PV CLIMATE METHODOLOGY CONCEPT NOTE

Coastal Blue Carbon Methodology

V1.0

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Contents

1 Summary

This methodology and its associated modules will provide carbon accounting procedures that can be used by locally-led[1] coastal 'blue carbon' projects wishing to generate Plan Vivo Certificates (PVCs). Initially it will only cover mangroves, but the modular structure will allow other coastal or marine ecosystems to be added depending on need and viability.

The methodology will initially be applicable to the following project interventions:

- Mangrove restoration
- Mangrove conservation, including through improving the sustainability of mangrove wood harvesting

Each module will focus on the greenhouse gas accounting procedures for a particular project intervention (i.e. resource management activity). Initially there will be three modules: mangrove restoration, mangrove conservation and sustainable mangrove wood management. The methodology itself will explain how the outputs from each module can be used to calculate PVCs and will also provide a framework for projects to combine multiple interventions (for instance if a community is conserving their remaining intact mangroves *and* restoring mangroves that have been deforested), where relevant.

Tools – for instance Excel spreadsheets – will also be developed to support the application of the methodology and specific modules, but these may be released after the methodology and modules.

2 Relationship to Existing Approaches

Whilst some of the carbon accounting procedures for terrestrial ecosystems are relevant to blue carbon ecosystems, particularly mangroves, blue carbon systems are unique in many ways. For instance, in coastal blue carbon ecosystems the majority of the organic carbon is stored in the soils rather than the vegetation biomass. Also, existing along the coastline, these ecosystems are uniquely impacted by ocean forces such as erosion or submersion due to sea-level rise.

Therefore, whilst some of the procedures in PM001 and its associated modules are applicable to some blue carbon ecosystems, coastal blue carbon ecosystems' unique setting warrants a specific carbon accounting methodology.

Where procedures are identical, for instance those relating to uncertainty (PU005), readers will simply be referred to the relevant already approved modules and provided with guidance regarding how to apply the procedures in their setting. Also, the methods and formulae within PM001 and its associated modules will be incorporated where possible, to ensure consistency across the Standard's approach. But to ensure useability, how these methods and formula are represented and explained may differ, and default values specific to coastal blue carbon ecosystems will be provided where possible.

The methodology will also incorporate some of the principles and guidance from the approved VCS methodologies VM0033 (Tidal Wetland Restoration Methodology) and VM0007 (modular, landscape-scale methodology that incorporates tidal wetland conservation and restoration).

[1] As per the requirements in Section 2.3 of version 5 of the Plan Vivo Carbon Standard (PV Climate)

3 Scope and Applicability

The methodology will be applicable to any project that fulfils the following criteria:

- Project activities include one or more of the following interventions: mangrove restoration, afforestation or assisted natural regeneration; mangrove conservation, including changing management practices from clear-cutting to sustainable partial (selective) felling of mangroves.
- Project activities do not convert ecologically important native ecosystems (e.g. mudflats that are important for wetland birds or other fauna) into mangroves for the purpose of generating PVCs.
- Project activities do not result in changes to the water table or tidal flows to adjacent wetland ecosystems.
- Project activities do not include the application of nitrogen fertilisers, such as chemical fertiliser or manure.
- Mangrove project activities do not include forest burning, clear-cutting or even-aged management.

The mangrove conservation and restoration modules will have the same applicability conditions, but with more detailed examples of valid project activities.

Clear-cutting or even-aged management are not applicable project activities, but partial (selective) harvesting of mangrove wood will be allowed for both conservation and restoration projects, including post-harvest burning of wood (for instance for fuel or charcoal production). The accounting procedures related to this harvesting in the project scenario will be dealt with in the sustainable mangrove wood management module. This module will have the following additional applicability condition:

- A sustainable wood harvesting plan defining volume-based quotas must be in place at the project start date and enforced throughout the crediting period.

The wood products carbon pool is omitted for all projects in both the baseline and project scenario.

There will be no geographical limitations to the applicability of the methodology or modules.

There will be no limitations on project size, but some simplified procedures and default values may only be available to microscale (<10,000 PVCs/year) projects.

