	t CO ₂ -e ha ⁻¹
Description:	Carbon stock in all pools in the baseline case in stratum <i>i</i>
Source of data:	Estimated from forest carbon inventory.
Description of measurement methods and procedures to be applied:	Detailed procedures provided below under monitoring plan description
Frequency of monitoring/recording:	Every ≤ 10 years.
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description
Calculation method:	
Any comment:	

Data Unit / Parameter:	$\Delta C_{pools,Def,u,i,t}$
Data unit:	t CO ₂ -e ha ⁻¹
Description:	Carbon stock in all pools in post-deforestation land use <i>u</i> in stratum <i>i</i>
Source of data:	Post deforestation carbon stocks in continuous agriculture in included pools (aboveground and belowground live aboveground trees = $C_{AB_tree,i}$ and $C_{BB_tree,i}$) is zero ($C_{BSL,post,i} = 0$).
Description of measurement methods and procedures to be applied:	None
Frequency of monitoring/recording:	Every ≤ 10 years.
Value applied:	0
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description
Calculation method:	

Any comment:	
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Data Unit / Parameter:	$A_{DegW,i,t}$
Data unit:	ha
Description:	Area potentially impacted by degradation processes in stratum i
Source of data:	Delineated based on survey results indicating general area of project potentially accessed and typical depth of penetration of illegal harvest activities from points of access
Description of measurement methods and procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Frequency of monitoring/recording:	Repeated each time the participatory rural assessment (PRA) indicates a potential for degradation. PRA conducted every ≤ 2 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Calculation method:	
Any comment:	

Data Unit / Parameter:	$C_{DegW,i,t}$
Data unit:	t CO ₂ -e
Description:	Biomass carbon of trees cut and removed through degradation process from plots measured in stratum i at time t
Source of data:	Estimated from diameter measurements of cut stumps in sample plots
Description of measurement methods and procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Frequency of monitoring/recording:	Every ≤ 5 years where surveys and limited sampling continue to indicate possibility of illegal logging in the project area
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Calculation method:	

Any comment:	
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Data Unit / Parameter:	AP_i
Data unit:	ha
Description:	Total area of degradation sample plots in stratum i
Source of data:	Calculated as 3% of $A_{DegW,i,t}$
Description of measurement methods and procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Frequency of monitoring/recording:	Every ≤ 5 years where surveys and limited sampling continue to indicate possibility of illegal logging in the project area
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Calculation method:	
Any comment:	

Data Unit / Parameter:	$\Delta C_{P,DegW,i,t}$
Data unit:	t CO ₂ -e
Description:	Net carbon stock changes as a result of degradation in stratum i in the project area at time t
Source of data:	Calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	Every ≤ 5 years where surveys and limited sampling continue to indicate possibility of illegal logging in the project area
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	Equation 8, VMD0015
Any comment:	

Data Unit / Parameter:	$PROP_{IMM}$
Data unit:	Proportion

Description:	Estimated proportion of baseline deforestation caused by immigrating population
Source of data:	Calculated based on results of survey of communities in the area around the project.
Description of measurement methods and procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Frequency of monitoring/recording:	Every ≤ 5 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	$PROP_{RES}$
Data unit:	Proportion
Description:	Estimated proportion of baseline deforestation caused by population that has been resident for ≥ 5 years
Source of data:	Calculated based on results of survey of communities in the area around the project.
Description of measurement methods and procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Frequency of monitoring/recording:	Every ≤ 5 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	$TOTFOR$
Data unit:	ha
Description:	Total available national forest area
Source of data:	Official data, peer reviewed publications, remotely sensed imagery (coarse scale imagery is appropriate) or cadastral maps and other verifiable sources

Description of measurement methods and procedures to be applied:	Not applicable
Frequency of monitoring/recording:	Prior to each verification event and at least every 5 years.
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	<i>PROTFOR</i>
Data unit:	ha
Description:	Total area of fully protected forests nationally
Source of data:	Official data, peer reviewed publications and other verifiable sources
Description of measurement methods and procedures to be applied:	Not applicable
Frequency of monitoring/recording:	Prior to each verification event and at least every 5 years.
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	<i>MANFOR</i>
Data unit:	ha
Description:	Total area of forests under active management nationally
Source of data:	Official data, peer reviewed publications and other verifiable sources
Description of measurement methods and procedures to be applied:	Not applicable
Frequency of monitoring/recording:	Prior to each verification event and at least every 5 years.

Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	
Any comment:	

Data Unit / Parameter:	$ARRL_{forest,t}$
Data unit:	ha
Description:	Remaining area of forest in RRL at time t
Source of data:	Calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	Prior to each verification event and at least every 5 years.
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	Calculated as the total area of the RRL minus all nonforested areas.
Any comment:	

Data Unit / Parameter:	$Aburn,q,i,t$
Data unit:	ha
Description:	Area burnt in post-natural disturbance stratum q in stratum i , at time t ;
Source of data:	See parameter $A_{DistPA,q,i,t}$
Description of measurement methods and procedures to be applied:	Monitored as part of $A_{DistPA,q,i,t}$
Frequency of monitoring/recording:	Every ≤ 5 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description
Calculation method:	$Aburn,q,i,t = A_{DistPA,q,i,t}$ for stratum where the natural disturbance included fire

Any comment:	
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Data Unit / Parameter:	dbh
Data unit:	cm
Description:	diameter at breast height
Source of data:	Monitored during the course of each forest inventory
Description of measurement methods and procedures to be applied:	Detailed procedures provided in Appendix B of VCS PD
Frequency of monitoring/recording:	Every ≤ 10 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures are provided below under monitoring plan description.
Calculation method:	
Any comment:	

Data Unit / Parameter:	dbasal
Data unit:	cm
Description:	Basal diameter
Source of data:	Monitored during the course of each forest inventory
Description of measurement methods and procedures to be applied:	Detailed procedures provided in Appendix B of VCS PD
Frequency of monitoring/recording:	Every ≤ 10 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures are provided below under monitoring plan description.
Calculation method:	
Any comment:	Dbh may be used as a conservative estimate of dbasal

Data Unit / Parameter:	H
Data unit:	m
Description:	Height of tree
Source of data:	Monitored during the course of each forest inventory
Description of measurement methods and procedures to be applied:	Detailed procedures provided in Appendix B of VCS PD
Frequency of monitoring/recording:	Every ≤ 10 years
Value applied:	

Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures are provided below under monitoring plan description.
Calculation method:	
Any comment:	

Data Unit / Parameter:	Dn
Data unit:	cm
Description:	Diameter of piece n of dead wood along the transect
Source of data:	Monitored during the course of each forest inventory
Description of measurement methods and procedures to be applied:	Detailed procedures provided in Appendix B of VCS PD
Frequency of monitoring/recording:	Every ≤ 10 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures are provided below under monitoring plan description.
Calculation method:	
Any comment:	

Data Unit / Parameter:	N
Data unit:	dimensionless
Description:	Total number of wood pieces intersecting the transect
Source of data:	Monitored during the course of each forest inventory
Description of measurement methods and procedures to be applied:	Detailed procedures provided in Appendix B of VCS PD
Frequency of monitoring/recording:	Every ≤ 10 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures are provided below under monitoring plan description.
Calculation method:	
Any comment:	

Data Unit / Parameter:	L
Data unit:	m
Description:	Length of the transect
Source of data:	Monitored during the course of each forest inventory
Description of measurement methods and	Detailed procedures provided in Appendix B of VCS

procedures to be applied:	PD
Frequency of monitoring/recording:	Every ≤ 10 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures are provided below under monitoring plan description.
Calculation method:	
Any comment:	

Description of the Monitoring Plan

This monitoring plan has been developed in close conjunction with module VMD0015 of the REDD Methodological Module, “Methods for monitoring of greenhouse gas emissions and removals (M-MON).” This section focuses on establishing procedures for monitoring deforestation, illegal degradation, natural disturbance, and project emissions ex-post in the project area and leakage belt. Further, procedures for updating the forest carbon stocks and revising the baseline are also provided below.

For accounting purposes, the project conservatively assumes stable stocks and no biomass monitoring is conducted in areas undergoing carbon stock enhancement, as permitted in the methodology monitoring module VMD0015, hence $\Delta C_{P,Enh,i,t}$ is set to 0.

Further as no commercial harvest of timber (including FSC selective logging) occurs in the baseline or with project case, the degradation due to harvest of timber will not be monitored, thus parameter $\Delta C_{P,SelLog,i,t}$ is set to 0.

A separate section on quality assurance/quality control and data archiving procedures covers all monitoring tasks. Organizations responsible for monitoring are also listed below. These organizations are responsible for implementing all aspects of a particular monitoring task, as described in the monitoring sub-sections below.

Monitoring Deforestation and Natural Disturbance

Forest cover change due to deforestation and natural disturbance is monitored through periodic assessment of classified satellite imagery, see below, covering the project area. Emissions ($\Delta C_{P,Def,i,t}$ and $\Delta C_{P,DistPA,i,t}$ for deforestation and natural disturbance, respectively) are estimated by the multiplying areas $A_{DefPA,u,i,t}$ and $A_{DistPA,q,i,t}$, for deforestation and natural disturbance, respectively, by average forest carbon stock per unit area (conservatively assuming $\Delta C_{P,Dist,q,i,t}$ and $\Delta C_{pools,Def,u,i,t} = C_{BSL,i}$). Note that $A_{DistPA,q,i,t}$, is limited to the area where credits have been issued and is identified as the overlap between the delineated area of the disturbance and the summed area of unplanned deforestation in the project area to the year in which the disturbance occurred. Stock estimates from the initial field inventory completed in 2011, are valid for 10 years (per VM0007).

Parameter	Description	Units	Source/ Justification of Choice of Data or Description of Measurement Methods
$\Delta C_{P,Def,i,t}$	Net carbon stock change as a result of deforestation in the project case in the project area in stratum i at time t	t CO ₂ e	Calculated
$\Delta C_{P,DistPA,i,t}$	Net carbon stock change as a result of natural disturbance in the project case in the project area in stratum i at time t	t CO ₂ e	Calculated
$A_{DefPA,u,i,t}$	Area of recorded deforestation in the project area stratum i converted to land use u at time t	Ha	Monitored for each verification event
$A_{DistPA,q,i,t}$	Area impacted by natural disturbance in post-natural disturbance stratum q in stratum i, at time t	Ha	Monitored for each verification event
$C_{BSL,i}$	Carbon stock in all pools in the baseline case in stratum i	t CO ₂ e ha ⁻¹	Estimated from the forest carbon inventory
$ARRL_{forest,t}$	Remaining area of forest in RRL at time t	Ha	Updated prior to each verification event

Table 1: Data and Parameters for Monitoring Deforestation and Natural Disturbance

Changes in forest cover ($A_{DefPA,u,i,t}$ and $A_{DistPA,q,i,t}$) will be monitored using data provided by the State of Acre. UCEGEO, the GIS department within the Climate Change Institute, Acre State government, produces an annual dataset on the extent and spatial location of all deforestation within the state using Landsat images. Deforestation and natural disturbance will be distinguished using ancillary data which may include but is not limited to high resolution imagery, digital elevation models (to identify steep areas prone to landslides), information from local land managers, etc.

In the case, where this dataset ceases to be available, ex-post deforestation will be determined by classification of remotely sensed imagery and land use change detection procedures.

The project area (and leakage belt boundary), as set in the VCS PD, will serve as the initial “forest cover benchmark map” against which changes in forest cover will be assessed over the interval of the first monitoring period; the entire project area has been demonstrated to meet the forest definition at the beginning of the crediting period. For subsequent monitoring periods, change in forest cover will be assessed against the preceding classified forest cover map marking the beginning of the monitoring interval. Thus, the forest benchmark map is updated at each monitoring event.

The area of remaining forest in the RRL ($ARRL_{forest,t}$) is derived by subtracting by the non-forested area within the RRL, as found in the forest benchmark map (updated at each monitoring event), from the total area of the RRL.

Monitoring Illegal Degradation

Emissions due to illegal logging will be tracked by conducting surveys in the surrounding areas every two years. Locations surveyed will include:

- Families residing on the Moura & Rosa property adjacent to the project area; and
- Nearby ranches and rural properties, along the Purus River and secondary roads approaching the project area.

Surveys will produce information on wood consumers (i.e., fuel wood and wood for construction and charcoal production) in the surroundings areas, as well as general indications on the areas where wood is sourced from and maximum depth of penetration of harvest activities from access points.

