Action C.5: Synergies between the Project and Environmental, Agricultural, Energy, and Water Management Sectors and Policies

Work carried out by Gesplan S.A. in the consolidation of the methodology and integration of results obtained in other sectors and management policies through the reforestation and climate change mitigation project through innovation in the capture of fog water

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1. Brief

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 being 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, 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 in 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 the development of ACTION C.5: “Synergies between the project and environmental, agrarian, energy, and water management sectors and policies”, as described by the technical team of the Life Nieblas project and in accordance with the relevant monitoring guidelines.

The Life Nieblas project aims to integrate its results into various political, social, and economic areas beyond those directly related to reforestation policies. The objective is to demonstrate the innovative capabilities of fog collectors and the pioneering reforestation methodologies based on fog water harvesting in suitable environments, in order to:

- Reduce greenhouse gas emissions and the carbon footprint associated with these actions.
- Increase seedling survival rates.
- Enhance the efficiency of innovative fog water collection methodologies and new environmental restoration techniques.

We have already identified socio-economic sectors interested in sharing information and learning about the project's results to explore potential implementation. On the one hand, water resource managers are keen to increase their water volumes through fog water collectors. On the other hand, various institutions and entities see an opportunity to utilise fog water harvesting to facilitate planting in hard-to-reach areas.

The implementation of Action C.5 has followed a structured approach, with the first step detailed in this technical report. This will subsequently lead to the creation of synergies with socio-economic stakeholders across the studied sectors. The process consists of the following steps:

- Step One: We will compile a sector-specific report (agriculture, energy, etc.), outlining procedures to improve the cost-benefit ratio of the new methodologies. For instance, the AFDS could help reduce labour costs in maintaining new fruit tree plantations, particularly in remote or difficult-to-access locations.
- Step Two: Meetings will be held with professional groups from the relevant sectors to present the details of the procedures, results, and potential applications. Guidance will also be provided on the implementation of the studied prototypes. At the end of these sessions, attendees will receive a catalogue summarising the results of the various methodologies along with proposals for their implementation.
- Step Three: Based on the feedback from these meetings, a sector-specific recommendations report will be produced. This document will contain concrete proposals, which will be used as examples in both regional and international sessions.

3. Existing Regulations on Climate Change Mitigation and Greenhouse Gas Reduction in Socio-Economic Sectors and Management Policies

The current legal framework in the European Union, Spain, and the Autonomous Community of the Canary Islands governs the implementation of the Life Nieblas project and related actions on climate change mitigation and greenhouse gas reduction through socio-economic sectors and public water management policies. The relevant regulations are as follows:

Regulations Governing the Life Nieblas Project at the European Level

In response to the LIFE19 European project call, the Life Nieblas project operates within this legal framework, which aligns with EU climate policies.

The project proposes, tests, and collects data to pilot approaches aimed at reducing carbon emissions, thereby contributing to climate change mitigation efforts, particularly those outlined in the 2050 Roadmap for a Competitive Low-Carbon Economy.

Life Nieblas, in line with the EU's commitment to the Paris Agreement, is testing innovative reforestation methodologies that demonstrate high potential for replication and transferability. The collected data is being analysed as part of the project's monitoring actions.

Life Nieblas aims to support the emission reduction targets set in the Paris Agreement for non-ETS sectors (sectors not included in the EU Emission Trading Scheme). Accordingly, the project is conducting a Life Cycle Assessment (LCA) (see Annex XXIV), which concludes that the proposed techniques and methods can positively contribute to the Paris Agreement and other regulations, including:

- The Effort Sharing Regulation (EU) 2018/842
- The Land Use, Land-Use Change, and Forestry (LULUCF) Regulation (EU) 2018/841

Additionally, Life Nieblas aligns with EU Climate Adaptation Strategies. The proposed reforestation methodologies, in addition to water collection applications, comply with EU policies on drought-prone area management, flood prevention, and coastal management. Furthermore, the project supports priority areas 4 and 5 of the EU's 2019 Call for Action, which focus on forestry resilience and support for EU outermost regions.