Projects that lead to a net removal of GHGs from the atmosphere (i.e. restoration projects) will be able use the methodology to generate future, reported and verified Plan Vivo Certificates (fPVCs, rPVCs and vPVCs). Projects that reduce GHG emissions (i.e. conservation or improved management projects) will be able to use the methodology to generate reported and verified Plan Vivo Certificates (rPVCs and vPVCs).

The following carbon pools will be included:

- Aboveground woody biomass – Yes
- Aboveground non-woody biomass – Optional
- Belowground biomass – Yes
- Litter – No
- Deadwood – Optional
- Soil organic carbon – Yes

- Wood products – No

Projects will be able to conservatively exclude carbon pools that they can prove have higher emissions in the baseline scenario compared to the project scenario.

The applicability conditions enable the exclusion of all emission sources except soil methanogenesis (CH_4) and fossil fuel use (CO_2). Only projects that involve the movement of soil with machinery (e.g. through the restoration of hydrology in aquaculture ponds) will be required to account for fossil fuel use in the project scenario. All other projects will be exempt from accounting for fossil fuel use. Only projects with activities that result in the flooding of dry land in areas where the salinity low point is below 18ppt will be required to account for soil methanogenesis in the project scenario. Procedures to assess salinity levels will be provided in the relevant modules. For simplicity and conservativeness, methane emissions in the baseline scenario will be assumed to be zero for all projects.

Conservative default values for soil organic carbon accumulation will be provided to prevent projects having to quantify the relative contribution of allochthonous carbon (carbon originating from outside of the project area but deposited within the project area). Whilst allochthonous carbon[2] can form a significant proportion of the carbon buried in coastal sediments in both baseline and with-project scenarios, contributions vary significantly depending on local conditions, making appropriate default allochthonous deductions difficult to establish. Determining the relative contribution of allochthonous carbon, and whether its long-term storage would have occurred without a project's interventions, is beyond the technical and financial capacity of most community-focused projects. However, projects wishing to establish their own soil organic carbon accumulation rates will be required to account for the contribution of allochthonous carbon.

There are a number of existing projects and projects under development that intend to apply the methodology. There are three mangrove projects currently certified under version 4 of PV Climate. Mikoko Pamoja and Vanga Blue Forest, both in Kenya, and Tahiry Honko in Madagascar. It is anticipated that this methodology will be adopted by these projects when they migrate to version 5 of PV Climate. There are a additional mangrove projects, or projects with a mixture of terrestrial forestry and mangrove interventions, in the pipeline that are at different stages of development. Once approved, this methodology will be available to these projects.

Preliminary discussions have also been had with further mangrove projects in the prefeasibility stage that have expressed interest in the methodology when/if they pursue certification.

4 Baseline Scenario and Additionality

For describing the baseline scenario, in-line with the approved PM001 methodology, this blue carbon methodology will use the procedures in the CDM AR-TOOL02 (version 1.0), disregarding all elements of the tool related to additionality.

Based on the tidal wetland activity list detailed and justified in the approved VCS module VMD0052[3], all projects fulfilling the methodology's applicability conditions will be deemed additional if they can

[2] Both intrinsically recalcitrant (not subject to decomposition) and labile (subject to decomposition)

[3] https://verra.org/wp-content/uploads/imported/methodologies/VMD0052-Demonstration-of-additionality-of-tidal-wetland-restoration-and-conservation-project-activities-ADD-AM-v2.0.pdf

prove regulatory surplus. Regulatory surplus means that project activities are not mandated by any systematically enforced law, statute, or other regulatory framework.

5 Quantification of Carbon Benefits

The bulk of the carbon benefit quantification will be done in the modules for each project intervention (i.e. resource management activity). The procedures in each module will result in values for gross emissions and/or removals. Clearly distinguishing between removals and avoided emissions in each module will allow projects and investors to understand the balance of removals vs avoided emissions across all project interventions.

