ASES ON-CHAIN PROTOCOL

METHODOLOGY FOR ASSESSING THE IMPACT ON BIODIVERSITY

IV. Methodologies V1.0

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On-Chain Protocol

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INTRODUCTION

The carbon market has centered on degraded habitats that require funding to be protected and repaired from the consequences of climate change, and the areas that need to preserve biodiversity but exhibit signs of degradation, deforestation or disturbance have typically gone unnoticed by the market. This approach intends to offer a brand-new source of funding for international biodiversity conservation initiatives.

Every project funded by the OCP program must include biodiversity preservation and protection as a fundamental element. As a result, this approach should be applied in programs devoted to regenerative agriculture, forest management, urban forest management, and water flow restoration.

The methodology allows for the calculation of the ecosystem's negative entropy using the Diversity Index (H) in the Project area with the goal of determining how the Project's activities will affect the species and habitats that are already present. The methodology should be used over three time periods: before the Project begins, after the Project has finished its activities and during the first year of its existence.

In the context of complexity, biodiversity refers to the amount and variety of various living forms and interactions present in an ecosystem. The greater an ecosystem's biodiversity, the greater its complexity and resilience. This is due to the fact that diverse species and interactions provide multiple paths for energy and nutrient input, which aids in maintaining ecosystem function even when certain components are absent.

The diversity index will assist the Verifiers in evaluating the Project's conformity with principles 3, 4, 6, and 7 of the aOCP Program in a technical and objective manner:

- **Principle 3:** Institutional structure for developing standards (baseline and monitoring(to mitigate GHGs, enhance biodiversity and restore water flows);
- **Principle 4:** Robust project cycle including a transparent and streamlined project registry and issuance of carbon, biodiversity and water-related credits;
- **Principle 6:** Environmentally and socially harmlessness of all projects;
- **Principle 7:** Recognition of the project´s contribution to the achievement of the UN SDGs.

The diversity index's calculation will assist in demonstrating at various stages of the Project that its operations are conserving and protecting species and their ecosystems as well as creating new habitats.

In order to meet the requirements of the Applicability conditions, the Project Proponent shall also prepare an analysis to determine the degree of deterioration currently present in the Project area and identify the agents that have generated it (as indicated in section II).

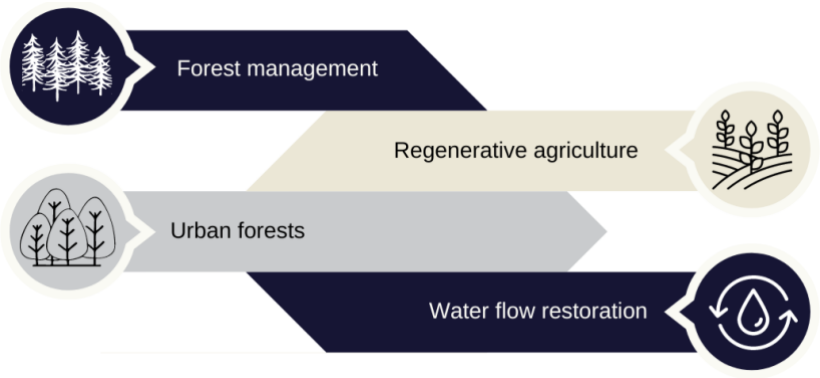
I. DEFINITIONS

- **Degradation:** The persistent reduction of canopy cover and/or carbon stocks in a habitat due to human activities such as animal grazing, fuelwood extraction, timber removal or other such activities, but that does not result in the conversion of forest to non-forest land, and falls under the *IPCC 2003 Good Practice Guidance land category of forest remaining forest*. Under this methodology, poaching of keystone species that inhabit the project area is also considered degradation.
- **Deforestation:** Is the purposeful clearing of forested land. Throughout history and into modern times, forests have been razed to make space for agriculture and animal grazing, and to obtain wood for fuel, manufacturing, and construction.
- **Restoration:** The act of restoring to a former state or position, or to an unimpaired or perfect condition.
- **Ecosystem:** A geographic area where plants, animals and other organisms, as well as weather and landscape work together to form a bubble of life. Ecosystems contain biotic, or living parts, as well as abiotic factors, or nonliving parts.
- **Habitat:** It is defined as the environment where the species develops, which may vary regionally depending on the needs of the individuals.
- **Biodiversity:** Refers to the range of life forms present in an ecosystem, including the diversity of species, genetic variation within species, and ecological roles and interactions. This notion is frequently employed to evaluate the complexity and health of an ecosystem. Entropy is a measure of a system's disorder and randomness. Entropy can be conceived of as the loss of biodiversity and complexity in ecosystems. When biodiversity is lost in an environment, the remaining species and interactions become more predictable and less robust. This can result in a reduction in ecosystem function and a heightened risk of ecological collapse. Margalef's concept of negative entropy of ecosystems implies that biodiversity functions as a buffer against entropy and that ecosystems with high biodiversity tend to be more resilient and stable with time. Consequently, biodiversity is essential to the long-term health and sustainability of ecosystems.

