



2026

BASELINE REPORT

VERIFIED BIODIVERSITY-BASED CREDITS (VBBC)

SB-001-14072025 PROVINCE DE GUARCIF, ORIENTAL, MAROC

Samir Benhalima
Guercif, Morocco

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EXECUTIVE SUMMARY

The baseline report of the projects is a necessary activity for their certification since it will allow for establishing the initial parameter of the area through the NDVI index, which is an indicator used to evaluate the vegetation and the health of the plants, thus allowing us to establish the scenario prior to the planting activities. It will also be the comparative basis for the quarterly monitoring of the project, which will be prepared following the "*aOCP Methodology for satellite monitoring of projects V2.0*". In addition, the Baseline report allows for establishing the number of credits to which each project may aspire according to the characteristics of the project that has been developed and based on the aOCP calculation Methodologies.

The restorative agriculture project in Guercif, Morocco entailed planting a total of 3,520 trees, representing six distinct species mainly native to the region and well-suited for adverse environmental conditions. The primary objective of this initiative was to enhance biodiversity, improve soil quality, improve ecological conditions, and provide resources to landowners. The total project area covers 10.12 hectares.

The actions implemented by the project will enable the removal of a total of 1,830.99 tonnes of carbon over its estimated 40-year lifespan, directly contributing to climate change mitigation. In addition, the project will generate **2,806 Verified Biodiversity-Based Credits (VBBC)** annually, because of the sustained benefits it delivers through the restoration and strengthening of biodiversity within the intervention area. These outcomes reflect the project's positive impact from both climatic and ecological perspectives, consolidating it as a high-value environmental initiative in the region over the long term.





I. PROJECT DESIGN

This section is based on the information compiled in the PSF Format - Project Submission Form prepared by the project developer.

I.1. PROJECT LOCATION

The project is in Guercif, Morocco, covering a total area of 10 hectares. Of this, 9 hectares are designated as active reforestation zones, while the remaining hectare is allocated for the cultivation of seasonal vegetables and herbs. A map of the project location is presented in Figure 1, and Table 1 provides the central coordinates of the site.

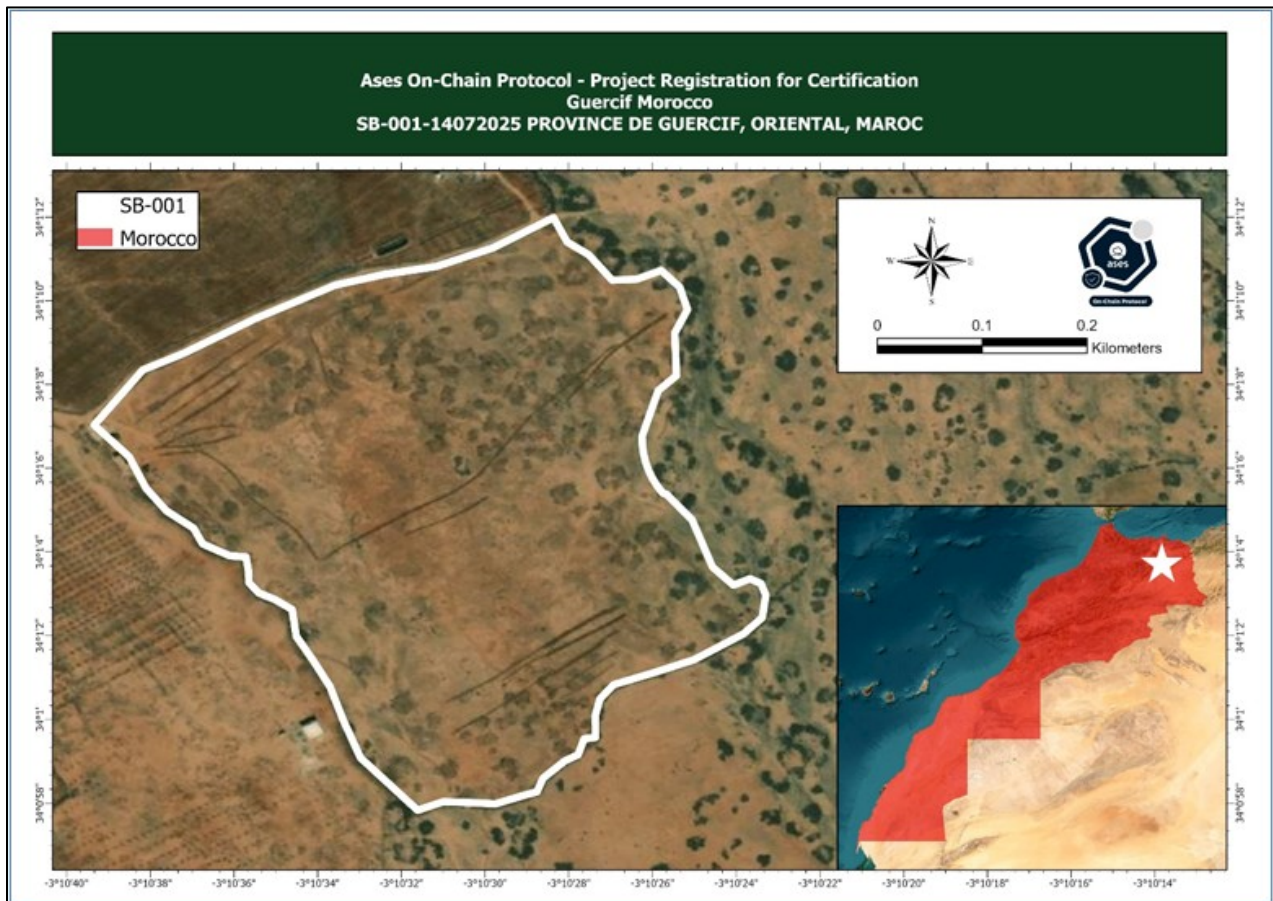


FIGURE 1. PROJECT LOCATION



TABLE 1. LOCATION OF PROJECT PLOT

Plot	Coordinates	
	Latitude	Longitude
1	34.0180583°N	3.1750787°W

I.2. ADMINISTRATIVE SPECIFICATIONS

This section introduces the project developer and provides a clear understanding of the roles and responsibilities assigned to each party involved. It also addresses the status of landownership, ensuring transparency and certainty regarding the agreements made with the landowners.

I.2.1. PROJECT DEVELOPER

Project Key	SB-001-14072025 PROVINCE DE GUERCIF, ORIENTAL, MAROC
Title of the project activity	Guercif Morocco
Company	Samir Benhalima
Person responsible	Samir Benhalima

I.2.2. TYPE OF PROJECT

Project registration year	2026
Project duration	40 years
Issuance of credits	Annual to 10 years
Methodology applied	<i>Methodology for the issuance of verified biodiversity credits V3.0¹</i>
Type	<input type="checkbox"/> Forest management <input checked="" type="checkbox"/> Regenerative agriculture <input type="checkbox"/> Silvopastoral management <input type="checkbox"/> Individual tree-based climate action / urban forest <input type="checkbox"/> Water flow restoration <input type="checkbox"/> Biochar

¹ <https://www.nat5.bio/wp-content/uploads/2023/12/aOCP-Methodology-for-biodiversity-assessment-V2.0.pdf>



I.2.3. VNPCs THE PROJECT IS APPLYING TO

Type of VNPCs the project is applying for	<input type="checkbox"/> Verified Carbon Credits (VCC) <input checked="" type="checkbox"/> Verified Biodiversity Based Credits (VBBC) <input type="checkbox"/> Verified Water Credits (VWC) <input type="checkbox"/> Verified Soil Credits (VSC)
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II. PROJECT AREA BASELINE

The project area is in an arid region of northern Morocco, characterized by low and irregular rainfall, high evapotranspiration, and generally poor soil fertility. Despite these challenging conditions, agriculture remains a key livelihood activity in the region. Traditional practices, particularly the cultivation of olive trees, are commonly observed around the project site, alongside other small-scale agricultural activities such as almond, fig, and citrus farming. These crops are typically chosen for their resilience to dry conditions and their economic importance to local farmers. Livestock grazing and seasonal vegetable cultivation are also practiced in surrounding areas, often relying on limited water resources. The implementation of this project aligns with regional agricultural traditions while introducing regenerative practices and improved water management systems, such as drip irrigation and rainwater harvesting, to enhance land productivity and climate resilience.