The methodology will show project developers how these values can be used to calculate total net emission removals and/or net avoided emissions – accounting for leakage, uncertainty and buffer allocation – across one or more project interventions in order to generate fPVCs, rPVCs or vPVCs. fPVCs will only be able to be claimed for emission removals.

i) **Carbon baseline**:

For expected and actual baseline emissions/removals, the **mangrove conservation** module will follow the same principles as the PT002 approved tool, with the deviations and clarifications detailed in Annex 1. The module will be standalone, with the relevant text and procedures extracted from PT002 and adapted as per the document linked above.

The **mangrove restoration** module will have two approaches available to projects; a simplified and an alternative approach. All projects will be able to choose between these approaches, however projects that complete validation using the alternative approach will be unable to change to the simplified approach at the point of verification. The simplified approach will use the ratio of the number of trees and saplings within 10m x 10m square or 7m radius circular project photo plots (within the project area) to the number of trees and saplings within the same sized reference plots (outside the project area) to calculate a % baseline deduction that will be applied to biomass and SOC removals in the project scenario. The full proposed approach is summarised in Annex 2. The number of trees and saplings within reference plots will need to be reassessed every ten years.

The alternative approach will use matched control plots outside of the project area to estimate expected baseline biomass and SOC removals and measure actual baseline biomass and SOC removals over the project crediting period. Emissions from biomass in the baseline scenario will be conservatively excluded. However, if using the alternative approach and there is clear evidence of the potential for baseline emissions from the SOC pool, projects will also have the ability to incorporate these emissions into their accounting. Acknowledging the challenges associated with monitoring baseline changes in the soil pool, projects can use a time-bound model to estimate baseline SOC emissions. Throughout the module, these avoided emissions will be quantified separately to removals, to enable easy distinction between removals and avoided emissions. Note that only projects using the alternative approach will be able to claim avoided emissions from the SOC pool.

ii) **Expected and actual project emissions and removals**

For expected and actual project emissions/removals, the **mangrove conservation** module will follow the same principles as the PT002 approved tool, with the deviations and clarifications detailed in Annex 1. The module will be standalone, with the relevant text and procedures extracted from

PT002 and adapted as per the document linked above. It should be noted that the same data source or remote sensing approach must be used for both baseline and project emissions and removals (e.g. projects using Global Mangrove Watch for estimated and/or actual baseline emissions will also need to use Global Mangrove Watch for estimated and/or actual project emissions and removals).

Again, the **mangrove restoration** module will have two approaches for calculating expected and actual project emissions/removals: simplified and alternative. Projects will need to use the same approach for project emissions/removals as they used for baseline emissions/removals. For **expected project removals**, projects using the simplified method will use IPCC default values for removals in the biomass and SOC pools together with the % baseline deduction explained above. Projects using the alternative approach will have the option of using either the IPCC default values or appropriately justified, project-specific vegetation growth curves and SOC accumulation models to estimate expected biomass and SOC removals. These removals will then be adjusted according to the expected baseline removals derived from a historical assessment of the control plots. Expected avoided emissions from the SOC pool will be according to the time-bound model described above.

Both the simplified and alternative approaches will require projects that flood dry land with water with salinity low points of less than 18ppt to estimate **expected methane emissions**.

For **actual project removals**, projects using the simplified approach will be required every year to take four geo-tagged photos at centre point of all project photo plots, facing in each cardinal direction (north, east, south and west). These photos can be used as evidence for the issuance of rPVCs. For vPVCs, projects using the simplified approach will have two options. The first being to monitor actual changes in biomass carbon stocks within the project area using CDM AR-Tool14 and, together with the IPCC default values for SOC accumulation, calculate total project removals and then apply the % baseline deduction. The second option available to projects using the simplified approach is tree counting, together with IPCC default values for removals in the biomass and soil pools, and a performance deduction if the average number of trees and saplings within the project photo plots is less than the average number of trees and saplings counted in the reference plots at the point of baseline assessment. The full proposed approach is summarised in Annex 2. Projects using the alternative approach will need to monitor actual changes in biomass carbon stocks within the project area using CDM AR-Tool14 and, together with the IPCC default values for SOC accumulation or field measurements, calculate project removals. These project removals will then be adjusted for baseline removals using measurements (via remote sensing or *in situ*) from the control plots. Actual avoided emissions from the SOC pool will be according to the time-bound model described above.