In the event that any potential of illegal logging occurring in the project area is detected from the surveys (i.e. $\geq 10\%$ of those interviewed/surveyed believe that degradation may be occurring within the project boundary), temporary sample plots will be allocated and measured in the area of the project indicated by the surveys as a potential source area for illegally-harvested wood. The potential degradation area within the project area ($A_{DegW,i}$) will be delineated based on survey results, incorporating general area information and maximum depth of penetration. Rectangular plots 10 meters by 1 kilometer (1 ha area) will be randomly or systematically allocated in the area, sufficient to produce a 1% sample of the area, and any recently-cut stumps or other indications of illegal harvest will be noted and recorded. Diameter at breast height, or diameter at height of cut, whichever is lower, of cut stumps will be measured.

In the event that the sample plot assessment indicated that illegal logging is occurring in the area, supplemental plots will be allocated to achieve a 3% sample of the area. Biomass will be estimated from measured diameters (conservatively assuming that diameters of stumps cut below breast height are equivalent to diameter at breast height) applying the allometric equations of Brown (1997) and otherwise maintain consistency with analytical procedures applied in the original forest inventory report. Emissions due to illegal logging ($\Delta C_{P,DegW,i,t}$) are estimated by multiplying area ($A_{DegW,i}$) by average biomass carbon of trees cut and removed per unit area ($C_{DegW,i,t} / AP_i$).

The more intensive 3% sample will be carried out once every 5 years where surveys and limited sampling continue to indicate possibility of illegal logging in the project area to produce an estimate of emissions resulting from illegal logging ($\Delta C_{P,DegW,i}$). Estimates of emissions will be annualized (to produce estimates in tCO₂e per year) by dividing the emission for the monitoring interval by the number of years in the interval.

Parameter	Description	Units	Source/ Justification of Choice of Data or Description of Measurement Methods
$A_{DegW,i,t}$	Area potentially impacted by degradation processes in stratum i	Ha	Delineated based on survey results indicating general area of project potentially accessed and typical depth of penetration of illegal harvest activities from points of access
$C_{DegW,i,t}$	Biomass carbon of trees cut and removed through degradation process from plots measured in stratum i at time t	t CO ₂ e	Estimated from diameter measurements of cut stumps in sample plots
AP_i	Total area of degradation sample plots in stratum i	Ha	Calculated as 3% of $A_{DegW,i,t}$
$\Delta C_{P,DegW,i,t}$	Net carbon stock changes as a result of degradation in stratum i in the project area at time t	t CO ₂ e	Calculated

Table 2: Data and Parameters for Monitoring Illegal Degradation

Monitoring Project Emissions

With-project emissions are calculated as the sum of emission from fossil fuel combustion ($E_{FC,i,t}$) + non-CO₂ emissions due to biomass burning ($E_{BiomassBurn,i,t}$) + direct N₂O emissions as a result of nitrogen application ($N_{2Odirect-N,i,t}$). As stipulated in the methodology, fossil fuel combustion in all situations is an optional emission source. Further, no nitrogen is applied on alternative land uses in the with-project case and hence project emissions therefore equal $E_{BiomassBurn}$ and are calculated using the VMD0013, “Estimation of greenhouse gas emissions from biomass burning (E-BB)” of the AD Partners modular REDD Methodology.

Non-CO₂ emissions from biomass burning in the project case include emissions from burning associated with deforestation and burning associate with natural disturbance, i.e. forest fire. It will be conservatively assumed that the total area burnt during the deforestation process is equal to the area deforested, $A_{DefPA,u,i,t}$. Thus, the area used when calculating E-BB is equal to $A_{burn,i,t}$. (area burnt) = $A_{burn,q,i,t}$. (area burnt in natural disturbance) + $A_{DefPA,u,i,t}$ (area burnt via deforestation in project ex post)."

Parameter	Description	Units	Source/ Justification of Choice of Data or Description of Measurement Methods
$E_{BiomassBurn,t}$	Greenhouse emissions due to biomass burning as part of deforestation activities in stratum i in year t	tCO ₂ e of each GHG (CH ₄ , N ₂ O)	Calculated
$A_{burn,i,t}$	Area burnt for stratum i at time t	Ha	Monitored for each verification event

$B_{i,t}$	Average aboveground biomass stock before burning stratum i , time t	tonnes d. m. ha-1	Conservatively assumed to be the carbon stock in all pools in the baseline case (CBSL, i).
COMF i	Combustion factor for stratum i ; dimensionless	Dimensionless	0.45 for primary open tropical forest. Derived from Table 2.6 of IPCC, 2006.
Gg, i	Emission factor for stratum i for gas g	kg t-1 dry matter burnt	GCH ₄ = 6.8 g kg-1 and GN ₂ O = 0.2 g kg-1. Derived from Table 2.5 of IPCC, 2006.
GWP g	Global warming potential for gas g	t CO ₂ /t gas g	Default values from IPCC SAR: CH ₄ = 21; N ₂ O = 310).

Table 3: Data and Parameters for Monitoring Emissions from Biomass Burning

Monitoring Leakage

Leakage by local agents of deforestation is quantified in the leakage belt. The area deforested in the leakage belt ($A_{DefLB,i,t}$) is estimated in the same manner as the area deforested in the with-project case ($A_{DefPA,u,i,t}$) using the procedures outlined above in the monitoring deforestation section. Activity shifting leakage within the leakage belt ($\Delta CLK-ASU-LB$) is then calculated as the with-project emissions in the leakage belt ($\Delta CP, LB$) minus the baseline emissions in the leakage belt ($\Delta CBSL, LK, unplanned$).

Parameter	Description	Units	Source/ Justification of Choice of Data or Description of Measurement Methods
$\Delta CP, LB$	Net greenhouse gas emissions within the leakage belt in the project case	t CO ₂ e	Calculated
$A_{DefLB,i,t}$	Area of recorded deforestation in the leakage belt at time t	ha	Monitored for each verification event
$\Delta C_{P,Def,i,t}$	Net carbon stock change as a result of deforestation in the project case in the project area in stratum i at time t	t CO ₂ e	Calculated

Table 4: Data and Parameters for Monitoring Activity Shifting Leakage

Immigrant leakage is calculated using a series of equations found in the LK-ASU module. Most of the data for calculating immigrant leakage has been derived for the ex-ante estimates (including $\Delta CBSL, LK, unplanned$; AVFOR; TOTFOR; PROTFOR; MANFOR; PROPLB; LBFOR; COLB; CLB; PROPCS; and ABSL,PA,unplanned,t) or gathered in the course of monitoring activity shifting leakage within the leakage belt and deforestation in the project area (including A_{DefPA} ; $A_{DefLB,i,t}$; and $\Delta CP, LB$).

