Action: A2. Environmental, social and economic indicators selection: Monitoring and evaluation protocol.

Environmental, economic and social indicators monitoring protocol

Compiled by Life-Nieblas team: GESPLAN, CIM, CREAF-UAB & ITC

Due date: 04/2021

Delivery date: 03/2021

Table of content

1. Brief of the project 3
2. Summary 4
3. Objectives 5
4. Environmental indicators 6
   4.1 Meteorological indicators 8
   4.2 Soil quality 9
      4.2.1 Soil sampling 9
      4.2.2 Granulometry (coarse fraction) 9
      4.2.3 Physicochemical characterization 10
   4.3 Soil humidity 10
   4.4 Erosion 10
      4.4.1 Rill erosion 10
      4.4.2 Other erosion and degradation processes 11
   4.5 Plantations monitoring 12
      4.5.1 Delivery and plantation of seedlings 12
      4.5.2 Seedling identification 13
      4.5.3 Plant vigour 14
      4.5.4 Growth 15
   4.6 Habitat restoration 17
      4.6.1 Vegetation structure 17
      4.6.2 Vegetation composition (biodiversity) 18
   4.7 The Support Irrigation Methodology 20
5. Socioeconomic indicators 21

Acknowledgements 23

Authors 24

Annex 1. Field forms 25

1. Brief of the project

Life-Nieblas is a Life Programme financed project provided by the European Commission that support projects involved in climate action, natural habitat restoration and sustainable development. In addition to the European financing, Life-Nieblas counts with the financial support from Cabildo de Gran Canaria as the public administration where this project has been developed.

Life-Nieblas is a pioneer case study on the use of fog water collection as main source of water supply for the irrigation and maintenance of reforested areas. Reforestation methods will take shape of different technologies that have been observed to be beneficial or that have the potential to be further developed including Individual Fog Water Collectors, Cocoons (developed in another Life project 'The Green Link'), AFDS (Autonomous Fluid Discharge System) and finally traditional reforestation as control group.

Furthermore, this Life-Nieblas looks into the transferability and replication potential of the technology tested. Not only will the project focus on the reforestation aspect but also on Fog Water Collectors (FWC) technology as the main (and only) source of water. In this case, technology has been tested in labs to improve FWC design and efficiency, they will not only become easier to install and transport but also will collect more water by surface exposed.

The final objective of this project will be to adapt technology to be exported to different European regions (and out of the EU) where fog conditions have the potential to improve water availability and assist in natural habitat recovery. Eventually, finding transferability into the agriculture sector where farmers can take advantage from collecting their own water. Henceforth, Life-Nieblas will contribute to climate change mitigation action (by reduction of emissions), carbon capture (by natural habitat recovered) and with the development of sustainable technology.

2. Summary

This deliverable is the result of Action A.2 *'Environmental, social and economic selection. Monitoring and evaluation protocol'* as established by Life-Nieblas' Technical Application form.

Here, GESPLAN, CIM, CREAF and ITC have compiled a series of measurements methodologies and monitoring indicators that will allow the project to track and check progression, measure success rate and establish best practice protocols from an environmental and socioeconomic perspective.

This document is divided in three sections: 1) Environmental indicators, and 2) Socioeconomic indicators. In the first section indicators for measuring meteorology, erosion and soil quality, and the evolution of the plantations and the passive restoration of the area are provided. Also, it provides a detailed prevision of the number of seedlings planted using the different irrigation technologies and an estimation of the water consumption. The second section proposes a series of indicators related to environmental social awareness and green economy.

All those indicators will provide the answers to Action D.1 *'Monitoring and project performance indicators'.*

3. Objectives

The main objectives of this protocol are to establish indicators and methods for evaluating main environmental and socio-economic trends in the project areas, in Gran Canaria (Spain) and Portugal (fig.1 & 2).