Both the simplified and alternative approaches will require projects that flood dry land with water with salinity low points of less than 18ppt to estimate **actual methane emissions**.

Restoration projects that involve the movement of soil with machinery (e.g. through the restoration of hydrology in aquaculture ponds) will be required to account for emissions due to fossil fuel use in the project scenario using AR-TOOL05, as per approved module PU003. All other projects will be exempt from accounting for fossil fuel use.

The **mangrove wood management module** will provide projects with the procedures to account for the GHG impact of partial (selective) harvesting of mangrove wood in the project scenario. Any baseline emissions from partial felling in the baseline scenario are conservatively excluded for conservation projects and accounted for in the baseline procedures for restoration projects. To address the impact on project removals, this module will follow the same procedures in approved

module PU001 (section 5.7.2) for calculating the long-term average net-removals in woody biomass as the minimum post-harvest removals in tree biomass. For projects that include the burning of harvested wood for fuel or charcoal production, the procedures will require the average projected volume of fuelwood to be gathered in the project area, the mean wood density of species harvested and the carbon fraction of dry matter to account for the emissions associated with these activities.

iii) **Potential and actual leakage emissions** from carbon pools and emission sources, for both mangrove conservation and restoration, will be estimated using the leakage discount factor procedures in approved module PU004 (section 5.2).

iv) **Calculation of carbon benefits**

The methodology will guide projects through the process of calculating their net carbon benefits from the gross emissions and/or removals output by one or more of the modules. This process will include:

- Deductions for leakage (as per PU004).
- A set % deduction for the impact of sea-level rise on project emission and/or removals over a 50 year period. The value for this deduction is in the process of being defined and will be based on an assessment of the likely impact of sea-level rise on mangrove carbon stocks at different sites across the world.
- Any necessary deduction for uncertainty, directly referencing the procedures in approved module PU005.
- Allocations to the risk buffer (vPVCs) as well as the future risk buffer and achievement reserve (fPVCs and rPVCs)

6 Development Team

The lead author of this methodology as well as the mangrove modules is Leah Glass. With an MSci in Geophysics from Imperial College in the UK, Leah has over 15 years professional experience in environmental remote sensing and for the last 10 years has focused on blue carbon science and project development. She works as a technical advisor for both Blue Ventures – a British marine conservation NGO – and Silvestrum Climate Associates, and has co-authored numerous peer-reviewed publications in the field of carbon dynamics in the coastal environment. She is also a contributing author of the two VCS tidal wetland methodologies and sits on various advisory panels and working groups, including the Science Working Group of the Blue Carbon Initiative and the focal group for the International Partnership for Blue Carbon.

The authors will be supported by a working group consisting of 17 sector leading scientists and practitioners.

Annexes

Annex 1 - Mangrove conservation module – PT002 deviations and clarifications

Introduction

The PV Climate approved tool PT002 - titled *Estimation of climate benefits from REDD in community managed forest* - provides procedures for avoided deforestation and degradation projects. At the time of writing, it is the sole GHG accounting tool referenced in PU002.

This tool provides a pragmatic approach to baseline assessment and GHG accounting for forest conservation projects. Thus, it is proposed that the procedures outlined in PT002 are used for the mangrove conservation module, with the following adaptations and clarification to ensure consistency and ease of applicability.

Suggested adaptations to PT002

Baseline scenario: To prepare for procedures later in the module, particularly those related to emission factors, projects will be required to conduct social research to establish pre-project drivers of deforestation in the project area. At a minimum, these are to be categorised as agriculture/aquaculture, clearing, erosion, extreme climate, and settlement. But projects wishing to define their own emission factors have the option to define the drivers in more detail.

If more than one driver exists, the relative importance of each driver, in terms of % of annual forest loss caused by each driver in the ten years prior to the project start, will also need to be defined. This can be done through social research, analysis of land cover change in Google Earth or remote sensing analyses.