The monitoring parameters MANFOR, PROTFOR, TOTFOR will be sourced from official data, peer reviewed publications or other verifiable sources, such as the Brazil Global Forest Resources Assessment Report published by the Food and Agriculture Organization of the United Nations (FAO) and these monitoring parameters will be updated on review of current literature at

least every 5 years. Demonstration that managed and protected forests will be protected against deforestation will further be demonstrated, as stipulated in the LK-ASU module.

Monitoring immigrant leakage will therefore consist of implementing surveys in communities living within 2 kilometers of the boundaries of the leakage belt and project area to determine what proportion of the agents of deforestation have been resident in and around the leakage belt and project area for ≥ 5 years (PROPRES) and the proportion of area deforested by population that has migrated into the area in the last 5 years (PROPIMM). As it is extremely sensitive to ask explicit questions regarding responsibility for deforestation, “the proportion of area deforested by population that has migrated into the area in the last 5 years” is assumed to be equal to the percentage of recent immigrants among local population with potential access to the project area (i.e. without directly asking if they are deforestation agents). Similarly, the “proportion of baseline deforestation caused by population that has been resident for ≥ 5 years” is assumed to be equal to the percentage of the local population residing in the area longer than 5 years with potential access to the project area.

Parameter	Description	Units	Source/ Justification of Choice of Data or Description of Measurement Methods
PROPIMM	Proportion of area deforested by immigrant agents in the leakage belt and project area	proportion	Monitored prior to each verification event and at least every 5 years
PROPRES	Proportion of baseline deforestation caused by population that has been resident for ≥ 5 years	proportion	Monitored prior to each verification event and at least every 5 years
TOTFOR	Total available national forest area	ha	Monitored prior to each verification event and at least every 5 years
PROTFOR	Total area of fully protected forests nationally	ha	Monitored prior to each verification event and at least every 5 years
MANFOR	Total area of forests under active management nationally	ha	Monitored prior to each verification event and at least every 5 years

Table 5: Data and Parameters for Monitoring Immigrant Leakage

Updating Forest Carbon Stocks Estimates

Forest carbon stock estimates will be derived from field measurements less than or equal to 10 years old. Sample plots will be randomly located in areas within the Purus Project and measured following standard operating procedures located in Appendix B of the VCS PD. Biomass will be estimated applying the following allometric equations and otherwise maintain consistency with analytical procedures applied in the original inventory (“Forest biomass carbon inventory for the Purus REDD Project, Acre State, Brazil,” 2011).

For live trees, biomass is calculated as a function of diameter at breast height (DBH; in cm) using the predictive model developed by Brown³ for tropical moist forest stands. Results of this equation are conservatively adjusted downward using a calibration factor of 0.985. Application of the “moist” equation reflects the annual precipitation for the inventoried area, 2100mm.

$$\text{aboveground biomass (kg)} = ((42.69 - 12.8 * (\text{DBH}) + 1.242 * (\text{DBH})^2)) * 0.985 \quad \text{Equation 4.1}$$

For palms, height and dbh (a conservative estimate of basal diameter) measurements are used to estimate the aboveground volume of a paraboloid and then mean (species level) Amazonian palm specific gravity of 0.31 g/cm³ estimated by Baker et al (2004) will be applied. The estimate of biomass for palms is therefore to be limited to the main trunk (bole) of the palm. Thus, for palms:

$$\text{aboveground biomass (Mg)} = 0.5 * \pi * (\text{basal diameter(cm)} / 200)^2 * \text{height(m)} * 0.31 \quad \text{Equation 4.2}$$

Root biomass density is estimated at the cluster sample level applying the equation developed by Cairns et al.⁴, where

$$\text{Root Biomass Density (t/ha)} = \text{EXP} (-1.085 + 0.925 \text{LN}(\text{aboveground biomass density})) \quad \text{Equation 4.3}$$

The volume of lying dead wood per unit area is estimated using the equation (Warren and Olsen⁵) as modified by Van Wagner⁶ separately for each dead wood density class:

$$V_{LDW} = \frac{\pi^2 * \left(\sum_{n=1}^N D_n^2 \right)}{8 * L} \quad \text{Equation 4.4}$$

where:

V_{LDW} Volume of lying dead wood per unit area; m³ ha⁻¹

D_n Diameter of piece n of dead wood along the transect; cm

N Total number of wood pieces intersecting the transect; dimensionless

L Length of the transect; m

Length of each transect was corrected for slope. The volumes per unit area of each dead wood density class are then multiplied by their respective densities to convert to a mass per unit area. Biomass of standing dead wood is estimated using the allometric equation for live trees in the decomposition class 1. In decomposition class 2, the estimate of biomass was limited to the main trunk (bole) of the tree, in which case the biomass was calculated converting volume to

³ Brown, S., 1997. Estimating biomass and biomass change of tropical forests: A primer. FAO Forestry Paper: vii, 55 p.

⁴ Cairns, M. A., S. Brown, E. H. Helmer, and G. A. Baumgardner. 1997. Root biomass allocation in the world's upland forests. *Oecologia* 111, 1-11.

⁵ Warren, W.G. and Olsen, P.F. (1964) A line intersect technique for assessing logging waste. *Forest Science* 10: 267-276.

⁶ Van Wagner, C.E. (1968). The line intersect method in forest fuel sampling. *Forest Science* 14: 20-26.

biomass using dead wood density classes. Volume was estimated as the volume of a cone, as specified in the VM0007 module, “Estimation of carbon stocks in the dead wood pool.”

Density of dead wood is determined through sampling and laboratory analysis. Discs are collected in the field and decomposition class and green volume determined as per standard protocols (see Appendix B of the VCS PD for more details). The resulting dry weight is recorded and used to calculate dead wood density as oven-dry weight (g) / green volume (cm³) for each sample.

Dry mass is converted to carbon using the default carbon fraction of 0.47 t C/t d.m. (as recommended by IPCC⁷ Guidelines for National Greenhouse Gas Inventories).

Revision of the Baseline

The baseline as outlined in the VCS Project Description is valid for 10 years, through May 23, 2021. The baseline will be revised every 10 years from the project start date.

Data collection procedures in regards to revision of the baseline will include participatory rural appraisals, interviews and collaboration with the Acre State government, UCEGEO, the GIS department within the Climate Change Institute, and municipal officials. In the case, where the Acre State government no longer produces the annual dataset on the extent and spatial location of all deforestation within the state, deforestation maps will be prepared by classifying remotely sensed imagery. Other datasets used to substantiate aspects of the baseline will be from official government sources, peer reviewed publications, or other reputable sources.