Regulations Governing the Life Nieblas Project at the National Level (Spain)

At the national level, Law 21/2013 of 9 December on Environmental Assessment, in its Article 7, defines the scope of environmental impact assessments:

"2. A simplified environmental impact assessment will be required for:

- a) Projects listed in Annex II.
- b) Projects not included in Annex I or Annex II that may significantly affect, either directly or indirectly, areas protected under the Natura 2000 Network."

As the study area of the Life Nieblas project is located within a Natura 2000 site, it falls under this regulatory framework.

Law 7/2021 of 20 May on Climate Change and Energy Transition

This law reflects Spain's commitment to international and EU climate goals and presents an economic modernisation opportunity. It promotes an equitable distribution of wealth in the process of decarbonisation, placing climate action and energy transition at the heart of Spain's political agenda. These elements are considered key drivers for economic and social development, aimed at building a sustainable future and generating new socio-economic opportunities.

This law provides an institutional framework to gradually align Spain's reality with climate action regulations, ensuring policy coordination and fostering synergies towards carbon neutrality.

The requirement to limit emissions influences sectoral policies and necessitates changes in consumption patterns. However, this transformation also brings benefits linked to the modernisation of Spain's production model and energy system, creating opportunities for employment, business, and growth—provided a long-term perspective facilitates an orderly transition towards decarbonisation.

Among the key transformations expected in the energy sector (and consequently across the economy) as a result of this energy transition, one of the most significant is the systematic improvement of energy efficiency. Specifically, the Spanish economy's primary energy intensity is expected to improve by 3.5% annually until 2030. Additionally, Spain's energy dependency (which stood at 74% in 2017) is projected to decrease to 61% by 2030, due to reduced imports of coal and oil. This shift will be driven by the transition to a more efficient economy based on renewable energy technologies across all sectors. This structural change will not only positively impact Spain's trade balance but also enhance national energy security.

Regulations on Climate Change Mitigation and Greenhouse Gas Reduction in the Canary Islands

Law 6/2022 of 27 December on Climate Change and Energy Transition in the Canary Islands

This regional climate and energy transition law was developed in response to the duty and responsibility of contributing to the global climate fight at a local level. The Canary Islands have made substantial efforts in recent years—both at the island council and municipal levels—to implement the Covenant of Mayors for Climate and Energy, through Sustainable Energy and Climate Action Plans (SECAPs). This initiative is the largest global movement of cities and municipalities committed to local climate and energy action.

Aligned with this commitment, the majority of local administrations in the Canary Islands have joined the initiative, and many have developed action plans aimed at achieving key European targets, including:

- A 40% reduction in greenhouse gas emissions by 2030.
- A shared approach to mitigation and adaptation to climate change.

To achieve these goals, a coordinated strategy is required between the Government of the Canary Islands, island councils, and municipalities.

Covenant of Mayors for Climate and Sustainable Energy (SECAPs)

The Covenant of Mayors for Climate and Energy is an initiative in which thousands of local governments pledge to achieve the European Union's climate and energy objectives.

This voluntary commitment involves municipalities developing actions to tackle challenges such as:

- Climate change mitigation
- Adaptation to its adverse effects
- Building more energy-efficient territories
- Promoting universal access to safe, sustainable, and affordable energy services

Beyond environmental benefits, these objectives will also drive the energy transition, enabling the adoption of renewable energy in both public infrastructure and private households and businesses. This shift will lead to significant public cost savings, reduce individual energy bills, and stimulate the creation of stable employment and economic growth. Furthermore, it will enhance energy independence and increase access to national and European subsidies and funding opportunities.

Decree 80/2023 of 18 May – Canary Islands Climate Action Strategy

The Canary Islands Climate Action Strategy is the regional planning instrument designed to fulfil commitments in the fight against climate change. It serves as a roadmap to transform the Canary Islands into a climate-neutral and climate-resilient society by 2040.