Environmental indicators included in this protocol will try to firstly characterize the meteorological conditions during the monitoring time, and secondly evaluate the whole restoration process of the areas by finding tendencies in soil quality and vegetation cover, diversity and vigour. Moreover, some indicators related to the monitoring of the plantation works, like the number of seedlings planted and the area occupied, are included. The plotted working areas will consist of 4 different irrigation and reforestation methods that will be analysed separately and in conjunction:

1) Traditional reforestation

2) Reforestation by means of Cocoons (from project - Life The Green Link)

3) Reforestation with the use of individual herbivores protection and fog collectors

4) Reforestation by the use of an innovative autonomous irrigation system (ADS) – this method will only be applied in Gran Canaria.

The project foresees that water supplied to the reforested areas both in Gran Canaria and Portugal will be extracted using fog collectors of traditional installation with the introduction and testing of innovative collectors specifically designed for ease of use, transportability and transferability. Their effectiveness will be tried and tested along with the rest of methodologies.

Regarding socio-economic indicators, these will try to evaluate impacts of the project on the creation of green jobs and its contribution to the green economy sector. By analysing different factors such as direct creation of jobs through Life-Nieblas, external contracts arising from this project's activities, third parties economically benefited from the project and even measuring the effect on local economy activity (i.e., green tourism), these indicators seek to quantify the extent to which Life-Nieblas will have a socioeconomic impact. Moreover, social awareness on climate change, reforestation and ecosystem services will also be measured through several talks, symposiums, thematic events and online communications (including website, social media, conferences and else).

4. Environmental indicators

The main environmental indicators that will be monitored in this project are:

- Meteorological station indicators: wind intensity, rainfall, insolation, number of days without rain and number of days with fog.

- Erosion and soil quality and its evolution:
    - Soil physicochemical characterization
    - Main erosion problems: presence of concentrated erosion (gullies), laminar erosion (indications). Area affected by erosion problems. Stabilization of gullies or slopes affected by laminar erosion
    - Soil humidity

- Surface area occupied by the species established in action A1 and planted in action C2.

- Surface area and evolution (health, vegetation strata distribution, total vegetation cover, species richness) of the priority habitats defined in A1.

- Semi-annual delivery of seedlings of the species established in action A1.

- Seedlings plantation on each reforestation typology testing plot.

- Plants vigour and survival rate on each reforestation typology testing plot, including root system

Table 1. Synthesis of field observations and measurements to be taken at each site

Task/Measure	How	When
Meteorological indicators	Through fixed meteorological stations installed specifically in the project area or previously existing at nearest location	Continuously during the project
Soil physicochemical characterization	Soil sampling and analysis	Before plantations At the end of the project
Soil humidity measures	Humidity sensors installed in representative plots in the project area	Continuously during the project
Erosion	Rill erosion measurements and observation of other erosion processes indications	Nov 2021 Sept 2024
Seedling characterization	Height and diameter measurements (10 seedlings per species), seedling health	Before plantations
Seedling identification	Labelling (50 seedlings per species, treatment, area and planting season)	Just after plantations
Vigour	Visual evaluation (all labelled seedlings)	May 2022 Oct 2022 May 2023 Oct 2023 May 2024 Sept 2024
Stem growth	Height and diameter measurements (all labelled seedlings)	Just after plantations Sept 2024
Root growth	Root elongation, volume and biomass in 3 seedlings per treatment and species	Sept 2024
Vegetation structure	Cover and height measures taken in 25 m transects	May 2022 May 2024
Vegetation composition (plant diversity)	Plant identification and species abundance, all sites	May 2022 May 2024

4.1 Meteorological indicators

The meteorological indicators have been defined by consensus of the scientific team during the Life-Nieblas project meetings. The chosen set of variables is intended to meet a balance between the available economic resources and the needs of the project. Some of these needs are as follows:

- Characterizing the meteorological conditions of the study area during the project lifetime.
- Generating in situ data, which is required for generating direct or indirect environmental indicators, such as wind speed, precipitation, insolation, number of days without rain, number of days with fog, and soil moisture.
- Evaluating the fog collectors' capability to generate irrigation water and assessing its impact on the terrain.
- Compare the state and evolution of the terrain under the effects of fog water discharges with that of the nearby terrain that will not be irrigated.