II.1. ECOLOGICAL ADDITIONALITY

II.1.1. SPECTRAL RESPONSE

When solar radiation interacts with an object, one of three situations can occur, either individually or in combination:

- **Reflection:** The radiation can bounce off the object partially or entirely, resulting in reflection.
- **Absorption:** The object can absorb the radiation, taking in its energy.
- **Transmission:** Radiation can pass through one object and reach another, known as transmission.

The extent to which radiation is reflected, absorbed, or transmitted depends on the specific physicochemical characteristics of the objects involved. However, for object identification purposes, our primary interest lies in the reflected light or radiation at different wavelengths. For instance, vegetation exhibits low reflectance in the visible range, but the presence of chlorophyll in plants increases reflectance in the green channel. On the other hand, plants demonstrate the highest reflectance in the near-infrared region of the electromagnetic spectrum.



II.1.1.1. Index

Vegetation indices (VI) are extensively employed for monitoring and detecting changes in vegetation and land cover. These indices are created by considering the contrasting absorption, transmittance, and reflectance of energy by vegetation across the red and near-infrared portions of the electromagnetic spectrum. Numerous studies have demonstrated that the Normalized Difference Vegetation Index (NDVI) is particularly resilient against the influence of topographic factors. NDVI is commonly utilized as a broad indicator of photosynthetic activity in plants and the corresponding aboveground primary production.

The calculation of NDVI was performed using Sentinel-2 satellite images in the Google Earth Engine platform. Images with less than 20% cloud cover were selected for each month. The assessment focused on the average monthly NDVI time series spanning from January 2020 to December 2025. The NDVI analysis (Figure 2) indicates generally stable but low NDVI values from 2019 through late 2023, with most values fluctuating around 0.2 and showing little evidence of a long-term upward trend. A notable increase begins in early 2024, suggesting an improvement in vegetation health or coverage. This rise in NDVI corresponds with the reported start of planting activities during the same period (January 2024). Although monthly rainfall has varied over the years, NDVI remained relatively steady until this recent increase, implying that the observed improvement is likely attributable to project interventions.

Given the known information that a healthy, dense vegetation canopy typically exhibits NDVI values above 0.5, while sparse vegetation generally falls within the range of 0.2 to 0.5, the current assessment indicates that the reforestation project has potential in fostering an ascending trend in the plot's NDVI as it transitions to a less sparse and more densely forested and planted area. With the project in place, it is anticipated that the NDVI will continue to rise further, eventually reaching a level indicative of a healthy and thriving vegetation cover.

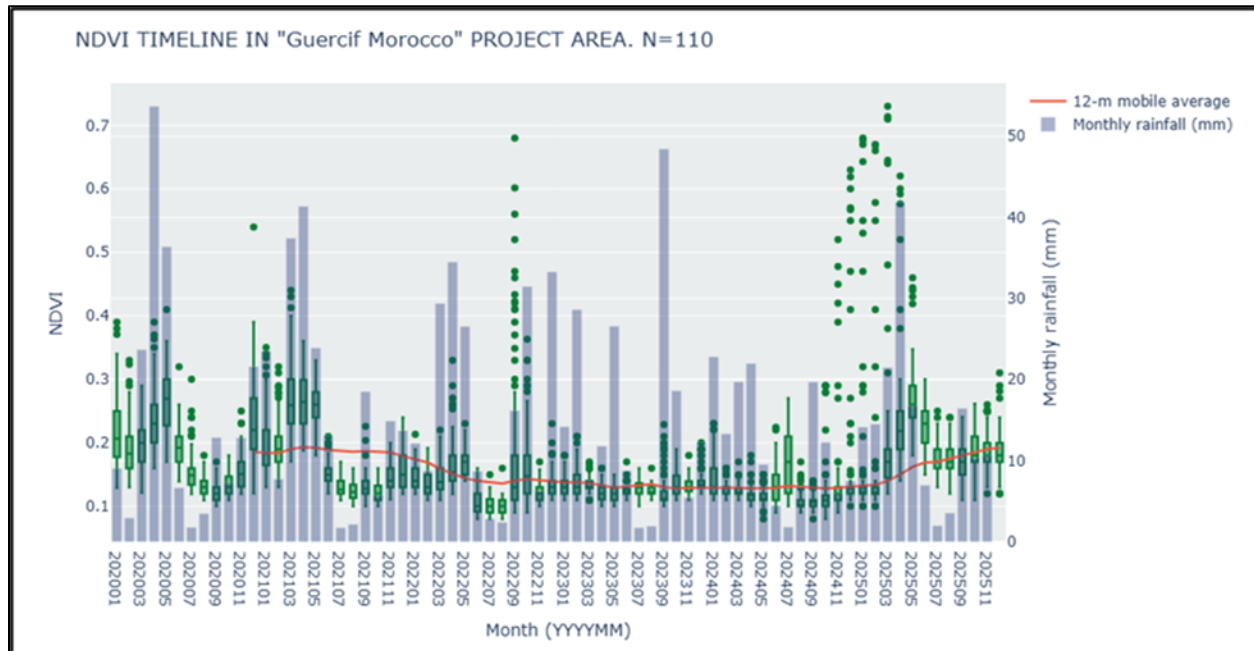
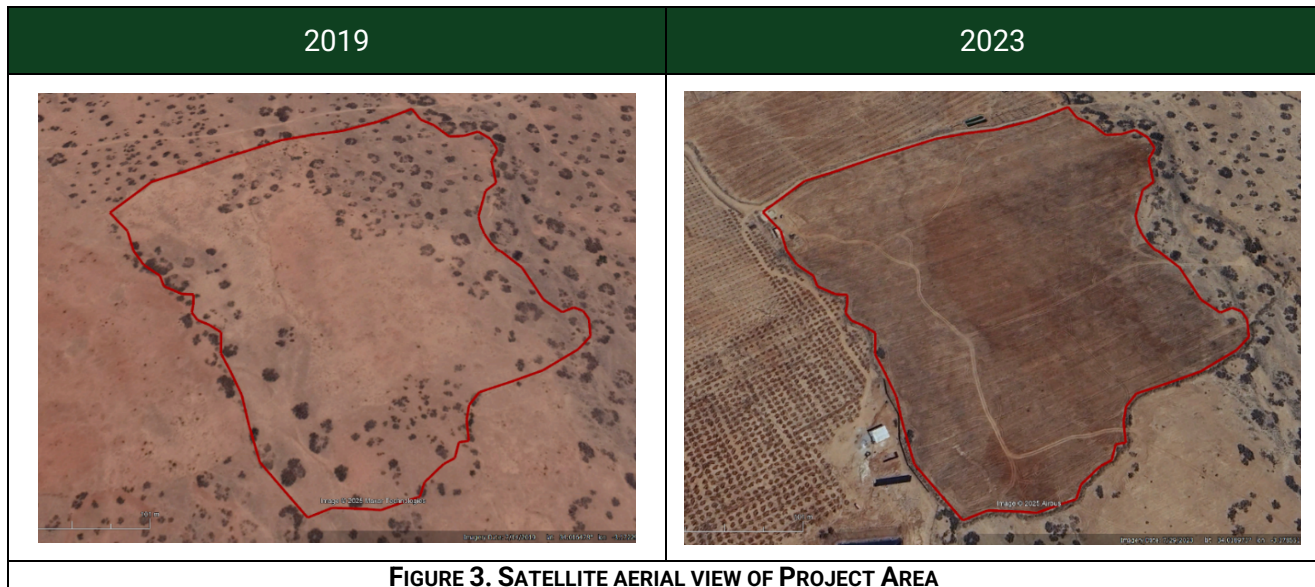