Quality Assurance/Quality Control and Data Archiving Procedures

Monitoring Deforestation, Natural Disturbance, and Leakage

To ensure consistency and quality results, spatial analysts carrying out the imagery processing, interpretation, and change detection procedures will strictly adhere to best practices and good practice guidelines, when using the alternative method for quantifying deforestation. All data sources and analytical procedures will be documented and archived (detailed under data archiving below).

Accuracy of the classification will be assessed by comparing the classification with ground-truth points or samples of high resolution imagery. Any data collected from ground-truth points will be recorded (including GPS coordinates, identified land-use class, and supporting photographic evidence) and archived. Any sample points of high resolution imagery used to assess classification accuracy will also be archived. Samples used to assess classification accuracy should be well-distributed throughout the project area (as far as is possible considering availability of high resolution imagery and/or logistics of acquiring ground-truth data), with a minimum sampling intensity of 50 points each for the forest and non-forest classes.

The classification will only be used in the forest cover change detection step if the overall classification accuracy, calculated as the total number of correct samples / the total number of samples, is equal to or exceeds 90%.

⁷ IPCC 2006 Guidelines for National Greenhouse Gas Inventories. Chapter 4 AFOLU (Agriculture, Forestry and Other Land-use).

All data sources and processing, classification and change detection procedures will be documented and stored in a dedicated long-term electronic archive. Information related to monitoring deforestation maintained in the archive will include:

- Forest / non-forest maps;
- Documentation of software type and procedures applied (including all pre-processing steps and corrections, spectral bands used in final classifications, and classification methodologies and algorithms applied), if applicable; and
- Data used in accuracy assessment - ground-truth points (including GPS coordinates, identified land-use class, and supporting photographic evidence) and/or sample points of high resolution imagery.

Forest Carbon Stocks and Degradation

The following steps will be taken to control for errors in field sampling and data analysis:

1. Trained field crews will carry out all field data collection and adhere to standard operating procedures. Pilot sample plots shall be measured before the initiation of formal measurements to appraise field crews and identify and correct any errors in field measurements. Field crew leaders will be responsible for ensuring that field protocols are followed to ensure accurate and consistent measurements. To ensure accurate measurements, the height of diameter at breast height (1.3 m) will be periodically re-assessed by personnel during the course of the inventory.
2. An opportunistic sample of plots will be re-measured to identify and correct any field measurement issues which arise during implementation of the monitoring plan and to assess measurement errors. Re-measurement for this purpose will be done by different field personnel.
3. Field measurement data will be recorded on standard field data sheets and entered into an excel database for data management and quality control. Potential errors in data entry (anomalous values) will be verified or corrected consulting the original data sheets or personnel involved in measurement. Original data sheets will be permanently archived in a dedicated long-term electronic archive. The electronic database will also archive GIS coverages detailing forest and strata boundaries and plot locations.

Quality control procedures for sampling degradation will include steps 1 and step 3, above. Quality control procedures related to monitoring leakage include conducting a review of the current literature at least every 5 years to source information on the area of the monitoring parameters MANFOR, PROTFOR, and TOTFOR. Further, participatory rural appraisals used to assess the length of time people have been living in the project area and leakage belt will be implemented by personnel with experience conducting community surveys in rural Brazil. Personnel involved in the revising of the baseline will have detailed knowledge in regards to spatial modeling and land use change and deep familiarity with REDD methodologies. Remote sensing data used will include officially published dataset, or classified imagery, which meets accuracy assessment requirements as laid out in the methodology.

Data Archiving

Data archived will be maintained through at least two years beyond the end of the project crediting period. Given the extended time frame and the pace of production of updated versions

of software and new hardware for storing data, electronic files will be updated periodically or converted to a format accessible to future software applications, as needed.

Organizations, Responsibilities, and Monitoring Frequency

For all aspects of project monitoring, Purus Project staff will ensure that data collection, processing, analysis, management and archiving are conducted in accordance with the monitoring plan.

Variables to be monitored	Responsible	Frequency
Monitoring deforestation and natural disturbance	Moura & Rosa	Prior to each verification
Monitoring illegal degradation	Moura & Rosa	Every two years
Monitoring project emissions	CarbonCo	Prior to each verification
Activity shifting immigrant leakage assessment	Moura & Rosa	Prior to each verification event and at least every 5 years.
Updating forest carbon stocks estimates	CarbonCo	At least every 10 years.
Revision of the baseline	CarbonCo	At least every 10 years.

Table 6: Type of Monitoring and Party Responsible for Monitoring

CM3. COMMUNITY IMPACT MONITORING

The Purus Project’s full community impact monitoring plan for communities living in the Project Zone will be centered on monitoring the indicators derived from the Participatory Rural Assessment (PRA), Basic Necessity Surveys (BNS) and Theory of Change. In addition, the Project Proponents will review the Brazilian Census to monitor the socio-economic variables of offsite communities in the municipalities of Sena Madureira and Manoel Urbano.

The community impact monitoring plan, and its ongoing monitoring results, will be made publicly available on the internet and will also be made available to the local communities and the Purus Project’s other stakeholders.

Initial Community Impact Monitoring Plan

The initial community impact monitoring plan involved regular communication between Moura & Rosa and the local communities living on the Purus Project. In addition, the Project Proponents designed and implemented a Basic Necessity Survey and Participatory Rural Assessment to establish an initial baseline for monitoring net community impacts for communities living in the Purus Project Zone.

With respect to outside stakeholders, the initial community impact monitoring plan involved informal conversations with outside stakeholders and reviewing the Brazilian Census' socio-economic variables for the municipalities of Manoel Urbano and Sena Madureira to establish a baseline for monitoring net community impacts for offsite communities.

Initial High Conservation Values Plan

The Participatory Rural Assessment (PRA) and Basic Necessity Survey (BNS) were also designed to measure the communities' high conservation values (HCVs) and the Project Proponents will continue to monitor these HCVs.

Full Community Impact Monitoring Plan

The Purus Project's full community impact monitoring plan for communities living in the Project Zone will be centered around monitoring the indicators derived from the Participatory Rural Assessment (PRA), Basic Necessity Survey (BNS) and Theory of Change's activities, outputs, outcomes and community impacts. The frequency of monitoring to ensure that these indicators are directly linked to the Purus Project's major community objectives and are leading to the anticipated net positive impacts will take place at least every two years. In addition, the Project Proponents will review the Brazilian Census to monitor the socio-economic variables of offsite communities in the municipalities of Sena Madureira and Manoel Urbano every four years.