In order to characterize the meteorological conditions, one Meteorological Central Station (MCS) is needed to monitor:

- Wind speed
- Wind direction
- Ambient Temperature
- Relative Humidity
- Global Horizontal Solar Irradiation
- Amount of accumulated rainfall water
- Visibility (if possible, to better determine the existence of fog).

Full technical descriptions on technical equipment have been gathered on Acton A.3 *'Equipment evaluation and selection. Monitoring and evaluation protocol'*.

4.2 Soil quality

In order to know the tendency in soil quality, a detailed physicochemical characterization is required before planting and at the end of the project. The first characterization will be useful for the discussion of vegetation development results. The second characterization will be focused in determining C storage in soil; a complete characterization is proposed in order to fully benefit from the sampling campaign.

4.2.1 Soil sampling

Prior to plantations a detailed soil physicochemical characterization is required. First, it is important to identify the presence of different soil types, or areas in the same soil type with different geomorphology or vegetation development, or areas where different planting treatments have been or will be applied. For each soil type or homogeneous zone in terms of geomorphology, vegetation type or planting treatments, a composite sample will be taken. This zone will be identified and represented in a map.

To take the soil sample we will use a shovel or a hoe, always trying to take the same volume of soil for 20 cm depth (Fig.1). For slightly stony soils, a Hedelman auger can also be used. In any case, the sampling density will never be fewer than 5 points per soil type or homogeneous zone. Those sampling points will be homogeneously distributed along the longest linear transect in each soil unit. When sampling, care should be given not to take blocks (fractions over 25 cm in diameter), as this will be determined qualitatively, documenting their presence on the surface.

The samples are mixed until a homogeneous mixture is obtained, called composite sample. It is important to let the sample dry before sieving it. It is also important to disintegrate it, to prevent lumps from being mistaken by graves when sieving it. Once dried and disintegrated, the composite sample is sieved to separate the different fraction sizes.

Figure 1. Soil sampling in a skeletal soil (<20 cm depth).

4.2.2 Granulometry (coarse fraction)

The composite sample, obtained after mixing the set of samples obtained in the sampling process, will be left to dry spread on a paper or similar for a few days. Once dry, we will sift the

sample with a 75 mm sieve. The fractions retained in the sieve consist of stones (fractions with diameters between 250 mm and 75 mm). The sieved material will be sieved again on a 2 mm sieve. Fractions retained will correspond to gravel (75-2 mm) and the material that passed through the sieve will be classified as fine earth (<2 mm). Weighting the three fractions and expressing them according to the overall weight of the composite sample will obtain the proportion of the three different fractions.

At least 500 g of the fine earth fraction will be sent to an accredited laboratory for a physicochemical analysis. It is important to indicate the date on which the sampling was performed, the reference or name of the sample, and the location (with geographic coordinates).

4.2.3 Physicochemical characterization

For each sample the following parameters will be determined:

- Texture type
- Clay content (g kg^{-1})
- Organic matter (g kg^{-1})
- Carbonates (g kg^{-1})
- Electrical conductivity, saturated extract (dS m^{-1})
- Soil pH
- Total nitrogen (%)
- Available phosphorous (mg kg^{-1})
- Available potassium (mg kg^{-1})

4.3 Soil humidity

Since soil humidity is a crucial parameter for explaining the success of the plantations, a network of soil moisture sensors measuring at 30 cm depth is required. This network will consist of at least 23 installed sensors:

· The irrigation zone of each AFDS should have at least 2 soil moisture sensors. This way, for 6 fog collectors, 12 soil moisture sensors will be needed.