FIGURE 2. NDVI TIME-SERIES IN THE AREA OF INTEREST

II.1.2. IMPACT ON THE LANDSCAPE

The primary objective of the Guercif project in Morocco is to implement regenerative agriculture practices by cultivating olive trees alongside a variety of other fruit-bearing species, with a strong emphasis on promoting biodiversity over monoculture. As shown in Figure 3, satellite imagery of the project area from 2019 to 2023 captures notable changes in land use and management, despite being taken prior to the official project launch in early 2024. Evidence of early site development is visible as early as 2023, including the construction of additional buildings, improved road infrastructure, and the establishment of clearly defined planting zones in the southeastern portion of the project site. Within the project boundaries, signs of land preparations, such as vegetation clearing and site organization, suggest proactive management efforts in anticipation of project implementation.





III. TECHNICAL SPECIFICATIONS

III.1. BIODIVERSITY

Biodiversity is fundamental to maintaining the stability and functioning of ecosystems; each species plays a specific role in its habitat, interacting with other species and contributing to the health and resilience of the ecosystem. Loss of species can trigger ecological imbalances and have negative effects on the food chain and natural processes.

Biodiversity credits have been developed to address the problem of species loss by promoting their conservation and rewarding those who take positive actions for their creation.

Credits are generated through projects that encourage conservation or restoration, representing certain amounts of benefits. In the aOCP protocol, to calculate the benefit of the project and objectively estimate the number of credits, the actions taken in favor of biodiversity are evaluated based on three key variables:

- Area preserved
- Restored area
- Ecological condition of the intervened area

The method followed is an evaluation in which each of the variables is relativized. The relativization function is performed to assign a common scale between 0 and 1 to all the amplitude indices.

When the index has a positive relationship on the study variable with reference to the factor, the following expression is used:



$$\text{Relativization} = \frac{X - m}{M - m}$$

$$\text{VBBC} = \sum_{i=1}^{N_i} TS^*(F_{ij}) / 100$$

$$\text{VBBC} = \frac{TS^*(F1)*\beta_1 + (F2)*\beta_2 + (F3)*\beta_3 + \dots + (Fn)*\beta_n}{100 m^2}$$

Where:

X= Variable value to be relativized

m= Minimum variable value

M= Maximum variable value

The preserved areas variables correspond to the baseline of the project, analyzing the surface factor (in m²) and the diversity index factor through Shannon. The areas restored are those created thanks to the construction of the project and their measurement will also consider the surface area factor (in m²) and the diversity index factor measured with Shannon. Finally, the ecological condition variable of the intervened area is formulated by five factors that together will allow evaluation of the state of the ecosystem impacted by the project, considering the following:

- **Protection of key species:** Keystone species in an ecosystem are those that have a disproportionately large impact on their functioning and structure, despite their low numerical abundance. These species play fundamental roles in regulating ecological processes and maintaining balance in the ecosystem.
- **Fragmentation:** Landscape fragmentation refers to the division or separation of natural habitats into smaller, isolated units, a phenomenon that causes a series of consequences at the ecosystem level and for the species that depend on them. Among the main effects are the loss of biodiversity, alteration of ecological processes, loss of ecological connectivity, and increased human pressure.
- **Fractal dimension:** A fractal dimension index is a useful tool for assessing the spatial structure of the landscape and understanding how the configuration of habitat patches can influence ecological processes and ecosystem function.
- **Spatial continuity:** The spatial continuity of natural areas guarantees the survival of plant and animal species and, therefore, the continuous exchange of genes, thus ensuring the movement of species, the maintenance of ecological functions, resilience to disturbances, and the conservation of biodiversity.





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- **Ecosystem vulnerability to climate change:** Climate change can influence the Net Primary Productivity (NPP) of ecosystems, which is the amount of energy that producers (such as plants) capture through photosynthesis. Variations in patterns of temperature, precipitation, and water availability can alter the quantity and quality of biomass produced, affecting the entire food chain and the availability of resources for consuming organisms.
- **Species vulnerability to climate change:** Climate change can lead to species extinctions and declines in biological diversity. Species that cannot adapt quickly to changes in temperatures or precipitation patterns may have difficulty surviving and reproducing.

Once each one of the factors has been relativized, the following adapted formula will be applied to determine the number of Biodiversity Credits that will be awarded for the project:

$$\text{VBBCs} = \frac{\text{Tsurf} * (\text{F}_1 + \text{F}_2 + \text{F}_3 + \text{F}_4 + \text{F}_5 + \text{F}_6) + (\text{RestSurf} * \text{F}_7) + (\text{PresSurf} * \text{F}_8)}{100}$$

Where:

Tsurf= Total surface (m²)

F₁= Protection of key species

F₂= Fragmentation

F₃= Fractal dimension

F₄= Spatial continuity

F₅= Climate change vulnerability

F₆= Vulnerability of species to climate change

RestSurf= Restored surface (m²)

F₇= **Biodiversity** index in the area restored

PresSurf= Preserved surface (m²)

F₈= Biodiversity index in the preserved area

This formula incorporates the relativized factors, Shannon index values, benefits adjacent to the ecosystem and the areas of each variable to calculate the biodiversity credit. Multiplying each variable by its respective area ensures that the spatial extent of each factor is considered. The result is divided by 100, as each credit issued will represent a 100 m² unit that has been preserved or restored by the project.

One of the most widely used indices to quantify specific biodiversity is the Shannon index, also known as Shannon-Weaver (Shannon and Weaver, 1949), derived from information theory as a





measure of entropy. The index reflects the heterogeneity of a community based on two factors: the number of species present and their relative abundance. The maximum potential diversity ($H_{max} = \ln S$) 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/H_{max} , which will be equal to 1 if all the species that compose the community have the same number of individuals.

The index is calculated through the following equation:

$$H = - \sum_{i=1}^{ps*} p_i \ln(p_i)$$

Where:

Pi (p₁, p₂, p₃... p_s*) = It is the relative abundance of target *i* in the collection

If only part of the area is sampled, biodiversity is expressed according to the following relationship.

$$H = \sum_{i=1}^s \left[\left(\frac{n_i}{n} \right) \ln \left(\frac{n_i}{n} \right) \right]$$

Where:

n_i = It is the abundance of the category *i*

n = It is the abundance of all categories of the sample

Diversity is influenced by the distribution of objects in the categories. The evenness (*J*) is calculated as follows:

$$J = \frac{D}{D_{max}}$$

Where:

D = This is the diversity

D_{max} = This is the maximum diversity that can be expressed through the sample

The following is a description of the variables of the project, which will subsequently be ranked in the corresponding relativized value.