This strategy:

- Identifies major climate risks in the Canary Islands
- Sets targets for emissions reduction, carbon capture, energy efficiency, renewable energy deployment, and sustainable mobility
- Outlines strategic lines and measures for climate change mitigation and adaptation
- Defines research, development, and training needs in climate action

Law 4/2017 of 13 July on Land and Protected Natural Spaces in the Canary Islands

Under Article 2, Section e of this law:

"An ordinary environmental impact assessment will be required for projects that:

- b) Are not listed under Category A or B but may significantly affect, either directly or indirectly, Natura 2000 Network areas."

As a conclusion, the Life Nieblas project, which focuses on reforestation and climate change mitigation through fog water collection technologies, should be exempt from simplified environmental impact assessment requirements. The impact on the Natura 2000 Network is not deemed significant, and the project falls under the management framework of the Protected Natural Space itself.

The study area is partially located within the Special Conservation Area (SCA) Barranco de La Virgen (ES7010038).

Special Area of Conservation (SAC) ES7010038 – Barranco de La Virgen

The Special Area of Conservation (SAC) ES7010038 – Barranco de La Virgen partially borders the SAC ES7010002 – Barranco Oscuro to the west, while its northern boundary is defined by the SAC ES7010004 – Azuaje. The first of these areas is part of the Canarian Network of Natural Spaces.

Since part of the SAC Barranco de La Virgen overlaps with the Doramas Rural Park, and the latter does not yet have an officially approved PRUG (Use and Management Plan), the Management Plans of the affected municipalities will serve as the urban planning instruments, structuring the management and execution of land use regulations.

The municipalities of Moya and Valleseco are impacted by the overlapping area between the SAC Barranco de La Virgen and the Doramas Rural Park.

4. Socio-Economic Sectors Identified for the Implementation of Innovative Fog Water Collection Techniques

The Life Nieblas project is designed as a participatory process that ensures the implementation of its findings following the scientific research phase and the achievement of its objectives in developing innovative atmospheric water collection technologies and environmental restoration techniques.

Life Nieblas is committed to transferring the acquired knowledge and results beyond the scope of its core environmental reforestation policies, integrating new perspectives from various socio-economic sectors. Through feedback from different sectors, the project has successfully developed prototypes adapted to specific sectoral needs. This maturation phase highlights the innovative capabilities of fog collectors and the practical applications of restoration methodologies while assessing their acceptance among the public.

To achieve this, key sectors of society, including professionals, scientists, activists, and policymakers, have played a crucial role in the project's development. This cross-sectoral integration is expected to foster synergies particularly in the following sectors and policy areas:

- Environmental Sector: The tested fog collection prototypes have been shown to increase plant survival rates at lower costs, improving both the scale and quality of reforestation efforts. Additionally, their implementation could lead to reduced dependence on water extraction from aquifers, rivers, and lakes, thereby lowering energy consumption and minimising greenhouse gas emissions associated with pumping and transporting water.

- Agriculture Sector: The water collection capacity demonstrated by the project indicates that even a modest investment could result in lower production costs and increased competitiveness. The reforestation techniques tested could also be repurposed for the planting of commercial fruit trees, enhancing sustainability in agricultural production.

- Energy Sector: By reducing reliance on conventional water sources, the project can help lower overall energy demand, particularly in regions where water extraction and distribution are energy-intensive processes.

- Water Management Sector: In specific areas, the project will contribute to a reduction in overall water demand, as well as in the infrastructure required for water transportation, improving water availability in a sustainable manner.

Environmental sector

In the context of prolonged droughts, it is crucial to explore and promote water-saving strategies, such as fog water collection systems, to maximise the use of every available drop of water.

The Life Nieblas project has provided valuable insights for the environmental sector, demonstrating the effectiveness of innovative technology in the collection of atmospheric water. Through the implementation of three different fog water collection systems, the project has successfully extracted approximately 119,460 litres of water between 2021 and 2024 in a pilot site on the island of Gran Canaria.

This outcome has facilitated the replication of environmental restoration efforts in degraded areas, reinforcing its role as a complementary irrigation source for reforested hectares. To date, this approach has supported reforestation efforts in areas severely affected by wildfires in 2017 and 2019 in Gran Canaria (Figure 1).