· To evaluate the effect of the different irrigation methods (Cocoon, Traditional and Individual Collection System), 2 soil moisture sensors per method will be needed. This amounts to a total of 6 soil moisture sensors.

· To monitor the effect of land cover in soil humidity, 3 sensors will be installed in the surrounding forests (one per forest type: chestnut, pinewood and elm forests), and two others in the surrounding clear areas. This amounts to a total of 5 soil moisture sensors.

4.4 Erosion

4.4.1 Rill erosion

It is important to determine the extent of the concentrated erosion processes that may occur in the area. To do this, it is necessary to delimit the areas where rills are more than 5 cm deep

(Fig.2). When the affected area is small it can be measured directly in the field, using a measuring tape or similar. When the surface is larger, the area could be delimited using aerial images trough photointerpretation. Lateral limits of the affected area will be established by the rills deeper than 5 cm located at the laterals of the area. The upper limit will be delimited by the line that joins the points from which rills started to have a depth of 5 cm. The lower limit will be delimited by the union of the drainage points of the rills. Already stabilised rills will not be included in the accounting. To consider a rill as stabilised, it must have vegetation along its entire length.

Measurements will be done just after plantations (2022) and three years after (2024).

Figure 2. The presence of vegetation inside the rills is an indicator of the stabilization of the erosive process.

4.4.2 Other erosion and degradation processes

This item aims to assess the presence of evidence of other processes of erosion or physical degradation such as surface encrustation, compaction, laminar erosion or subsurface erosion, trough qualitative indicators (Fig.3). It is important noting the presence of these processes in case that we observe them during sampling of the areas. Some signs of degradation or erosion processes are summarized in the table 2. Measurements will be taken just after plantations (2021) and three years after (2024).

Table 2. Main signs of degradation processes, apart from concentrated erosion that can be observed in degraded areas.

Laminar erosion	Subsurface erosion	Encrustation	Soil compaction
Pedestals, pinnacles, or unburied roots along the slope Presence of sediment at the slope base	Tubular holes Localized terrain subsidence	Crusts on the soil surface	Formation of puddles Difficulty in penetrating the soil

Figure 3. Degradation processes, apart from concentrated erosion, and indications of their occurrence (from left to right and top to bottom): surface crust formation, crust detail, subsurface erosion, pinnacle formed under a stone by laminar erosion, accumulation of sediments caused by laminar erosion, and flooding caused by a low infiltration capacity.

4.5 Plantations monitoring

4.5.1 Delivery and plantation of seedlings

It is important to control the quantity and quality of the seedlings provided for planting in order to guarantee that the planting actions will be executed according to the working plan. Thus the number of the seedlings delivered and planted for each of the reforestation techniques (control, Cocoon, autonomous discharge system and individual fog collectors) will be recorded. Moreover, the area planted using the different planting techniques will be also delimitated in a map. It is important to correctly distribute the planting methodologies (traditional, Cocoon, individual fog collectors, ADS) in the planting area in order to catch all the variables that can affect plant development (orography, soil depth, orientation, etc.), and try to distribute the planting methodologies interspersed (avoid concentrating in unique areas).

In order to characterise the planting material used we propose to measure shoot and root height, and seedling base diameter in a sample of at least 10 seedlings per species, prior to planting, as soon as possible after the reception of the seedlings (Fig.4). The measures should be taken using a measuring tape/stick (height) and a calliper (diameter).

Moreover, a qualitative evaluation of the seedlings must be done. This evaluation allows detecting shoots and roots health problems (insects, diseases, chlorosis, loss of leaves, stem scars, rotten roots). Moreover, we must pay attention to the presence of spiralized roots or J-rooting. If any of these problems (or others) is detected, it should be noted.

The type and dimensions of the containers, and the nursery where the seedlings come from must be recorded too.

Figure 4. Evaluation of *F. carica* and *O. europaea* planting material. Appropriate root structure in *F. carica* seedlings (right). Bad root development in the container can explain future problems in root growth (left).