III.2.1. PROJECT EVALUATION VARIABLES

III.2.1.1. Preserved area variable

The preserved and restored areas of the project can be seen in Figure 4. The preserved area (yellow) corresponds to the area within the property boundary where no inventory and no project activities relevant to this report were conducted, correlating to a total area of 0.65 hectares. This





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area includes a central passageway for travel to the different plots of the project, as well as an established vegetable patch which was not considered for carbon or biodiversity calculations. The restored area (green) corresponds to a total area of 9.10 hectares, and project activities including tree plantation and soil restoration were completed here. Organized vegetation, seen in Figure 4 as the uniformly placed dots, shows visual evidence of successful replantation activities that have occurred in the project area since the project's implementation.

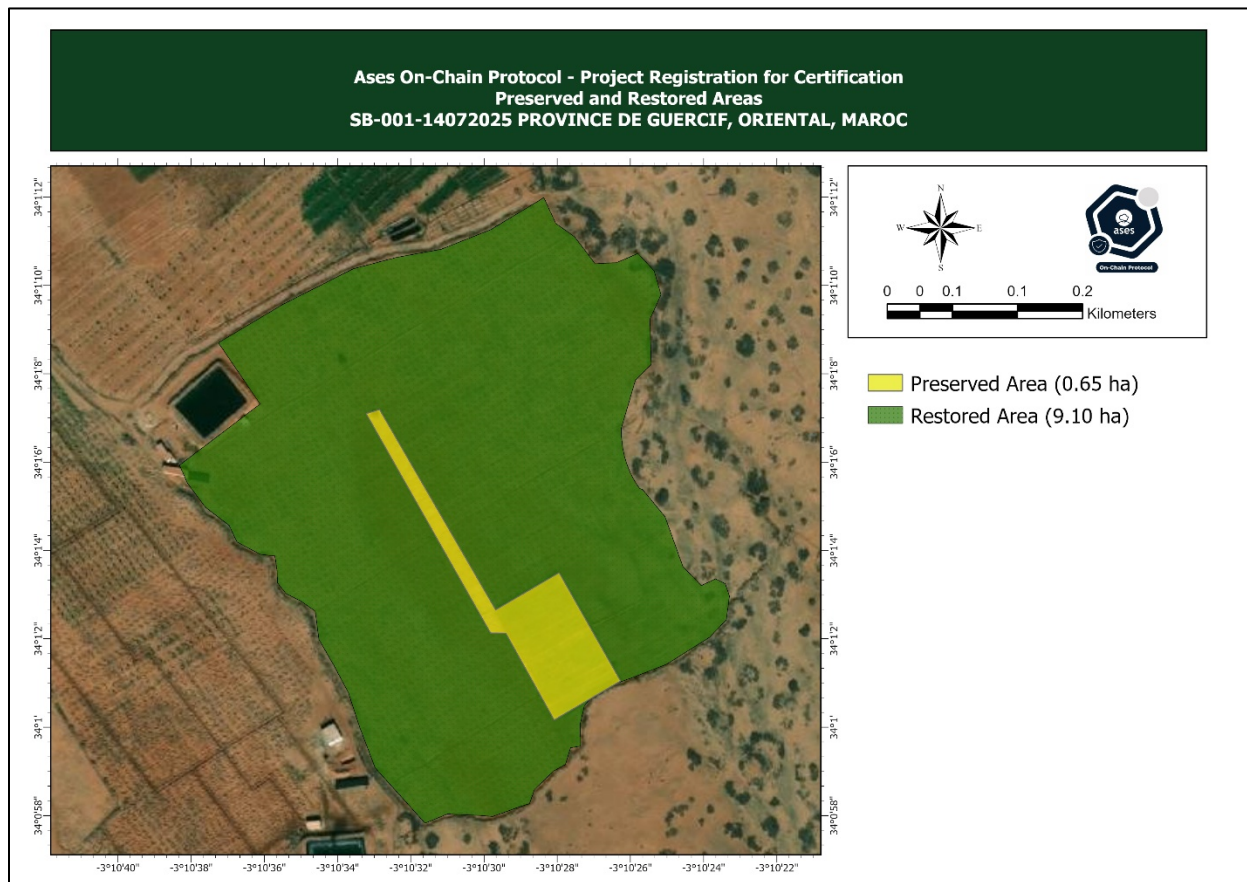


FIGURE 4. PRESERVED AND RESTORED AREAS

Because no inventory and no relevant activities have been completed in the preservation zone of the project, all relativized variables pertaining to biodiversity will be indicated as **low** for the purpose of credit calculation in the preserved zone.

III.2.1.2. Restored area variable

The area restored corresponds to the 9.10 ha where the activities of the project were carried out. To evaluate this parameter, the benefits of reforestation were calculated through the diversity indexes based on the flora and fauna that were observed in-situ during the onsite visit in December 2025.





The results of the restored flora and fauna indices are presented below.

III.2.1.1.1. Flora

To calculate the biodiversity index of the flora present in the study area, a count of the trees and shrubs present was made by sampling 2 fixed points each with an area of 100 m² (Figure 5).