Communities Living in the Project Zone

A Participatory Rural Assessment (PRA, also known as a Participatory Rural Appraisal) was conducted by CarbonCo, Carbon Securities, and Moura & Rosa in March 2012. The Project Proponents attempted to sample each community living within the Purus Project Area, along with all adjacent communities living along the Purus River and within the Project Zone. A total of sixteen communities - thirteen communities within the Purus Project Area and three communities living alongside the Purus River and in the Project Zone - were interviewed as part of the PRA in March 2012.

CarbonCo, Carbon Securities, and Moura & Rosa also conducted a Basic Necessities Survey (BNS) in March 2012 among the sixteen communities. Essentially, a focus group was created among the Project Proponents and the community to identify the top 25 assets or services which were believed to be basic necessities or things that no one from the local communities should have to live without. The Project Proponents then individually surveyed each of the 16 communities and only those assets or services which at least 50% of the communities deemed a basic necessity were included in the final calculations of a poverty index and poverty score.

For example, the aggregated results of the BNS among the thirteen communities living inside the Purus Project were as follows:

Aggregated Data from Basic Necessities Survey (Communities Inside Project)							
Total Surveys: 13							
	Asset or Service	Item	Are Basic Necessities? (Total Number of No Responses)	Are Basic Necessities? (Total Percentage of No Responses)	Are Basic Necessities? (Total Number of Yes Responses)	Are Basic Necessities? (Total Percentage of Yes Responses)	Weighting (Fraction)
1	Service	Access to Enough Food	0	0.0%	13	100.0%	1.000
2	Asset	House	0	0.0%	13	100.0%	1.000
3	Service	Access to School	2	12.5%	11	84.6%	0.846
4	Asset	Electricity (PV or Generator)	3	18.8%	10	76.9%	0.769
5	Service	Access to Clean, Drinking Water	0	0.0%	13	100.0%	1.000
6	Service	Access to Health Clinic	2	12.5%	11	84.6%	0.846
7A	Asset	Boat	2	12.5%	11	84.6%	0.846
7B	Asset	Engine for Boat	3	18.8%	10	76.9%	0.769
8	Asset	Machete	1	6.3%	12	92.3%	0.923
9	Asset	Planting Tool	3	18.8%	11	84.6%	0.846
10	Asset	Chain Saw	4	25.0%	9	69.2%	0.692
11	Asset	Diesel or Gasoline	2	12.5%	11	84.6%	0.846
12	Asset	Television	4	25.0%	9	69.2%	0.692
13	Asset	Refrigerator	3	18.8%	10	76.9%	0.769
14	Asset	Radio	3	18.8%	10	76.9%	0.769
15	Asset	Fishing Pole	5	31.3%	8	61.5%	0.615
16	Asset	Fishing Net	5	31.3%	8	61.5%	0.615
17	Asset	Chicken Coop	6	37.5%	7	53.8%	0.538
18	Asset	House for Pigs	8	50.0%	5	38.5%	0.385
19	Service	Access to Medicine	3	18.8%	10	76.9%	0.769
20	Asset	Cooking Stove	1	6.3%	12	92.3%	0.923
21	Asset	Clothes	0	0.0%	13	100.0%	1.000
22	Asset	Hammock	0	0.0%	13	100.0%	1.000
23	Asset	Furniture (Table, Chairs, Bench)	2	12.5%	11	84.6%	0.846
24	Asset	Bed	2	12.5%	11	84.6%	0.846
25A	Asset	Telephone	2	12.5%	11	84.6%	0.846
25B	Asset	Tower for Telephone	4	25.0%	9	69.2%	0.692

**Yellow Highlighted Indicates Item is Not a Basic Necessity*

Figure 1: Aggregated Results of Participatory Rural Assessment (Credit: Brian McFarland)

Collectively, the PRA and BNS helped to shape the Project Proponent’s Theory of Change. As noted in the Social Impact Assessment Toolbox, in simple terms, {the Theory of Change} is a roadmap drawn up by the Project Proponents and stakeholders of how the project plans to get from Point A (project strategy and activities) to Point Z (project impacts).”⁸ Likewise, the Purus Project strategies and activities will lead to outputs, followed by outcomes, and ultimately by net positive climate, community and biodiversity impacts.⁹

⁸ Richards, M. and Panfil, S.N. 2011. Social and Biodiversity Impact Assessment (SBIA) Manual for REDD+ Projects: Part 1 – Core Guidance for Project Proponents. Climate, Community & Biodiversity Alliance, Forest Trends, Fauna & Flora International, and Rainforest Alliance. Washington, DC., Page 13.

⁹ The linkages between the Purus Project’s Strategies and Activities, Outputs, Outcomes, and Impacts were conceptualized with assistance from Brigitta Jozan, Independent Advisor

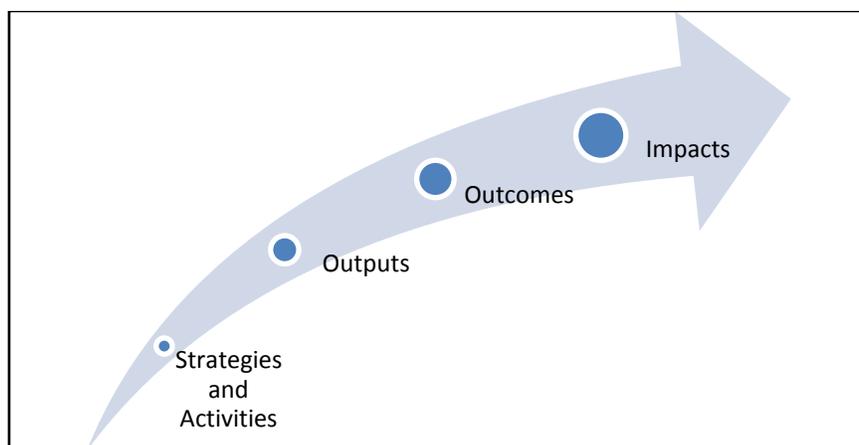


Figure 2: Progression from Project Strategies and Activities through Community Impacts

To clearly define activities, outputs, outcomes and impacts, the following definitions were utilized:

Project *activities* are the physical or implemented activities of the projects.