II. APPLICABILITY CONDITIONS

The following conditions apply to the methodology:

a) The type of Project is:



For complementary information see Table 1.

b) The Project complies with the standards of the aOCP Program;
c) The Project was developed less than 24 months ago;
d) The Project activities exclusively focus on conservation, protection and restoration of ecosystems, with no conversion to non-native habitat / land use (i.e. conversion of forest to agriculture land);
e) The Project area has not been deforested in the last 24 months or degradation is in progress and restoration is urgently needed;
f) If a project area does not meet requirement "e," the project proponent must offer a technical reason arguing that ecological restoration is necessary because the area's biodiversity and environmental services are vulnerable;
g) The Project embeds local communities into the project activities to ensure local knowledge and cultures are applied within the project activities;
h) The biodiversity of the project area is vulnerable to degradation or perturbation if not conserved;
i) The Project shall design and implement strategies to remove or manage invasive species from within the project area;

If project activities are to be carried out, the project must also abide by the following applicable conditions in addition to the ones mentioned above:

a) Vegetation planted as part of the activities is native to the project area;
b) The creation of new habitats considers species present in the ecosystem of the project area.

III. METHODOLOGICAL CONSIDERATIONS

III.1. APPLICATION OF METHODOLOGY

The projects included in the following table should apply the methodology for assessing the impact on biodiversity since they would either directly or indirectly benefit local ecosystems and, consequently, flora and fauna:

TABLE 1. APPLICATION OF METHODOLOGY BY PROJECT

Type of project	Use of methodologies			
	Carbon in vegetation	GHG emission	Biodiversity	Water
Regenerative agriculture			✓	
Forest management			✓	
Silvopastoral				
Urban forest			✓	
Water flow restoration			✓	

III.2. METHODOLOGY PARAMETERS

The methodology's parameters and the factors that will be taken into account when using it are listed in the following table:

TABLE 2. PARAMETERS OF THE METHODOLOGY

Parameters	Index	Explanation
Biodiversity	Species richness	Indicate the number of species in a community.
	Shannon-Wiener Diversity Index (H)	Is a mathematical measure of species diversity in a given community.
	Equitability index (J)	Ratio of observed diversity to maximum expected diversity.

III.2.1. COLLECTION OF DATA SOURCES

The Project Proponent must conduct an inventory of the flora and fauna in the study region in order to calculate the diversity index, which includes the species richness, diversity, maximum potential diversity, and equitability index.

The inventory should be done on-site identifying the types of plants and animals (birds, mammals, reptiles, amphibians, fish, insects, etc.) that are present for each ecological community, as well as keeping track of how many of each species are present at any given time (Table 3).

TABLE 3. REGISTER FOR SPECIES COUNT

No.	Area of study *(Project or buffer area)*	Group *(Flora or fauna)*	Species		Number of individuals
			Scientific name	Common name	
1					
n					

IV. BASELINE SCENARIO

According to the application requirements, Project Proponents must show that the project area has not been deforested in the previous 24 months and that, if biodiversity is not maintained, it will degrade or be perturbed.

When this condition is not applicable, the technical justification set forth in section II, subsection “F” must be provided.

IV.1. AREA HAS NOT BEEN DEFORESTED

The project proponent must show that the region has not been deforested in the previous 24 months by an analysis of satellite imagery. A current aerial photograph of the project site and one from two years ago that fulfill the same requirements for resolution and coverage must be used for this purpose.