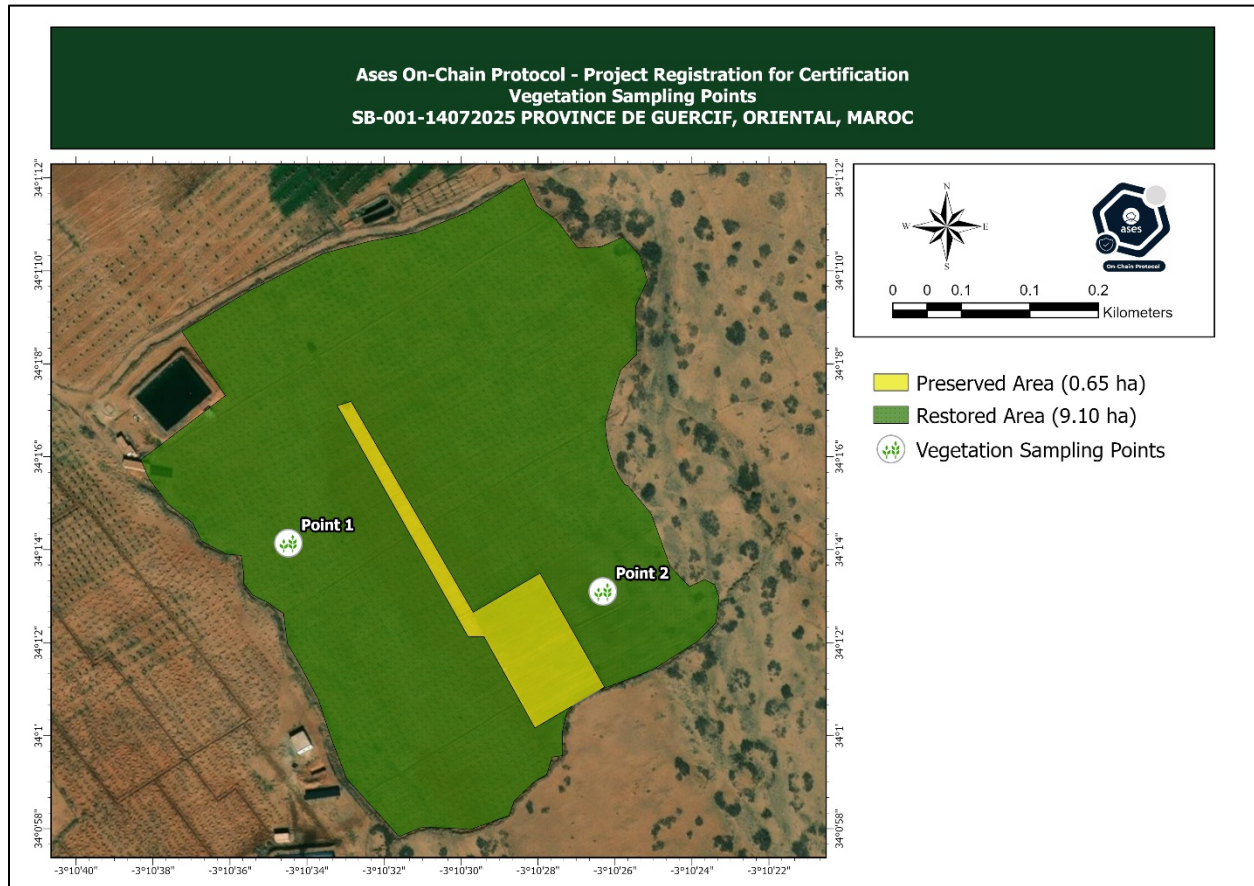


FIGURE 5. VEGETATION SAMPLING POINTS

The count resulted in the presence of 219 individuals of 8 different species (Table 2).

TABLE 2. PLANT SPECIES PRESENT IN THE RESTORATION AREA

Species	Individuals
<i>Amaranthus albus</i>	28
<i>Asphodelus tenuifolius</i>	4
<i>Cynodon dactylon</i>	70
<i>Erigeron bonariensis</i>	5
<i>Ficus carica</i>	55





Species	Individuals
<i>Lycopersicon esculentum</i>	1
<i>Olea europaea 'Arbequina'</i>	55
<i>Ziziphus lotus</i>	1

The results of specific richness, Shannon-Weaver diversity index, maximum diversity, and evenness of the tree and shrub community in the project restoration area are shown in Table 3.

TABLE 3. BIODIVERSITY PARAMETERS OF THE FLORA BIODIVERSITY IN THE RESTORATION AREA

Parameters of flora diversity index	Value
Species richness	8
Diversity (nats)	1.53
Maximum potential diversity (Hmax)	2.08
Equitability index (J)	0.74

When the value of the diversity index is 0, there is only one category, i.e., there is no diversity; and the index increases as the number of objects or classes increases or if the proportional distribution of the occupied area among the types of ecosystems or objects, species, etc., is more equitable. For the preservation area, a flora diversity index of 1.53 was obtained, which could be interpreted as a **low diversity** according to the categories presented in Table 4.

TABLE 4. QUALITATIVE CATEGORIES OF INTERPRETATION OF THE SHANNON INDEX

Diversity	Shannon index (nats)
Very low	<1.02
Low	1.03 – 1.53
Medium	1.54 – 2.11
High	2.12 – 2.65
Very high	>2.65

Bibliographical source: Qualitative interpretation of the index based on the interpretations expressed by Margalef (1975;1993).

III.2.1.1.2. Fauna

Fauna was observed at three different sites in and around the project area (Figure 6).

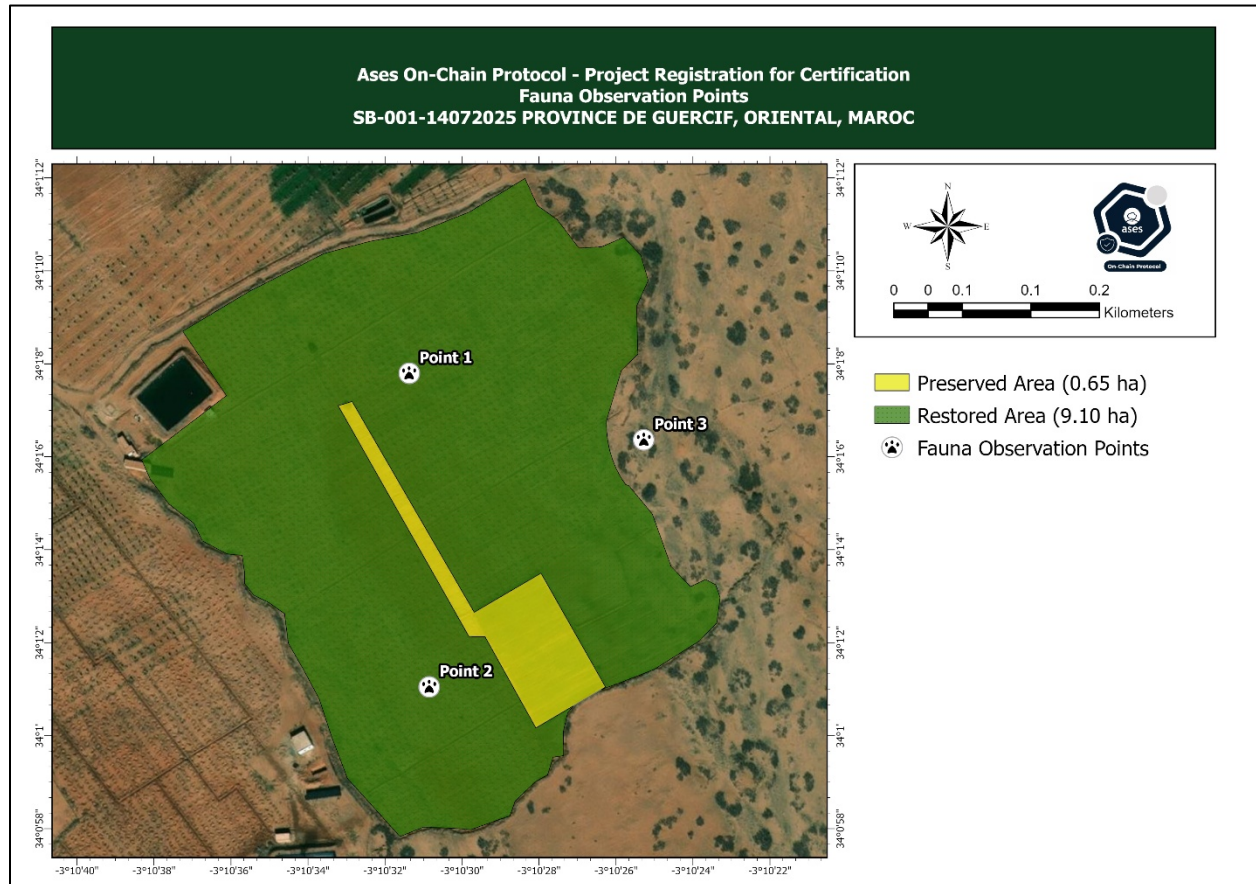


FIGURE 6. FAUNA OBSERVATION POINTS

During the fauna sampling carried out in the project area, a total of 5 individuals of 5 different species were recorded, of which 60% are birds and 40% reptiles (Table 5).