Project *outputs* are the tangible short-term results of project activities and normally take the form of products or services provided during the project lifetime and as a direct result of project funding.

Project *outcomes* are the direct intended results stemming from the outputs. They are short- and medium term changes experienced by project stakeholders and/or by the physical environment, and are less tangible and easy to measure than outputs.

Project *impacts* are the end results sought by the project, especially as regards net social changes. They may occur as a direct or indirect result of project outcomes.¹⁰

As further described in the Social and Biodiversity Impact Assessment (SBIA) Manual,

“Examples of indicators are: income level; life expectancy; adult literacy rates; species presence/absence; population size of a species. {...} When a desired social or biodiversity result is written as a SMART (Specific, Measureable, Achievable, Relevant, and Time-bound) objective, identifying appropriate indicators is relatively easy. {...} It is desirable to have a mixture of output, outcome and impact indicators, especially if they form part of a casual chain.”¹¹

The Purus Project’s indicators of activities, outputs, outcomes and impacts are as follows:

¹⁰ Sources: Based on GEF Evaluation Office and Conservation Development Centre 2009; Schreckenberg et al. 2010.

¹¹ Richards, M. and Panfil, S.N. 2011. Social and Biodiversity Impact Assessment (SBIA) Manual for REDD+ Projects: Part 1 – Core Guidance for Project Proponents. Climate, Community & Biodiversity Alliance, Forest Trends, Fauna & Flora International, and Rainforest Alliance. Washington, DC., Page 42.

Indicators of Activities

- Signed Tri-Party Agreement between Project Proponents
- Completion of Forest Carbon Inventory
- Completion of Regional Deforestation and Land-Use Modeling
- Completion of VCS Project Description and CCBS Project Design Document
- Completion of the Agricultural Survey, Basic Necessities Survey and Participatory Rural Appraisal

Indicators of Outputs

- Validation Statement for VCS Project Description and CCBS Project Design Document
- Spreadsheet with Top-10 Agricultural Courses Identified
- Invoice for Top-10 Agricultural Courses Purchased
- Agricultural Extension Trainings / Courses Conducted
- Spreadsheet Compiling Data on Basic Necessities including: What are Considered Basic Necessities; Total Value of Owned Assets and Total Value of Owned Assets per Capita; Price of Assets; Poverty Score and Poverty Index
- Summary Statistics on: Income/Asset Inequality; Most Disadvantaged Communities; Most Under-Owned Assets; Most Desired Basic Necessities
- Qualitative Surveys and Spreadsheet Compiling Data on: Land-Use; Patterns of Deforestation and Yearly Cycle of Deforestation; Why and Where Deforestation Occurs; Deforestation from Residents vs. Recent Migrants

Indicators of Outcomes

- Value of Carbon Finance Generated
- Communities Gain New Knowledge, Practices and Skills About Sustainable Agricultural and Rotational Cattle Pastures
- Prioritization and Implementation Plan for Social Projects and Programs to Reduce Deforestation and Improve Community Benefits
- Baseline for Monitoring Community Benefits
- Formulation of Plan to Mitigate Leakage
- Formulation of Plan to Monitor Deforestation

Indicators of Impacts

- Community Income Diversified
- Increased Income Generation
- Reduced Deforestation
- Intensified Agricultural Practices
- Rotational Cattle Pastures Implemented
- Diversified Crops
- Increasing Communities' Owned Assets and Owned Assets per Capita
- Improved Poverty Figures and Poverty Scores
- Increased Access to Basic Necessities
- Increased Access to School
- Increased Rural Electrification
- Increased Access to Health and Dental Clinic

Offsite Communities

Although very limited leakage is predicted outside of the Project Zone due to the project activities of the Purus Project, the other stakeholders who might be negatively impacted due to the Purus Project are the communities and landowners living adjacent to the Project Zone and within the municipalities of Sena Madureira and Manoel Urbano.

To quantify and document changes in the social and economic well-being of these outside stakeholders which result from the project activities, the Project Proponents will first review the Brazilian Census every four years to document the socio-economic variables in the municipalities of Sena Madureira and Manoel Urbano. These specific socio-economic variables to be monitored include:

- Total employed personnel
- Resident population
- Gross Domestic Product (GDP) per capita at current prices
- Value of average nominal monthly income of permanent private households with household income, by status of the housing unit – Rural
- Value of average nominal monthly income of permanent private households with household income, by status of the housing unit – Urban
- Resident population – literate
- Enrollment - Elementary school
- Enrollment - High school
- Number of Health institutions
- Percentage of Permanent private housing units, by existence of piped water and type of water supply - With water supply
- Percentage of Permanent private housing units - with energy supply¹²

The Project Proponents will then interview the outside stakeholders adjacent to the Project Zone every four years to quantify their socio-economic variables (i.e., the same socio-economic variables described above). Next, the Project Proponents will conduct a statistical analysis to determine whether the outside stakeholders' socio-economic variables are significantly worse off than the residents throughout the municipalities of Sena Madureira and Manoel Urbano due the project activities of the Purus Project.

B3. BIODIVERSITY IMPACT MONITORING

The Project Proponents have an initial biodiversity impact monitoring plan and a full biodiversity impact monitoring plan. The full biodiversity impact monitoring plan, and its ongoing monitoring results, will be made publicly available on the internet and will also be made available to the communities and the Purus Project's other stakeholders.

¹² IBGE, "Click here to get information about municipalities at Cities@," Available: <http://www.ibge.gov.br/estadosat/perfil.php?sigla=ac#>

Initial Biodiversity Impact Monitoring Plan

The Project Proponents' initial biodiversity impact monitoring plan is to monitor forest loss (i.e., habitat availability) in the Project Zone on a yearly basis using the State of Acre's satellite imagery, to conduct aerial monitoring via a trike, and to utilize the rapid biodiversity assessment of the Purus Project's flora and fauna which was conducted by Maria José Miranda de Souza Noquelli of Tenório Dias and Alternativa Ambiental from August to September 2009.

The Project Proponents are using the Avoided Deforestation Partners VCS REDD Methodology, entitled, "VM0007: REDD Methodology Modules (REDD-MF), v1.3." and the VCS Monitoring Plan to estimate the changes in forest cover. In conjunction with monitoring changes in forest cover, the Project Proponents utilized the island biogeography methodology to estimate changes in biodiversity as a result of the project. The biodiversity concept of island biogeography was originally developed by Robert MacArthur and E.O. Wilson and was extrapolated to theorize that habitat area is related to species diversity and species abundance.