4.5.2 Seedling identification

In order to evaluate the effectiveness of the techniques tested in the project it is necessary to select a representative sample of all the species and areas. We must identify at least 50 seedlings per methodology, species and site, differencing site-specific variables (flat vs slopes, soil types, etc.). In planting methodologies with species or sites with less than 50 seedlings, all individuals will be identified.

Identification can be made, for example, using aluminium tags (be aware of using high quality materials in order to avoid degradation of the tags) (Fig. 5). Moreover, we strongly recommend having a map of the area with a schematic localization of the seedlings, and/or geolocalize them using a GPS and by photointerpretation of high resolution orthoimages (if we do not have a high precision GPS).

Figure 5. Left: *Q. ilex* seedling labelled with an aluminium tag. Right: *O. europaea* seedling labelled with soft plastic tag (not recommended).

4.5.3 Plant vigour

Tree/shrub vigour is a health indicator, also giving insights on survival rates (Fig.6). Vigour is assessed by the following semi-quantitative scores during their normal growing period:

3: Healthy seedling, with more than 75% of green, not wilted leaves. Also, active growing points (apices) may be visible

2: Affected seedling, with 25-75% of the leaves being wilted, yellow or brown

1: Severely affected seedling with less than 25% of the leaves being green (i.e., the majority wilted, yellow of brown)

0: Presumably dead seedling with none or only wilted leaves. Seedlings, however, may still recover by resprouting after a rain event

R: Resprouted seedling

A form could be found in Annex 1, that could help taking this information at field (SEEDLINGS VIGOR AND GROWTH FORM).

Vigour will be evaluated in all the labelled seedlings. Measurements will be taken in spring 2022, autumn 2022, spring 2023 (new plantations), autumn 2023, spring 2024 (new plantations) and autumn 2024.

Figure 6. Tree seedlings in different health states, according to the proposed scores: healthy tree (left), affected tree (centre) and severely affected tree (right).

4.5.4 Growth

Seedling growth will be assessed by measuring maximum plant height, from root crown to the shoot apex, using a measuring tape/stick. In Cocoon treatments, be careful not to measure from Cocoon lid (Fig.7). In order to also account for tree volume (multiple branching), stem diameter will be measured at the tree base at 10 cm of the soil, using a calliper. Plant selection for growth measurements will be the same as vigour.

Grazing on saplings may cause negative growth. Moreover, plague infestation can affect seedlings development. Fast growth, wind or deficient root system development can cause seedling fall. All these situations must be recorded. A form could be found in Annex 1, that could help taking this information at field (SEEDLINGS VIGOR AND GROWTH FORM).

Figure 7. Taking height and diameter measurements in Cocoon planted seedlings.

Additionally, root elongation, volume and biomass will be measured in 3 seedlings per treatment and species. To take these measures it is necessary to carefully unearth the selected seedlings (Fig. 8). We will take pictures of stems and roots (having a 20 cm ruler as reference), and we will measure total shoot and root volume and length, taken from fresh seedlings. After soil cleaning we will measure shoot and root volume, and after drying at 60°C for 4 days we will measure total plant, shoot, root and lateral root weight.

Growth measures will be taken just after plantations and before the end of the project (autumn 2024). Root elongation will be measured only at the end of the project (autumn 2024).

Figure 8. Unearthing a *Rosmarinus officinalis* seedling (above) and measuring root elongation in the lab (below).

4.6 Habitat restoration

4.6.1 Vegetation structure

The growth of spontaneous and planted vegetation is an indicator of the restoration of the site. The evaluation of the structure and composition of this vegetation will allow determining the degree of restoration of the targeted habitats (Fig.9).