TABLE 5. REGISTERED FAUNA

Scientific name	Common name	Number
Birds		
<i>Ardea cinerea</i>	Grey Heron	1
<i>Bulbucus ibis</i>	Cattle egret	1
<i>Lanius elegans</i>	Great Grey Shrike	1
Reptiles		
<i>Testudo graeca graeca</i>	Greek Tortoise	1
<i>Uromastyx acanthinura</i>	North African spiny-tailed lizard	1



The results of the specific richness, Shannon-Weaver diversity index, maximum diversity, and evenness of the fauna in the project conservation area are shown in Table 6.

TABLE 6. BIODIVERSITY PARAMETERS OF THE FAUNA BIODIVERSITY IN THE RESTORATION AREA

Parameters of flora diversity index	Value
Species richness	5
Diversity (nats)	1.61
Maximum potential diversity (Hmax)	1.61
Equitability index (J)	1.00

According to Table 4 *Qualitative categories of interpretation of the Shannon index*, the index value obtained would be categorized as **medium** diversity.

To know the general biodiversity index of the restoration area (Table 17), the index was calculated for all species recorded in this area, including flora and fauna, resulting in a diversity of 1.64, which could be interpreted as **medium diversity** according to the categories in Table 4.

TABLE 7. GENERAL BIODIVERSITY PARAMETERS IN THE RESTORATION AREA

Parameters of flora & fauna diversity index	Value
Species richness	13
Diversity (nats)	1.64
Maximum potential diversity (Hmax)	2.56
Equitability index (J)	0.64

III.2.1.3. Ecological condition of the intervened zone

III.2.1.3.1. Protection of key species

Keystone species are those that play a fundamental role and whose conservation has a positive impact on the preservation of other organisms and the ecosystem itself. No key protected species were identified within this project area; therefore, **no relativized value for protection of key species will be applied** in the calculation of credits for the project.

III.2.1.3.2. Fragmentation

Fragmentation refers to the process by which large contiguous ecosystems are divided into smaller, isolated patches, often because of anthropogenic activities such as urbanization, agriculture, and infrastructure development. This process disrupts the continuity of natural landscapes, leading to adverse effects on biodiversity, ecosystem services, and ecological processes. Assessing fragmentation involves evaluating changes in landscape structure over





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time, identifying patterns of habitat loss and isolation, and understanding their ecological implications.

The fragmentation analysis was carried out at the microbasin scale because this scale of study allows the integration of the different elements of the landscape such as vegetation, hydrology, and land use patterns. The microbasin delimited for the project area has a total area of 16,712 ha.

Using a binary grid of the project area (grassland vs. non-grassland) obtained from Google Earth Engine, fragmentation of the study area was analyzed in Guidos ToolBox using the five-scale multiscale analysis tool (Vogt & Ritters, 2017), as described in the aOCP Methodology for the Assessment of Conservation Biodiversity Credits V2.0. This analysis generated an aggregate map of the five-scale observations and a bar chart detailing the fragmentation classes and the number of grassland patches (Figure 7).

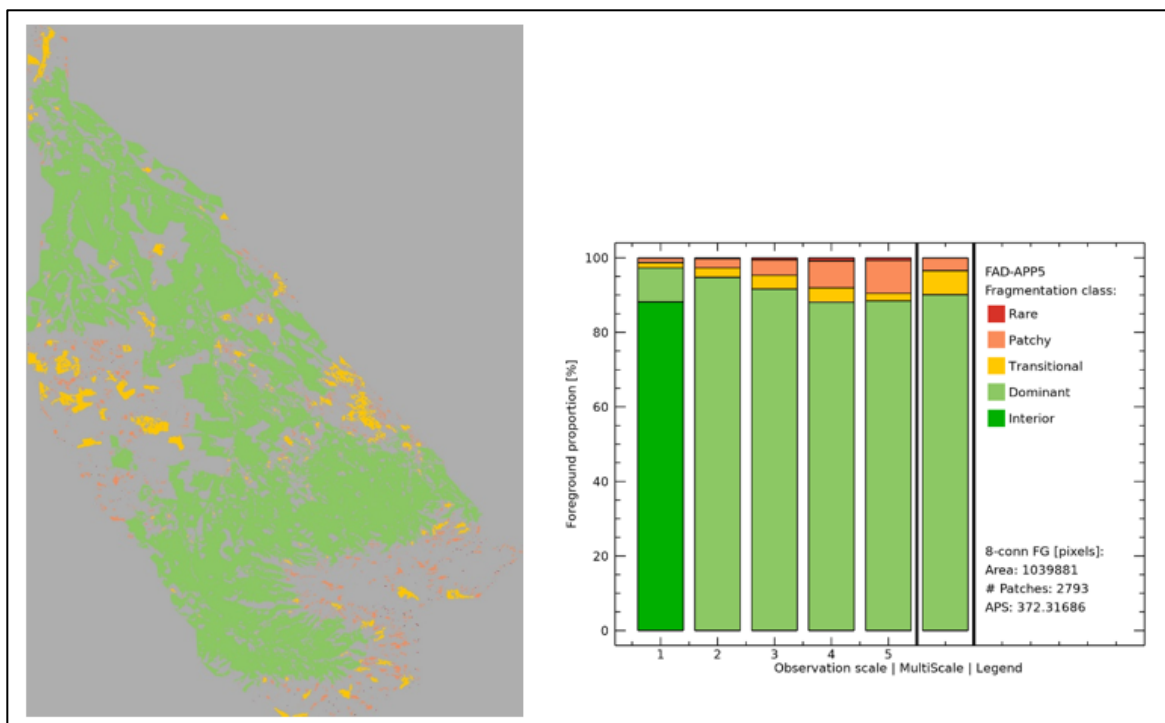


FIGURE 7. AGGREGATE MAP (MULTISCALE) OF FRAGMENTATION CLASSES ON FIVE OBSERVATION SCALES

The fragmentation analysis (FAD-APP5) shows that, at the different observation scales, the largest proportion of the area corresponds mainly to the Dominant class, indicating continuous and relatively well-preserved coverage (Figure 8). At scale 2, there is a significant reduction in the Interior category, with an increase in the Dominant class that remains until class 5. In total, an area of 1,039,881 pixels was recorded, distributed in 2,793 patches with an average size of 372.32





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pixels, suggesting a landscape structure dominated by connected patches, with occasional signs of transition towards fragmentation.

```

FAD-APP: Foreground Area Density summary analysis for image:
C:\Users\kylen\Downloads\sb-001\Guercif_LandCover2021.tif
=====
8-conn FG: area, # patches, aps [pixels]: 1039881, 2793, 372.31686
Fragmentation class: foreground proportion at observation scale/area:
Observation scale:      1          2          3          4          5          mscale
Neighborhood area:    7x7       13x13      27x27      81x81     243x243
=====
FAD-APP_5class:
  Rare:      0.1296    0.3081    0.5617    0.8052    0.7391    0.0739
  Patchy:    1.1529    2.3712    4.1376    7.2480    8.7780    3.3796
  Transitional: 1.4675    2.5525    3.6969    3.8745    2.0798    6.4705
  Dominant:  9.0858    94.7682   91.6035   88.0707   88.4031   90.0760
  Interior:  88.1641    0.0000    0.0004    0.0016    0.0000    0.0000
FAD-APP_2class:
  Separated:  1.2826    2.6793    4.6993    8.0532    9.5171    3.4535
  Continuous: 98.7175   97.3206   95.3007   91.9468   90.4829   96.5465
=====
  FAD_av:    88.8271   83.6953   77.1844   68.0530   59.2482   75.0786
  
```

FIGURE 8. STATISTICAL SUMMARY TABLE SHOWING THE PERCENTAGE OF FRAGMENTATION CLASSES ON THE FIVE OBSERVATION SCALES AND FOR MULTISCALE ANALYSIS IN THE PROJECT AREA

The fragmentation analysis (FAD-APP5) of the grassland area recorded a total of 2,793 patches. At a fine scale (7x7), the predominant class was Interior (88.16%), reflecting continuous coverage. As the observation window was enlarged, the proportion of Interior decreased, giving way almost entirely to the Dominant category. At the largest scale (243x243), the Dominant class remained the largest at 88.40%, followed by Patchy (8.78%), Transitional (2.08%), and Rare (0.74%). The aggregate mscale index reached a value of 75.0786, reflecting that although the landscape has large, continuous patches at local scales, at regional scales there is an overall transition towards moderate fragmentation.