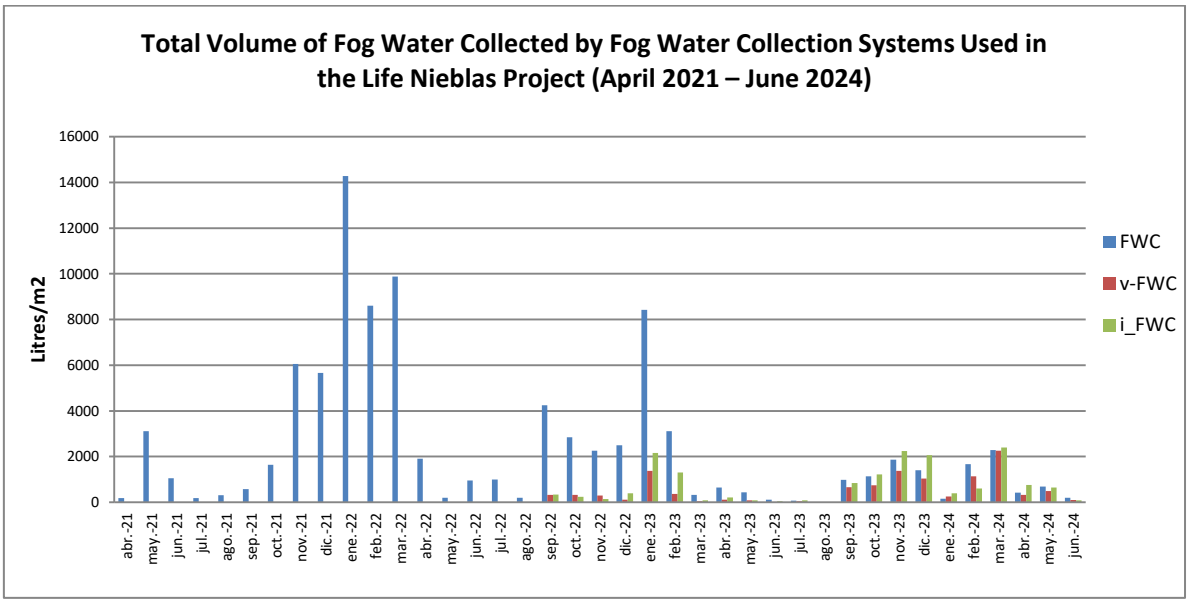

Figure 1 Total Volume of Water Collected by Fog Water Collection Systems Used in the Life Nieblas Project (April 2021 – June 2024, Gran Canaria).

According to Figure 1 and the Action C.1 report "Innovation on Fog Collectors: Monitoring and Evaluation Protocol", the following prototype systems have been installed:

The first system used for fog water collection was the Traditional Fog Water Collector (FWC). This collector is designed as a four-metre-high tower with a concrete base and a polyethylene mesh.

From its installation in April 2021 until June 2024, a total of nine FWC units have been deployed, collectively capturing 91,631 litres of water (Figure 2).

Figure 2 Tradictional Fog Collector

The Volumetric Fog Water Collector (v-FWC) was installed from September 2022 onwards. This system features a higher water capture capacity, achieved through a 3D mesh structure on the primary microdroplet collection screen, which increases the surface area for water accumulation. From its installation until June 2024, a total of six v-FWC units have been deployed, collectively capturing 11,492 litres of water (Figure 3).

Figure 3 Volumetric Fog Collector

The third prototype, the Innovative Fog Water Collector (i-FWC), is inspired by the natural moisture-capturing ability of the Canary Island pine needles. This system was developed to create a more efficient, easy-to-install, and transportable fog collector while also being more cost-effective than the previously mentioned models.

The i-FWC consists of metallic filaments hanging from crossbars, mimicking the needle-like leaves of the Canary Island pine to enhance fog water collection.

Thanks to its simplified installation and affordability, this system has collected approximately 23,280 litres of water from September 2022 to June 2024. In total, 24 i-FWC units have been deployed (Figure 4).

Figure 4 Innovative fog collector

Based on the prototypes used and the results obtained, it can be concluded that fog water collection systems are highly beneficial for various applications within the environmental sector. Among their key contributions are their effectiveness in reforestation efforts and environmental management.