Island biogeography in the Brazilian Amazon was demonstrated by the "Biological Dynamics of Forest Fragments Project (BDFFP, also known as the Minimum Critical Size of Ecosystems Project) {... which concluded that} censuses of beetles, birds, and primates in 1-, 10-, and 100-hectare reserves indicate that the number of species, and in some cases population sizes, in these groups varies with the size of the reserve."¹³

Furthermore, the rapid biodiversity assessment demonstrated there were at least two endangered flora species identified at the Purus Project as classified on the International Union for Conservation of Nature (IUCN) Red List. These endangered flora species are Car-cara (common name in French, Portuguese name is Canela rosa, English translation is Cinnamon Rose, scientific name is *Aniba rosaeodora*)¹⁴ and Baboonwood (Portuguese name is Virola Branca/Ucuuba Branca, scientific name is *Virola surinamensis*)^{15 16}.

Initial High Conservation Values Plan

The Project Proponents recognize the particular importance of the Purus Project's high conservation values and will assess the effectiveness of the Project's conservation activities vis-à-vis the Project's high conservation values.

The measures to maintain or enhance the significant concentrations of biodiversity – particularly threatened species, endemic species and threatened ecosystems - within the Purus Project are the various deforestation mitigation activities (e.g., agricultural extension training, deforestation monitoring, etc.) as outlined in section *G3. Project Design and Goal*, subsection *2. Major Activities* of the CCBS Project Design Document.

The initial plan to assess the effectiveness of these various deforestation mitigation activities will include:

¹³ Richard O. Bierregaard Jr. et. al., "The Biological Dynamics of Tropical Rainforest Fragments," pages 859-866.

¹⁴ IUCN, "Aniba rosaeodora," Available: <http://www.iucnredlist.org/details/33958/0>

¹⁵ IUCN, "Virola surinamensis," Available: <http://www.iucnredlist.org/details/33959/0>

¹⁶ Maria José Miranda de Souza Noquelli, "Diagnóstico Ecológico Rápido da Vegetação dos Seringais Porto Central e Itatinga, no Município Manuel Urbano – AC.," May 2012.

- Review satellite imagery for deforestation and aerial monitoring via trike of deforestation to ensure effective conservation of forest cover (i.e., a threatened or rare ecosystem)
- Incorporate analysis of the diversity, population and distribution of threatened and endemic species identified with wildlife camera traps into biodiversity monitoring plan
- Review ongoing Participatory Rural Assessments and Basic Necessity Surveys to ensure effectiveness of maintaining or enhancing community HCVs

Additional mechanisms to ensure effective maintenance or enhancement of HCVs will be developed utilizing adaptive management and stakeholder consultation.

Full Biodiversity Impact Monitoring Plan

The Project Proponents' full biodiversity impact monitoring plan will continue to monitor forest cover and habitat availability on an annual basis via satellite imagery and monthly flights over the Purus Project with a trike. In addition, the Project Proponents will monitor the diversity, distribution, and populations of medium-to-large mammals with wildlife camera traps. Furthermore, a Theory of Change shall be used to link the Projects activities to outputs and outcomes, and to the overall biodiversity impacts.

Indicators of Activities

The main activities associated with the wildlife camera traps are:

- Review vegetation maps of the Purus Project to identify general areas within the Project to set up wildlife camera traps
- Consult local communities and André Luis Botelho de Moura (the former graduate student of Dr. Armando Muniz Calouro) to identify the specific locations to set up wildlife camera traps
- Purchase and placement of wildlife cameras throughout the Project Area for six to twelve months, rotating the cameras to different vegetation strata as necessary
- Work with André Luis Botelho de Moura to train community on wildlife cameras such as preventative maintenance, periodic movement of cameras between different locations, along with regular retrieval and replacement of camera memory and batteries
- Photographic images will be then be organized, identified and analyzed by specialists
- Disseminate the full biodiversity impact monitoring plan and the results of the monitoring plan specifically to the local communities and other stakeholders, along with making the plan and results publicly available to the general public.

Adaptive management will be incorporated into the biodiversity monitoring plan in order to allow for a change in the camera locations and camera models based off results.

Indicators of Outputs

The main outputs of the biodiversity monitoring plan will be photographs from the wildlife camera traps and deforestation monitoring reports to document forest cover and habitat availability. In addition, an analysis of the diversity, population and distribution of any threatened and endemic species identified by the wildlife camera traps will be conducted.

Indicators of Outcomes

The outcomes based off the outputs will be an analysis of medium-to-large mammal diversity and populations and a better understanding of their distribution throughout the Purus Project.

Indicators of Impacts

The ultimate impact will be the preservation of biodiversity and particularly, the preservation of the Project's high conservation values such as threatened species.

The Purus Project shall monitor biodiversity impacts both spatially throughout the Purus Project as well as temporally over the Purus Project Lifetime. The goal is to annually review satellite imagery and habitat availability, while conducting a biodiversity impact monitoring project with wildlife camera traps every four years.

Offsite Impacts

The Project Proponents will monitor offsite biodiversity impacts, which are believed to be minimal, using satellite imagery to assess leakage.

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ACRONYMS

AVFOR	Available Forest
BNS	Basic Necessity Survey
CCBS	Climate, Community and Biodiversity Standard
CLB	Carbon Stock Across Leakage Belt
COLB	Carbon Stock Outside Leakage Belt
DBH	Diameter at Breast Height
FAO	Food and Agriculture Organization of the United Nations
GIS	Geographic Information System
GPS	Global Positioning System
HCV	High Conservation Value
IPCC	Intergovernmental Panel on Climate Change
LBFOR	Leakage Belt Forest
MANFOR	Managed Forest
MRV	Monitoring, Reporting and Verification
PD	Project Description (For VCS)
PDD	Project Design Document (For CCBS)
PRA	Participatory Rural Assessment
PROTFOR	Protected Forest
QA/QC	Quality Assurance / Quality Control
RRL	Reference Region for Projecting Location of Deforestation
SBIA	Social and Biodiversity Impact Assessment (Manual)
TOTFOR	Total Forest
tCO ₂ e	Metric Tons of Carbon Dioxide Equivalent
UCEGEO	Unidade Central de Geoprocessamento e Sensoriamento Remoto do Estado do Acre (In English: Central Unit of GIS and Remote Sensing of Acre)
VCS	Verified Carbon Standard