The fragmentation index gives values ranging from 0 to 1, where values less than 0.5 indicate an insularized degree of fragmentation, meaning that the landscape has a high level of fragmentation resembling the way islands are scattered in an ocean, whereas a value of 1 represents a landscape with no fragmentation (Table 8).





TABLE 8. FRAGMENTATION RANGE

Fragmentation range	Level
<0.5	Insularized
0.5 – 0.7	Highly fragmented
0.7 – 0.9	Moderate fragmentation
1	Without fragmentation

Bibliographical source: Díaz, A (2003)

Therefore, applying this scale to the FAD-APP5 result of 0.75, this indicates that the microbasin has a **moderate degree** of fragmentation.

III.2.1.3.3. Fractal dimension

This index measures the complexity of shapes, its value lies between 1 and 2, where values closer to 1 correspond to the most regular perimeters, while values closer to 2 correspond to very complex shapes.

The fractal dimension index was calculated with the Landscape Ecology Statistics (LecoS) plugin of QGIS, which was modeled at the micro-watershed scale and used as input for the forest area in raster format.

The result obtained was **1.059** which indicates that the landscape structure has a **round** perimeter (Table 9).

TABLE 9. FRACTAL DIMENSION RANGE

Fractal dimension range	Level
< 1.25	Round
1.26 - 1.50	Oval-round
1.51 - 1.75	Oval oblong
1.76 - 1.99	Rectangular
2	Amorphous or irregular

Bibliographical source: Patton D.R. 1975

III.2.1.3.4. Spatial continuity

For the evaluation of spatial continuity as an indicator of fragmentation, the Volgelmann Index (FCI) applied at the micro-watershed scale of the project was used. The formula is made up as follows:





$$FCI = \ln (\Sigma A / \Sigma P)$$

Where:

ΣA = Total area of forest patches in the landscape (m²)

ΣP = Total perimeter of forest patches in landscape (m)

Values less than zero indicate a landscape with spatial continuity, while higher values represent greater discontinuity and fragmentation of patches (Table 10).

TABLE 10. SPATIAL CONTINUITY

Index value	Spatial continuity
< 0	Continuous
0.10 - 5	Discontinuous
> 5	Highly discontinuous

The total area of forest patches in the project's microbasin landscape is 17,050,000 m² and its perimeter is 359,976.43 m, which applied to the above formula gives a result:

$$FCI = \ln (17,050,000 / 359,976.43) = 3.86$$

Using the Vogelmann Index, the level of spatial continuity in the project's micro basin is 47.36, thus classified as **discontinuous** according to Table 10.

III.2.1.3.4. Ecosystem vulnerability to climate change

Biomass is fundamental to sustaining species diversity in ecosystems, and its reduction could lead to a decrease in habitats and resources available for species, which would have a direct impact on biological diversity.

Vulnerability to climate change is a key factor in assessing the long-term performance of the project area. This evaluation is based on the biomass and Net Primary Productivity (NPP) data presented in Section III.1.1.5.1. Under current conditions using observed (real) climate data, the ecosystem shows an average NPP of 127.87 gC/m²/yr, which corresponds to 272.06 gDM/m²/yr and 469.27 gCO₂/m²/yr. At the project scale, this represents an annual sequestration of approximately 47,486.14 kgCO₂ per plot.

Climate change is expected to alter temperature, precipitation, and other environmental drivers that directly influence ecosystem productivity. Using CMIP climate projections, future NPP for the year 2064 is estimated at 239.44 gC/m²/yr under modelled present conditions, but when applying the projected climate change signal (-16.96%), NPP declines to the equivalent of 106.18 gC/m²/yr based on current real-data baselines. This corresponds to a reduction of 21.69 gC/m²/yr, or 79.60 gCO₂/m²/yr, relative to present-day observed conditions.





At the plot scale, this translates to a decrease in annual carbon sequestration from 47,486.14 kgCO₂/plot/yr to 39,431.54 kgCO₂/plot/yr, representing a loss of **8,054.60 kgCO₂** per plot per year, or **8.05 tn/yr**. These results indicate that climate change could significantly reduce the carbon sequestration capacity of the ecosystem over time, highlighting the importance of incorporating climate resilience into long-term project planning and carbon accounting.

III.2.1.3.5. Species vulnerability to climate change

The vulnerability to climate change of the reforested species was evaluated based on the current and future potential distribution models (2050 RCP 45) of each planted species, using the Climpact Data Science tool (<https://www.cdtoolbox.shop>) with the objective of determining the percentage of conditions that the project area has with respect to the ecological (temperature, precipitation, etc.), physical (altitude) and biological (vegetation) needs that each planted species requires to ensure its adaptability and survival.

Table 11 indicates the success probability of the planted species, based on the ecological conditions that the area will have in 2050 in response to climate change.

TABLE 11. SPECIES VULNERABILITY TO CLIMATE CHANGE

Species	Probability of Distribution (%)	
	Current	2050
<i>Prunus spp.</i>	94.307	93.945
<i>Citrus limon</i>	53.945	47.105
<i>Ficus carica</i>	87.143	91.603
<i>Olea europaea</i>	87.435	92.524
<i>Punica granatum</i>	84.121	86.831
Average	81.390	82.402

As can be seen in the table above, currently the project area has on average **81.390%** of all the necessary ecological conditions of the reforested species, and in 2050 the percentage will increase by **1.012%** to **82.402%**, indicating that the planted species have a **moderate - high resilience** to the effects of climate change. Distribution maps of the species probability at the state-scale can be seen in Figure 9 and the classifications for this metric can be found in Table 12.