Within this project, four reforestation methodologies have been implemented, each benefiting from the fog water collection systems mentioned earlier:

Traditional reforestation: is a method used as a control group in the Life Nieblas project, allowing for the establishment of a database to compare field results with those of other reforestation methodologies.

This approach consists of planting individual seedlings in holes measuring 40 × 40 × 40 cm, without additional soil preparation or tillage. A minimum spacing of 1.50 metres is maintained between each plant to facilitate optimal growth and development. Irrigation is provided through polyethylene (PE) pipes, delivering water directly to each plant.

One of the key characteristics of traditional reforestation is that no specialised equipment is required for its implementation. It is widely regarded as a suitable technique for reforesting degraded soils, even though, in this project, it serves as a benchmark for assessing the effectiveness of different reforestation approaches.

Regular irrigation is required in the first year to ensure seedling survival and growth. Water is delivered directly to the base of each plant using PE pipes, with the amount of water required depending on site conditions and the water needs of the selected plant species.

It is crucial to monitor soil moisture levels closely and provide an adequate water supply to support healthy plant development (Figure 5).

Figure 5 Taditional reforesatation system

Cocoon: The Cocoon system is a self-contained, biodegradable nurturing system designed for individual tree planting. It is buried beneath each tree, creating a humid and cool environment, while also offering protection from harsh weather conditions and herbivores.

Each Cocoon reservoir has a capacity of 20 litres of water, which is gradually released into the soil. The slow water release process, combined with underground insulation, significantly reduces evaporation losses.

This irrigation method was originally developed under the Life Green Link project, where it was tested in high drought risk areas in southern Gran Canaria. One of its most notable advantages is that it eliminates the need for regular irrigation and constant monitoring, reducing both human intervention and financial investment (lower water consumption, no need for irrigation infrastructure, etc.).

Additionally, the biodegradable materials used in Cocoon production are more cost-effective than synthetic alternatives used in similar systems. Another significant benefit is that as the Cocoon naturally degrades, its organic components, including crop residues, pasture materials, and other organic compounds, enrich the soil, providing a continuous source of nutrients for the seedlings during their first years of growth. This feature enhances the success rate and supports full forest establishment.

While Cocoon reforestation requires some initial irrigation during the first year, water is supplied individually to each plant via PE pipes.

At the time of planting, each Cocoon reservoir is filled with 20 litres of water. Additional irrigation may be applied as needed during the first year to support seedling growth. It is essential to monitor soil moisture levels and ensure that plants receive sufficient water for healthy development (Figure 6).

Figure 6 Cocoon reforestation system

Individual fog water collector (IFWC): Technical observations have demonstrated the ability of anti-herbivore metal mesh to reach the dew point due to diurnal temperature variations, as observed in the Life Guguy project (2013).

To enhance this effect and improve the efficiency and durability of the method, Life Nieblas has implemented a 25 × 25 mm steel mesh, overlaid with a 3 × 3 mm Russell-type polyethylene (PE) mesh, the same material used in traditional fog collection technology.

This dual-layer structure serves two main functions:

- Condensation and impact-based water collection for the plants.
- Additional protection for seedlings, offering shade and wind resistance during their early growth stages.

To assess the effectiveness of the second layer, 50% of the IFWC units were installed with Russell netting, while the remaining 50% were installed without it. The results indicated that IFWCs incorporating PE mesh had significantly higher survival rates than those using only the metallic mesh.

The IFWC method is directly dependent on fog availability. However, rain and drizzle events also contribute to increased humidity within the structure, enhancing water collection efficiency. Additionally, this system offers protection against excessive exposure to sunlight and strong winds, making it more versatile than any other method tested in Life Nieblas.

Despite its ability to condense water, IFWC-based reforestation still requires regular irrigation during the first year to ensure plant survival and growth. Water is delivered individually to each plant via PE pipes, with the amount required depending on site-specific conditions and the water needs of the selected plant species.

It is crucial to monitor soil moisture levels closely and provide sufficient irrigation to support healthy plant development (Figure 7).