Reference region: To improve standardisation and acknowledge the fact that mangroves are included in some countries' FRELs, the reference region will be standardised as follows for all projects:

- for projects in countries with less than 200,000 ha of mangroves at the project start date, the national boundary will form the reference region.
- projects in countries with more than 200,000 ha of mangroves may also use the national boundary as their reference region. But they will also have the option of choosing the largest administrative unit below the national boundary (for instance, *Provinsi*/Province in the case of Indonesia).

Clear justification will be required from projects choosing to use the largest administrative unit below the national boundary. The impact of the 200,000 ha cut off can be found in Annex 3.

For expected baseline emissions, the reference region will include the project area. However for actual baseline emissions, the reference region will exclude the project area.

$\mathbf{A_{Def}}$ and $\mathbf{AA_{Def}}$: To simplify and standardise procedures, all projects will be able use Global Mangrove Watch[4] (GMW) to estimate the baseline mangrove deforestation trends. GMW recently added a tool

[4] https://globalmangrovewatch.org/

to allow historical analysis over user-defined areas. But projects which stratify their project area, and/or find GMW inaccurate and/or choose to account for degradation can use other remote sensing data to estimate baseline mangrove deforestation or degradation. The required overall accuracy of the maps will be 90%. The GEM[5] tool will be available for projects looking to do this.

Projects using GMW for measuring and monitoring baseline deforestation must also use GMW for monitoring changes in forest within the project area (D_{PA}).

T_{RP}: The length of the reference period will be set to 10 years. Projects using GMW must use the most recent 10 years of GMW data available. Thich is currently 2010-2020, but the creators of GMW have provided assurances that this will be updated over the coming months. For projects using their own remote sensing data, the reference period should be the 10 years prior to the project start date ±3 years (for instance if a project starts in 2024, the reference period could be 2011-2021). This is to acknowledge the fact that remote sensing analyses may be done as part of a feasibility assessment several years before the actual project start date.

C_i-C_{NF}: It is proposed that all projects have the option to use default per hectare carbon stocks and emission factors for each carbon pool. So this would become EF*C_i where EF is an emission factor, based on the drivers of deforestation in the project area.

The IPCC default values will be used for above- and below-ground woody biomass carbon stocks. For soil carbon stocks, it is proposed that the data in Sanderman et al., 2018[6] is used. This data is freely available as a raster dataset, so projects could easily calculate average SOC stocks in the top 1m within their project area.

For the emission factors, it is proposed that those in Adame et al., 2021[7] are used. See Table S2. There are emission factors for a variety of drivers of mangrove deforestation (agriculture/aquaculture; clearing; erosion; extreme climate; and settlement) for each marine province. Projects use the information derived regarding the baseline scenario to determine which drivers are relevant in the project area.

These emission factors were derived from Sasmito et al., 2019[8]. Dr. Sasmito kindly provided the data collated in this publication and an uncertainty assessment has been completed using the procedures detailed in PU005. The uncertainty ($U_{v,T}$) was calculated to be 7.19%, thus the approach does not require a deduction for uncertainty.

Projects looking to define their own carbon stock values and/or emission factors can use peer-reviewed published literature and will be pointed towards the Coastal Blue Carbon Manual[9] for guidance regarding field measurements.

Project cannot use the default values to calculate baseline emissions (i.e. equation 6 in PT002) and then project specific-values to calculate their avoided emissions in the with-project scenario (i.e. equation 8), or vice versa. If default values are used in one situation they must be used in both.

Leakage: Leakage will be dealt with using the discount factor procedures in PU004.

[5] https://blueventures.org/what-we-do/climate-solutions/blue-forests/gem/
[6] https://iopscience.iop.org/article/10.1088/1748-9326/aabe1c/meta
[7] https://onlinelibrary.wiley.com/doi/full/10.1111/gcb.15571#gcb15571-bib-0015
[8] https://onlinelibrary.wiley.com/doi/10.1111/gcb.14774
[9] https://www.thebluecarboninitiative.org/manual

Table S2 From Adame et al., 2021, showing the emission factors (described as a percentage of carbon stock change) for different mangrove deforestation drivers in each marine province. To calculate estimated/actual emissions, a project should provide initial carbon stocks for each carbon pool, which can be obtained from Sanderman et al 2018 or locally generated data.