TABLE 4. DATA USED FOR LANDSCAPE STRUCTURE ANALYSIS

Vector (Satellite or drone)	Sensor Name	Resolution		Coverage	Acquisition date	Source or point identifier	
		Spatial	Spectral	M^2	(DD/MM/YY)	Path Latitude	Row Longitude

With both satellite images, a supervised classification should be performed to obtain the spectral signature and identify the trajectory of the forest cover. This will determine that the vegetation has not undergone changes due to deforestation in the period analyzed.

The area identified with deforestation should be digitized and located using polygons to estimate the area affected, and depending on the eligibility criteria, these area should be excluded from the Project area.

IV.2. VULNERABILITY TO DEGRADATION

The study area's forest cover will be evaluated using the findings from section IV.1 in order to determine its current condition and the impact it has on the existence of fauna (birds, mammals, reptiles, and amphibians) and flora. To do this, it is first necessary to identify the species that may have a range in the project region using bibliographic information.

IV.2.1. POTENTIAL DISTRIBUTION SPECIES

Species with a likely distribution in the project region will be identified using the most recent official bibliographic data; this will allow for advance knowledge of the species that might be recorded during the inventory in the project area. The IUCN Red List should be used for classifying species.

Additionally, the information from section IV.1 will be used to identify the disruption to the wildlife caused by deforestation activities, identifying those species with high ecological value.

IV.2.2. IDENTIFICATION OF AGENTS OF DEGRADATION

Should be determine the primary agents of degradation (farmers, ranchers, loggers, etc.) and the importance of each group (i.e. the amount of historical land-use change that can be attributed to each of them). Use current studies, remote sensing, expert consultations, field surveys, and other reliable information sources as necessary to carry out this identification.

It may be advantageous to stratify the reference region, the project area, and to continue the baseline assessment for each stratum I independently if the relative importance of different agents is geographically associated (for example, small farmers are concentrated in the hills, whereas ranchers on the plains).

For each identified agent group, provide the following information:

1. Name of the main agent group or agent, and whether they area responsible for degradation and/or perturbation;
2. Brief description of the main social, economic, cultural and other relevant features of each main agent group. Limit the description to aspects that area relevant to understand why the agent group is degrading and/or perturbing the biodiversity;
3. Brief assessment of the most likely development of the population size of the identified main agent group in the reference region and Project area;
4. Statistics on historical degradation and/or deforestation attributable to each main agent group in the reference region and project area.

IV.2.3. DEGRADATION LEVEL

The projects must show that the reference region contains the minimal level of degradation, as shown below:

TABLE 5. REFERENCES FOR THE THRESHOLD OF DEGRADATION

Criteria	Classification	Level			
		Critical	High	Medium	Low
Deforestation	More than 70% of the Project area is deforested	✗			
	Between 30% and 70% of the Project area is deforested		✗		
	Between 10% and 30% of the Project area is deforested.			✗	
	Less than 10% of the Project area is deforested.				✗
Fauna	More than 70% of the fauna species is recorded as “Vulnerable” or on the IUCN Red List.	✗			
	Between 40% and 70% of the fauna species is recorded as “Vulnerable” or on the IUCN Red List.		✗		
	Between 10% and 40% of the fauna species is recorded as “Vulnerable” or on the IUCN Red List.			✗	
	Less than 10% of the fauna species is recorded as “Vulnerable” or on the IUCN Red List.				✗
Flora	More than 70% of the flora species is recorded as “Vulnerable” or on the IUCN Red List.	✗			
	Between 40% and 70% of the flora species is recorded as “Vulnerable” or on the IUCN Red List.		✗		

Criteria	Classification	Level			
		Critical	High	Medium	Low
	Between 10% and 40% of the flora species is recorded as “Vulnerable” or on the IUCN Red List.			✗	
	Less than 10% of the flora species is recorded as “Vulnerable” or on the IUCN Red List.				✗
Degradation agents	More than 5 degradation agents were identified in the Project area	✗			
	3 or 4 degradation agents were identified in the Project area		✗		
	1 or 2 degradation agents were identified in the Project area.			✗	
	No degradation agents were identified in the Project area.				✗

The analysis should come to a conclusion regarding the main threats to the project area, the effects of earlier conservation efforts within the project area, and what steps need to be taken to address the threats that have been identified.