Figure 7 Individual Fog Collector (IFWC) system

Autonomous Fluid Discharge System: The Autonomous Fluid Discharge System (AFDS) aims to grow plants that are difficult to access autonomously, without energy or human intervention. It was invented from the original idea of a farmer called Emilio Navarro Rosario. He has worked on the project collaborating in the development and monitoring of these systems together with ITC staff. As a farmer in remote places, with difficult access and scarcity of water, Emilio had to overcome the difficulties of the environment by making time compatible with other jobs. This intelligent solution has not only saved you time, but has also given you autonomy and a considerable reduction in energy use.

The AFDS reforestation systems will be aimed to supply water through a drip irrigation system. For this purpose, reforestation systems with AFDS have been assigned to supply specific irrigation areas.

Water generated on an irregular basis by means of a fog collector, is hydraulically transferred into a water tank where the AFDS will be installed. Once a certain water level has been reached, the AFDS will start running automatically and discharging water from the tank through the drip irrigation network and watering each plant.

Once the tank will be empty, the AFDS returns to its initial state, waiting for the tank to fill up in order to begin the cycle all over again.

The amount of time needed for each irrigation cycle will depend on the amount of water generated by the fog collector (or irregular source of water) and the amount of water to be stored in the tank before the AFDS is activated and starts irrigating and de characteristics of the irrigation network. For this reason, the AFDS system can be adjusted in height, so that irrigation can be carried out with a smaller amount of water (Figure 8).

Figure 8 Autonomous Fluid Discharge System (AFDS)

The various reforestation methods implemented in the Life Nieblas project have evolved towards greater effectiveness and higher plant survival rates. The success rates recorded for each methodology are as follows:

- 74% survival rate for the Individual Fog Water Collector (IFWC) system.
- 68% survival rate for the Cocoon system.
- 86% survival rate for the Autonomous Fluid Discharge System (AFDS).
- 33% survival rate for the traditional reforestation method.

Additionally, the most effective reforestation techniques for plant survival also prove to be the most cost-efficient. When comparing investment per methodology and total survival rates, the 2024 market prices indicate that:

- The IFWC system, at €59 per unit, is the most economical among all reforestation methods, factoring in costs related to manufacturing, acquisition, and material handling by technical staff.
- In contrast, the traditional irrigation system costs €136 per surviving tree, significantly increasing the financial burden due to higher material costs and a greater dependence on human intervention. This also results in a higher economic footprint and greater carbon emissions.

Considering the current climatic conditions and global warming trends, the effectiveness of these methods is expected to be impacted by:

- The increasing frequency and intensity of heatwaves.
- Extended drought periods and erratic precipitation patterns (including extreme torrential rains).
- The weakening or alteration of wind patterns, which influence the transportation of fog microdroplets.
- Greater duration and severity of wildfires.

In this context, atmospheric water collection and environmental restoration techniques present a viable alternative to combat desertification, facilitating:

- Increased CO_2 capture.
- Reduced reliance on fossil fuel-based water extraction methods (such as groundwater pumping).
- Enhanced water infiltration capacity in the subsoil, contributing to better soil retention.

The fog water collection and restoration prototypes developed in Life Nieblas are considered a high-value tool for environmental professionals, technicians, and scientists. They not only strengthen ecosystem restoration efforts but also play a crucial role in wildfire prevention and management by increasing vegetation cover compared to the current shrubland, which is a direct consequence of anthropogenic impacts.

Another key advantage is the localised water supply, which eliminates the need for external transportation. This water can be used not only for irrigation but also for storage as a localised emergency water resource in the event of wildfires.