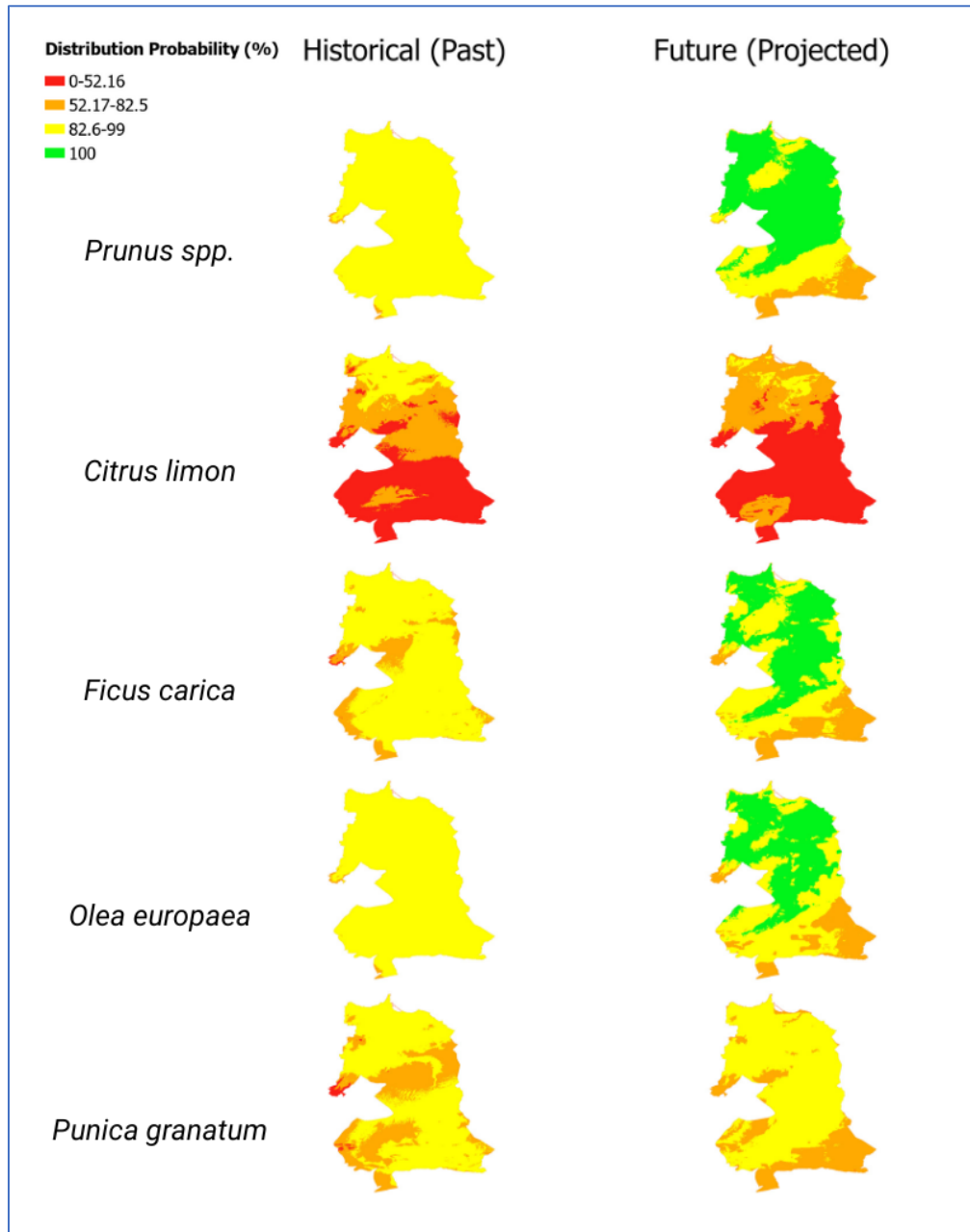


FIGURE 9. SPECIES PROBABILITY MAPS OF PAST AND FUTURE DISTRIBUTION



TABLE 12. SPECIES PROBABILITY DISTRIBUTION CLASSIFICATIONS

Percentage (%)	Interpretation
1-52.16	This range indicates that the area is poorly suited for the development of the species or species community. The environmental conditions are likely to pose significant challenges, and the species' capacity to adapt to future changes is considerably limited.
52.17-82.5	Areas within this range suggest moderate suitability, where the species may need to adjust to altered environmental conditions. Mild stress periods could occur, and there is a higher degree of uncertainty regarding the species' ability to successfully adapt to these changes.
82.6-99	This range reflects high suitability, with environmental conditions closely matching the species' ecological niche. The impacts of climate change in these areas are expected to be minimal, and the species is likely to adapt well to future environmental shifts.
100	A value of 100% indicates full suitability, meaning the environmental conditions perfectly align with the species' ecological requirements. In such areas, the species or community is expected to thrive, with optimal potential for long-term survival and development.

III.2.2. CLASSIFICATION OF RELATIVIZED VARIABLES

Table 13 presents the detailed breakdown of classifying each factor and assigning them a relativized factor using the value indexes.

TABLE 13. CLASSIFICATION OF RELATIVIZED VALUES

Factor		Value obtained for the project	Classification	Value index	Relativized factor
F1	Biodiversity index of key protected species	No key species identified *	Very low	< 1.02	0.01
			Low	1.03 - 1.53	0.14
			Medium	1.54 - 2.11	0.32
			High	2.12 - 2.65	0.67
			Very high	> 2.65	1
F2	Fragmentation	0.75	Insularized	<0.5	0.2
			Highly fragmented	0.5 - 0.7	0.33
			Moderate fragmentation	0.7 - 0.9	0.66
			Without fragmentation	1	1
F3	Fractal dimension	1.059	Round	< 1.25	1
			Oval-round	1.26 - 1.50	0.68





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Factor		Value obtained for the project	Classification	Value index	Relativized factor
			Oval oblong	1.51 - 1.75	0.34
			Rectangular	1.76 - 1.99	0.26
			Amorphous or irregular	>2	0.16
F4	Spatial continuity	3.86	Continuous	< 0	1
			Discontinuous	0.10 - 5	0.02
			Highly discontinuous	> 5	0.01
F5	Ecosystem vulnerability to climate change	-8.05 tn/yr	Very low	0 - 10	1
			Low	10 - 50	0.67
			Medium	50 - 100	0.33
			High	100 - 500	0.16
			Very high	> 500	0.11
F6	Species vulnerability to climate change	82.402% (+1.012%)	Species with very high resilience	95 - 100	1
			Highly resilient species	80 - 95	0.72
			Species with medium resilience	61 - 80	0.44
			Species with low resilience	41 - 60	0.15
			Species with very low resilience	21 - 40	0.07
			Non-resilient species	0 - 20	0.01
F7	Biodiversity index in the area restored	1.64	Very low	< 1.02	0.01
			Low	1.03 - 1.53	0.14
			Medium	1.54 - 2.11	0.32
			High	2.12 - 2.65	0.67
			Very high	> 2.65	1
F8	Biodiversity index in the preserved area	Low * Not calculated	Very low	< 1.02	0.01
			Low	1.03 - 1.53	0.14
			Medium	1.54 - 2.11	0.32
			High	2.12 - 2.65	0.67
			Very high	> 2.65	1

$$VBBCs = \frac{101,183.56*(0.66+1.00+0.02+1.00+0.72)+(91,056.29*0.32)+(6,471.80*0.14)}{100} = 3,741$$





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Based on the benefits generated for biodiversity restoration, it is estimated that the Regenerative Agriculture in Guercif, Morocco project could generate a total of 3,741 biodiversity units, positioning it as a high-impact ecological initiative in Morocco.

The project's score under the Nat5 Scoring classifies it as a Type A project. The corresponding assessment can be consulted in the document Nat5 Scoring SB-001-14072025 PROVINCE DE GUERCIF, ORIENTAL, MOROCCO.

As established in Section III.1.5 of the *Project Procedures* document, version 2.3, for **Type A** projects, a buffer pool reserve of **25%** is applied as a measure to ensure the permanence of the project's benefits. This corresponds to **935 biodiversity units**, resulting in the issuance of **2,806 VBBC**, which will be generated once Independent Validation has been completed.





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