V. QUANTIFICATION

In order to measure the benefits to biodiversity from Project, the Proponent shall quantify index of diversity in three stages:

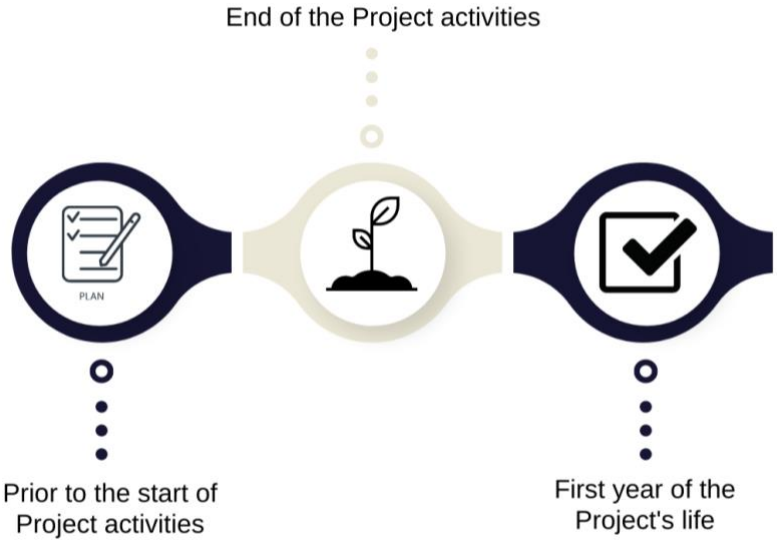


FIGURE 1. STAGES OF PROJECT QUANTIFICATION

To accomplish this the project proponent must conduct a baseline survey of the plant and animal species present in the project region (Table 3) and calculate the biodiversity index before project activities begin (see section V.1). The species must be re-invented and the diversity index must be determined after the Project's activities, taking the newly planted individuals into account (in the case of a Project that considers reforestation activities).

And after the first year of the project's life, the inventory should be carried out again, considering flora and fauna, in order to obtain the third biodiversity index.

The biodiversity index reflects the heterogeneity of a community based on two factors: the number of species present and their relative abundance. The maximum potential diversity (Hmax= lnS) depends on the number of species present in the community, the more species there are, the higher the maximum potential diversity, and is reached when all species are equally represented.

An index of homogeneity, also called equitability, associated with this measure of diversity can be calculated as the ratio H/Hmax, which will be equal to 1 if all the species that compose the community have the same number of individuals.

The methodology to be followed for the calculation of the biodiversity index is presented below.

V.1. BIODIVERSITY INDEX

A diversity index is a mathematical measure of the diversity of species in a community. Diversity indices provide more information about community composition than simply species richness (e.g., the number of species present), but also the relative abundances of the species.

The Shannon-Wiener diversity index expresses the uniformity of importance values across all species sampled. It measures the degree, on average, of uncertainty in predicting to which species a randomly chosen individual from a collection will belong.

This index was developed to measure the amount of information that can be transmitted in a code, for example, in telephone signals (Shannon and Wiener, 1949). Shannon's index indicates that all individuals that are randomly sampled at the time of sampling represent everyone in the community. This index is described for indefinitely large communities that cannot be studied in their entirety, results are an estimated value.

The calculation formula is as follows:

$$H = -\sum_{i=1}^{S} \quad Pi \; log_2 \; Pi$$

Where:

- **H =** Diversity index
- **S =** Number of species
- **Pi =** Total proportion of the sample corresponding to species i
- **Log 2 =** Logarithm of base 2

$$Pi = \frac{ni}{N}$$

Where:

Ni = Number of individuals of the species

N = Total number of individuals of all species

V.1.1. PIELOU´S EQUITY INDEX

This index measures the proportion of observed diversity in relation to the maximum expected diversity and should be calculated in parallel. Its value ranges from 0 to 1, so that 1 corresponds to situations where all species are equally abundant.

$$J = \frac{H}{H_{max}}$$

Where:

H **=** Diversity

H_{max} **=** Maximum diversity

VI. MONITORING

Monitoring considers two steps: the data and parameters that will be used by the Verifier to review the Project and the temporality in which the activities must be carried out.