Marine Province	**Agriculture/aquaculture**				**Erosion**			**Clearing**				**Extreme Climate**			**Settlement**		
	ABG	Tier	SOC	Tier	ABG	SOC	Tier	ABG	Tier	SOC	Tier	ABG	SOC	Tier	ABG	SOC	Tier
Agulhas	0.83	1	0.52	1	1	1	1	0.70	1	0.21	3	0.31	0.14	1	1	0.66	1
Andaman	0.90	2	0.27	3	1	1	1	0.88	3	0.45	3	0.31	0.14	1	1	0.66	1
Bay of Bengal	0.83	1	0.52	1	1	1	1	0.70	1	0.33	1	0.31	0.14	1	1	0.66	1
East Central Australian Shelf	0.83	1	0.52	1	1	1	1	0.70	1	0.33	1	0.31	0.14	1	1	0.66	1
East Coral Triangle	0.83	1	0.52	1	1	1	1	0.70	1	0.33	1	0.31	0.14	1	1	0.66	1
Gulf of Guinea	0.83	1	0.52	1	1	1	1	0.70	1	0.33	1	0.31	0.14	1	1	0.66	1
North Brazil Shelf	0.97	2	0.67	3	1	1	1	0.70	1	0.33	1	0.31	0.14	2	1	0.66	1
Northeast Australian Shelf	0.83	1	0.52	1	1	1	1	0.70	1	0.33	1	0.31	0.14	1	1	0.66	1
North New Zealand	0.83	1	0.52	1	1	1	1	1.00	3	0.33	1	0.31	0.14	1	1	0.66	1
Northwest Australian Shelf	0.83	1	0.52	1	1	1	1	0.70	1	0.33	1	0.31	0.14	1	1	0.66	1

Red Sea and Gulf of Aden	0.83	1	0.52	1	1	1	1	0.70	1	0.33	1	0.31	0.14	1	1	0.66	1
Sahul Shelf	0.90	2	0.27	3	1	1	1	0.88	3	0.45	3	0.31	0.14	1	1	0.66	1
Somali/Arabian	0.83	1	0.52	1	1	1	1	0.88	2	0.45	2	0.31	0.14	1	1	0.66	1
South China Sea	0.83	1	0.52	1	1	1	1	0.88	3	0.45	3	0.31	0.14	2	1	0.66	1
Southeast Australian Shelf	0.83	1	0.52	1	1	1	1	0.88	3	0.45	3	0.31	0.14	1	1	0.66	1
Southern New Zealand	0.83	1	0.52	1	1	1	1	1.00	2	0.60	3	0.31	0.14	1	1	0.66	1
Southwest Australian Shelf	0.83	1	0.52	1	1	1	1	0.88	2	0.45	2	0.31	0.14	1	1	0.66	1
Sunda Shelf	0.90	2	0.27	3	1	1	1	0.88	3	0.45	3	0.31	0.14	1	1	0.66	1
Tropical East Pacific	0.83	1	0.52	1	1	1	1	0.88	2	0.45	3	0.31	0.14	1	1	0.66	1
Tropical Northwestern Atlantic	0.76	2	0.46	3	1	1	1	0.88	2	0.45	2	0.31	0.14	1	1	0.66	1
Warm Temperate Northeast Pacific	0.83	1	0.52	1	1	1	1	0.88	2	0.45	2	0.31	0.14	1	1	0.66	1
Warm Temperate Southwestern Atlantic	0.97	2	0.67	3	1	1	1	0.88	3	0.45	3	0.31	0.14	1	1	0.66	1