Structure will be evaluated quantifying cover types in each site or sub-site (differencing site-specific variables: flat vs slopes, soil types, etc.). It is necessary to distinguish between herbaceous cover, woody species cover (shrubs and trees), other soil cover types (plant remains and rocks) and bare soil (no cover). The method proposed is the point transect (Fig.10), where the evaluator records the cover type every 20 cm in a 25 cm transect, measuring the height when herbaceous or woody vegetation exist. A form could be found in Annex 1, that could help taking this information at field (VEGETATION SRUCTURE FORM). Vegetation height measures must be noted in the cells, and a tick must be putted when plant remains or rocks are present.

A minimum of 3 transects per hectare must be done in order to have representative measurements. In slopes, transects must be done parallel and perpendicular to the slopes. Transect vertex must be fixed with metal bars in order to repeat measures at the same place. It is recommendable to sketch a map with transects localization or localize transect vertex using a differential GPS or similar. Alternatively, we can associate vertex localization to a geolocalized seedling (see 4.5.2 section).

Vegetation structure measurements must be taken just after plantations and in spring 2024.

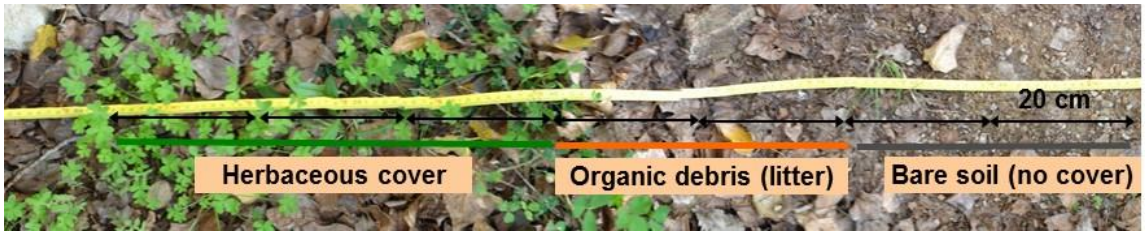

Figure 9. Different soil covers (herbaceous, litter, bare soil) in an evaluation transect.

Figure 10. Preparing transects for measuring vegetation cover in a restored area. See the fixed metal bars that will be let in the field in order to repeat the measures after three years (located jointly with a monitored seedling).

4.6.2 Vegetation composition (biodiversity)

In order to determine vegetation composition, all plant species must be identified in each site or sub-site (according to site specific variability: flat vs slopes, soil types, etc.), including the planted ones. The evaluator could take advantage of the transects to do this despite a general walk for the site or sub-site will be needed in order to detect all the plants (not all the existing plants will appear in the transects). For each plant, abundance estimation must be recorded, using this pattern ranks:

1: testimonial

2: low frequency (<25% soil cover)

3: high frequency (25%-75% soil cover)

4: dominant (>75% soil cover)

A form could be found in Annex 1, that could help taking this information at field (BIODIVERSITY MEASURES FORM). Flora inventories must be done in spring 2022 and 2024 in parallel to structure evaluation.

Figure 11. CREAF field-team doing flora inventories in a restored area. It is important to make this works when most of the vegetation have inflorescences, in order to facilitate species identification.

4.7 The Support Irrigation Methodology

To establish the basis for an accurate and unbiased data collection, Life-Niebla's team has defined a segregated support irrigation method divided in sectors as explained below. It is worth noting that this methodology follows estimations of one year. Support irrigation will be reviewed and updated annually in order to adapt and improve any deviations that might significantly impact the project's overall data collection.

Land division:

1. Every typology should be divided in similar plot areas (or as close as possible given the terrain).
2. Every plot will be divided in 3 parts (sector 1, 2 and 3):
    a) Sector 1 will contain at least 15 individual seedlings per species.
    b) Sector 2 & 3 will be divided in equal parts, with at least 50 seedlings per sector and species.
3. Support irrigation pipelines will be set in such a manner that two hoses can be connected and used simultaneously from each side of every sector.

Irrigation regime:

1. If the plot is located on a hillside, sector 1 should be located at the top, making sector 3 the bottom section of the plot (this is relevant for the irrigation regime).