VI.1. DATA AND PARAMETERS CONSIDERED IN THE VERIFICATION

The results of the Project's impact on biodiversity in the stages: before and post activities, as well as the information capture forms on site, will be the data that will be verified by the aOCP Expert Panel. The following factors must be taken into account by the project's proponent:

TABLE 6. PARAMETER CONSIDERED IN THE VERIFICATION

Parameter	H (Diversity index)
Description	The biodiversity index should show an increase due to Project activities.
Equation	$H = -\sum_{i=1}^{S} Pi \log_2 Pi$
Source of data	Information captured during the inventories in the Project area (as described in section III.2.1.)

Justification of choise of data	Knowing the impact of the Project on local biodiversity ensures compliance with principles 3, 4, 6 and 7 of the aOCP Program.
Purpose of data	To know the biodiversity index before and after the Project.
Stage to be realized	Pre- and post- Project activities

VI.2. TEMPORALITY

TABLE 7. SCHEDULE OF ACTIVITIES

Activity	Temporality		
	Prior to the start of the Project	**End of the Project activities**	**First year of the Project's life**
Inventory of fauna (birds, mammals, reptiles and amphibians)	✓		✓
Inventory of flora	✓	✓	✓
Calculation of Biodiversity Indexes for fauna	✓	✓	✓
Calculation of Biodiversity Indexes for flora	✓	✓	✓

The diversity index for fauna should be generated prior to the start of the project and one year after the conclusion of the activities. While for flora, the inventory and calculation of diversity index should also be carried out in the end of the Project activities.

VII. SECTORAL SCOPE APPLICABLE TO AOCP VALIDATOR/VERIFIER

The verifiers that will review and verify the results of the Project's impact on local biodiversity will be those that comply with the competencies established in section VII.3.3. of the Procedure for Approval of aOCP Validator and Verifiers (as show in Figure 2), and specifically those that comply with the **Accreditation of Biodiversity** course.

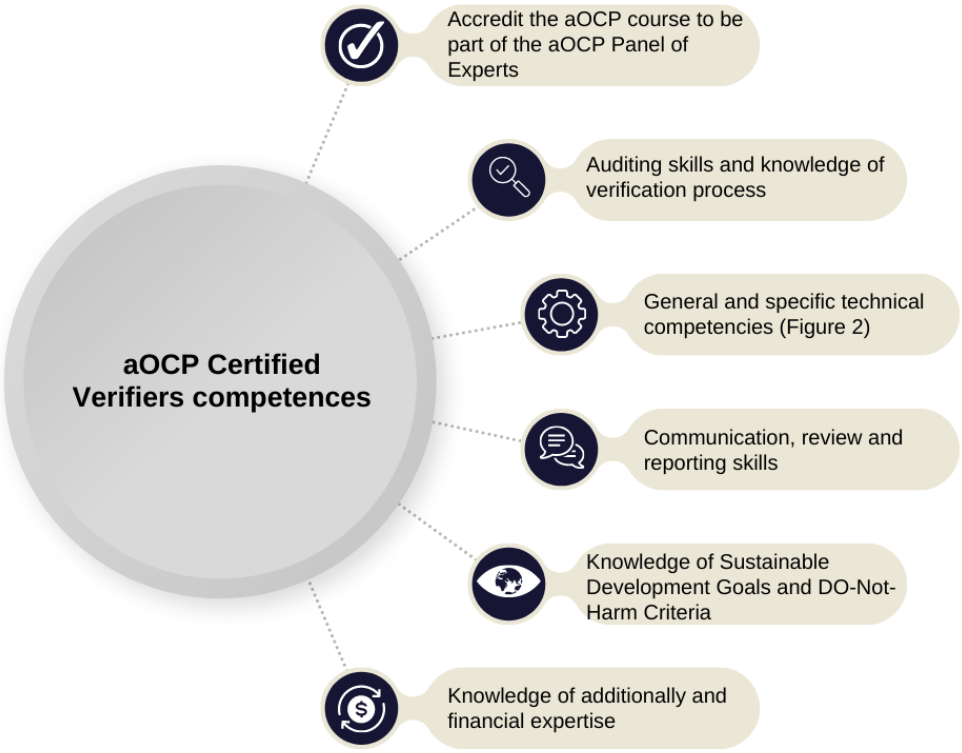


FIGURE 2. AOCP CERTIFIED VERIFIERS COMPETENCES

DOCUMENT HISTORY		
Version	**Date**	**Comments**
V1.0	10/01/2023	• Initial version released for review by the aOCP Steering Committee under the aOCP Version 1.