West African Transition	0.83	1	0.52	1	1	1	1	0.88	2	0.45	2	0.31	0.14	1	1	0.66	1
West and South Indian Shelf	1.00	2	0.45	3	1	1	1	0.88	2	0.45	2	0.31	0.14	1	1	0.66	1
West Central Australian Shelf	0.83	1	0.52	1	1	1	1	0.88	2	0.45	2	0.31	0.14	1	1	0.66	1
Western Coral Triangle	0.90	3	0.27	2	1	1	1	0.88	3	0.45	3	0.31	0.14	1	1	0.66	1
Western Indian Ocean	0.83	1	0.52	1	1	1	1	0.70	3	0.21	3	0.31	0.14	1	1	0.66	1

Annex 2 – simplified mangrove restoration procedures – baseline deduction and monitoring

Annex 2 includes a presentation deck explaining the proposed baseline deduction and monitoring for the mangrove restoration simplified procedures. It can be found following this link: simplified mangrove restoration procedures – baseline deduction and monitoring.

Annex 3 – GMW Mangrove Extents by Country

Countries highlighted in green show those above the 200,000ha threshold for the mangrove conservation module. Derived from Bunting et al., 2022[10]; Table A1.

Country	GMW 2.5 area (2010)
Indonesia	2,801,795
Brazil	1,081,106
Australia	988,842
Mexico	939,502
Nigeria	847,894
Malaysia	515,743
Myanmar	496,686
Papua New Guinea	445,785
Bangladesh	444,159
India	370,984
Cuba	332,816
Mozambique	298,841
Venezuela	275,325
Guinea−Bissau	262,631
Colombia	262,212
Philippines	260,993
Madagascar	260,271
Thailand	223,137
Guinea	222,286
United States	209,544
Cameroon	199,109
Gabon	176,632
Sierra Leone	160,038
Vietnam	157,028
Panama	153,337
Ecuador	146,544
Senegal	128,077

[10] https://www.mdpi.com/2072-4292/14/4/1034

Tanzania	107,775
Bahamas	93,139
Suriname	77,108
Nicaragua	73,988
Pakistan	63,600
Gambia	60,673
Honduras	59,732
French Guiana	59,466
Cambodia	58,517
Solomon Islands	55,519
Kenya	52,888
Fiji	49,984
Belize	44,507
El Salvador	37,589
Costa Rica	36,475
New Caledonia	33,593
New Zealand	30,216
Angola	28,969
Guyana	28,640
Equatorial Guinea	25,904
Democratic Republic of the Congo	24,017
Guatemala	23,523
Ghana	20,021
Sri Lanka	18,941
Liberia	18,938
Dominican Republic	18,741
Haiti	14,432
China	14,221
Brunei	11,491
Turks and Caicos Islands	10,420
Jamaica	9,411
Micronesia	9,084
Puerto Rico	8,685

Trinidad and Tobago	7,696
Iran	7,587
Eritrea	6,918
United Arab Emirates	6,759
Palau	6,014
Côte d'Ivoire	5,890
Saudi Arabia	5,367
Peru	4,569
Cayman Islands	4,148
Guadeloupe	3,713
Benin	3,390
South Africa	2,573
Somalia	2,253
Republic of Congo	2,063
Martinique	2,052
Vanuatu	1,724
Yemen	1,314
Tonga	1,193
Timor−Leste	957
Japan	918
Antigua and Barbuda	863
Mayotte	702
French Southern Territories	672
Djibouti	545
Singapore	534
Sudan	433
Qatar	428
Seychelles	385
Mauritius	345
Samoa	264
Virgin Islands, U.S.	197
Grenada	190
Mauritania	177

Bonaire, Sint Eustatius and Saba	165
Saint Lucia	164
Taiwan	159
Egypt	147
Kiribati	135
French Polynesia	122
Oman	111
Comoros	99
Maldives	97
British Virgin Islands	83
Bahrain	59
Guam	57
American Samoa	33
Saint Vincent and the Grenadines	31
Wallis and Futuna	29
Saint Kitts and Nevis	28
Aruba	26
Togo	21
Barbados	14
Saint−Martin	14
Tuvalu	9
Bermuda	8
Curaçao	7
Marshall Islands	6
Cook Islands	3
Dominica	2
Anguilla	1
São Tomé and Príncipe	0