2. All new reforestation will receive a settlement watering of 5L per plant at the time of planting.

3. Sector 1 (containing 15 individual seedlings per species), will only receive the settlement irrigation, except for the traditional reforestation method that will receive 5L watering per plant, twice a month from May to September (both inclusive).

4. In 'Sector 2' plants with individual FWC and AFDS treatments will receive 5L watering per plant, twice a month from July to September (both inclusive). Cocoon system treatment will receive two tanks refill during summer. Traditional reforestation method will receive 5L watering per plant, twice a month, from May to September (both inclusive).

5. In 'Sector 3' all plants will receive 5L watering per plant, twice a month from May to September (both inclusive) – At exemption of Cocoon system method which will require two tanks refill during summer.

The typology that will take the most water is Cocoon, however we must account for the nature of its own testing methodology. Cocoons will be closely followed by the 'Traditional method', working as control group for the whole experiment. Finally, Individual FWCs and the AFDS system will take the least amount of support irrigation.

5. Socioeconomic indicators

To better assess to what extend the project has had a socioeconomic impact, technicians, coordinators and other relevant members of the project must aim to accurately answer the questions below set as indicators, including quantitative data when feasible. The protocol described below, provides answers to Action D.2 *'Social and economic impact of the project's actions'*.

First, environmental social awareness must be prioritised. Helping local communities and international groups understand why habitat restoration is important not only for the sake of natural environment but for socioeconomic development and climate change mitigation, is key to success. Hence, several indicators will be measured as listed below:

- companies and professionals of the technology sector related to climate change, reforestation and fog collection participating on Climate Change International Days programmed for the project
- projects and investigations presented at Climate Change International Days on reforestation and fog collection
- number of people and entities participating at Climate Change International Days
- economic impact estimation from the International Days
- farmers and land workers who will receive direct information about the project
- and number of talks or workshops at:
    - schools and number of students participating
    - neighbourhood associations and number of participants
    - different environmental events and number of participants
    - ranchers or hunters associations and number of participants
    - environmental associations and number of participants

Furthermore, several communication channels have been opened (website, Facebook, Instagram, etc.) and will be constantly monitored in order to analyse the reach of the present project.

The abovementioned communication channels and dissemination activities are supported by the '*E'* Actions; *'Promotional and dissemination material', 'Information and awareness-raising'*, *'International Days on Climate Change, Reforestation and Fog Collection'* and *'Replication and transfer plan'*.

On the other hand, a more economic focused variable relating to the creation of green jobs (directly or indirectly) and the stimulation of the so called 'green economy and services' through Life-Nieblas development, will be measured. It is so, that the indicators listed below shall be recorded and analysed to quantify the economic impact of these actions:

- Jobs generated directly by the project:
    - personnel hired for the execution of the tasks assigned in the project for each beneficiary
    - beneficiaries pre-existent personnel with tasks assigned in the project
    - and total personnel of each beneficiary
- number of companies and professionals directly hired as an external assistance by the project – Including third parties hired by the external contractors that directly result from this project development
- number of jobs created or affected by the replications of the different reforestation typologies tested on the project

To bring all this information together, several graphs, tables, maps and charts will be produced in order to visually represent the socioeconomic activity that Life-Nieblas has generated.

Acknowledgements

Cabildo de Gran Canaria and Heredad de Aguas de Arucas y Firgas for their continuous support during field visits and research on this action.

Authors:

Gustavo Viera Ruiz - gvierui@gesplan.es

Saúl Oliva Cabrera - solicab@gesplan.es

André Mota - andremota@cimvdl.pt

Ana Paula Pereira - paulapereira@cimvdl.pt

Antonio Ortegón Gallego - aortegon@itccanarias.org

Gilberto Martel Rodríguez - gmartel@itccanarias.org

Gustavo Melian Monroy - gmelian@itccanarias.org

Xavier Domene - x.domene@creaf.uab.cat

Vicenç Carabassa - v.carabassa@creaf.uab.cat

Annex 1. Field forms

SEEDLINGS VIGOR AND GROWTH FORM

Date of measurement: **Site:**

Sub-site: **Sector:**

Seedling identification (code)	Treatment[1]	Vigor[2]	Height (cm)	Diameter (mm)	Other observations[3]

[1]Treatment codes:

T: Traditional

CO: Cocoon without refilling

CO70: Cocoon with refill of 70l/plant

CO90: Cocoon with refill of 90l/plant

FWC: individual fog water collector without irrigation

FWC30: individual fog water collector + irrigation with 30l/plant

FWC50: individual fog water collector + irrigation with 50l/plant

AFDS: Autonomous Fluid Discharge System without additional irrigation

AFDS30: Autonomous Fluid Discharge System + additional irrigation with 30l/plant

AFDS50: Autonomous Fluid Discharge System + additional irrigation with 50l/plant

Others (specify treatment)

[2]Vigor codes:

3: Healthy tree, with more than 75% of green, not wilted leaves. Also active growing points (apices) may be visible

2: Affected tree, with 25-75% of the leaves being wilted, yellow or brown

1: Severely affected tree with less than 25% of the leaves being green (i.e. the majority wilted, yellow of brown)

0: Presumably dead tree with no or only wilted leaves. Tree seedlings, however, may still recover by resprouting after a rain event

R: resprouted tree

[3]Other observations codes:

G: Grazing

B: Broken stem

P: Plague infestation

T: Tree fall

VEGETATION ESTRUCTURE FORM

Date of measurement: **Site:** **Sub-site:**

Transect ID:

	0 m					1 m					2 m					3 m					4 m				
	0-20	20-40	40-60	60-80	80-100	0-20	20-40	40-60	60-80	80-100	0-20	20-40	40-60	60-80	80-100	0-20	20-40	40-60	60-80	80-100	0-20	20-40	40-60	60-80	80-100
Herbaceous																									
Woody																									
Org. debris																									
Rocks																									

	5 m					6 m					7 m					8 m					9 m				
	0-20	20-40	40-60	60-80	80-100	0-20	20-40	40-60	60-80	80-100	0-20	20-40	40-60	60-80	80-100	0-20	20-40	40-60	60-80	80-100	0-20	20-40	40-60	60-80	80-100
Herbaceous																									
Woody																									
Org. debris																									
Rocks																									

	10 m					11 m					12 m					13 m					14 m				
	0-20	20-40	40-60	60-80	80-100	0-20	20-40	40-60	60-80	80-100	0-20	20-40	40-60	60-80	80-100	0-20	20-40	40-60	60-80	80-100	0-20	20-40	40-60	60-80	80-100
Herbaceous																									
Woody																									
Org. debris																									
Rocks																									

	15 m					16 m					17 m					18 m					19 m				
	0-20	20-40	40-60	60-80	80-100	0-20	20-40	40-60	60-80	80-100	0-20	20-40	40-60	60-80	80-100	0-20	20-40	40-60	60-80	80-100	0-20	20-40	40-60	60-80	80-100
Herbaceous																									
Woody																									
Org. debris																									
Rocks																									

	20 m					21 m					22 m					23 m					24 m				
	0-20	20-40	40-60	60-80	80-100	0-20	20-40	40-60	60-80	80-100	0-20	20-40	40-60	60-80	80-100	0-20	20-40	40-60	60-80	80-100	0-20	20-40	40-60	60-80	80-100
Herbaceous																									
Woody																									
Org. debris																									
Rocks																									

BIODIVERSITY MEASURES FORM

Date of measurement: **Site:** **Sub-site:**

SPECIES	ABUNDANCE

Abundance codes:

1: testimonial

2: low frequency (<25% soil cover)

3: high frequency (25%-75% soil cover)

4: dominant (>75% soil cover)