	SWOT Analysis of the Application of Life Nieblas Reforestation and Irrigation Systems in the Environmental Sector	
	Internal Factors	**External Factor**
	WEAKNESSES *(Challenges)*	**THREATS** *(Risks)*
Negative aspects	**-** Fog water collection does not fully meet irrigation needs for large-scale reforested areas during the initial planting phase**.** - Can only be applied in reforested areas where fog exposure is consistent**.** - Water capture is not guaranteed daily, as it depends on weather conditions.	**-**Prolonged droughts due to climate change may compromise fog water collection efficiency, requiring complementary irrigation systems**.** **-**Extreme weather events (e.g., hurricanes, wildfires) pose a high risk to infrastructure durability**.** -Potential land-use regulations could impose restrictions on soil suitability for fog water collection infrastructure.
	STRENGTHS *(Advantages)*	**OPPORTUNITIES** *(Potential Benefits)*
Positive aspects	-- Higher plant survival rates due to the effectiveness of restoration systems. -Substantial reduction in carbon footprint and greenhouse gas emissions. -Ease of installation for fog water collection irrigation systems. -Strong public sector support for reforestation and environmental development through sustainable restoration techniques.	- Significant cost savings in irrigation system expenses and operational costs for plantations. - Potential for completely sustainable self-sufficiency in well-established plantations. - Higher irrigation water quality compared to other sources, while also contributing to groundwater recharge**.** - Versatile reforestation systems that can be implemented by both public and private entities**,** contributing to climate change adaptation and desertification mitigation.

Agricultural Sector

A territorial demonstration site has been established as a pilot project to serve as a reference for other regions, facilitating participatory discussions with professionals from the agricultural sector. This model has been implemented in Gran Canaria and the Canary Islands, where agriculture plays a significant role, both in terms of commercial farming and subsistence agriculture.

Although agriculture currently represents a smaller share of the socio-economic landscape compared to other sectors, it has historically played a dominant role in shaping human activity and land use over the years.

The northern and northeastern mid-altitude areas of islands such as Gran Canaria remain the main hubs of agricultural land use and active production. These areas have maintained their agricultural identity over time. However, in contrast, coastal regions—particularly in the southeast and south of the island—have seen a steady decline in agricultural activity.

This abandonment of agriculture in coastal zones has led to severe desertification processes and biodiversity loss, largely driven by the negative environmental impacts of industrial agriculture (Figure 9).

Figure 9 Geographical Distribution of the Agricultural System in Gran Canaria (2019)

Analysis of Agricultural Systems and Land Use in Gran Canaria

The territorial model analysed in Gran Canaria can be extrapolated beyond the Canary Islands, applying to many other national and international regions where professionals, technicians, and scientists from the agricultural sector have contributed insights.

It is important to acknowledge that modern and unsustainable agricultural practices place significant stress on natural ecosystems, leading to:

- Increased soil erosion
- Loss of biodiversity
- Water scarcity

These factors can destabilise ecosystems and disrupt the balance of nature.

Agricultural systems are heterogeneous and dynamic, making their classification complex, particularly when analysing land use variations. This complexity is evident in all territories, but in the Gran Canaria model, a classification system was applied, categorising 55 types of crops and agricultural associations (including pastureland, fallow land, and forested areas), which were then grouped into 10 broader categories.

In the first classification, the land use categories are divided as follows:

- Seven categories linked to cultivated land:
  - Other crops
  - Vegetable gardens
  - Vineyards
  - Ornamental plants
  - Tomato crops
  - Fruit orchards
  - Banana plantations
- One category for pastureland
- Two categories for non-cultivated land:
  - Fallow land
  - Forested areas

The land use balance by category reveals a decline in the area dedicated to agriculture across nearly all crop types, with the exception of fruit orchards and banana plantations. These two high-yield, water-intensive crops continue to expand, contributing to significant environmental stress, particularly in terms of water resource depletion. Additionally, the proportion of non-cultivated land has also increased (Figure 10).

	2013	2019	Diferencia
Otros	554,15	384,64	-169,50
Huerta	4.547,45	4.414,37	-133,09
Viña	224,74	208,76	-15,98
Ornamentales	134,27	98,09	-36,18
Tomate	688,10	481,81	-206,29
Frutales	2.140,43	2.528,17	387,74
Platanera	1.719,74	1.862,84	143,09
Pastizal	1.356,70	1.302,55	-54,14
Sin cultivo	17.614,92	17.762,79	147,87
Resto de superficies	126.617,65	126.554,12	-63,53
TOTAL	**155.598,16**	**155.598,16**	

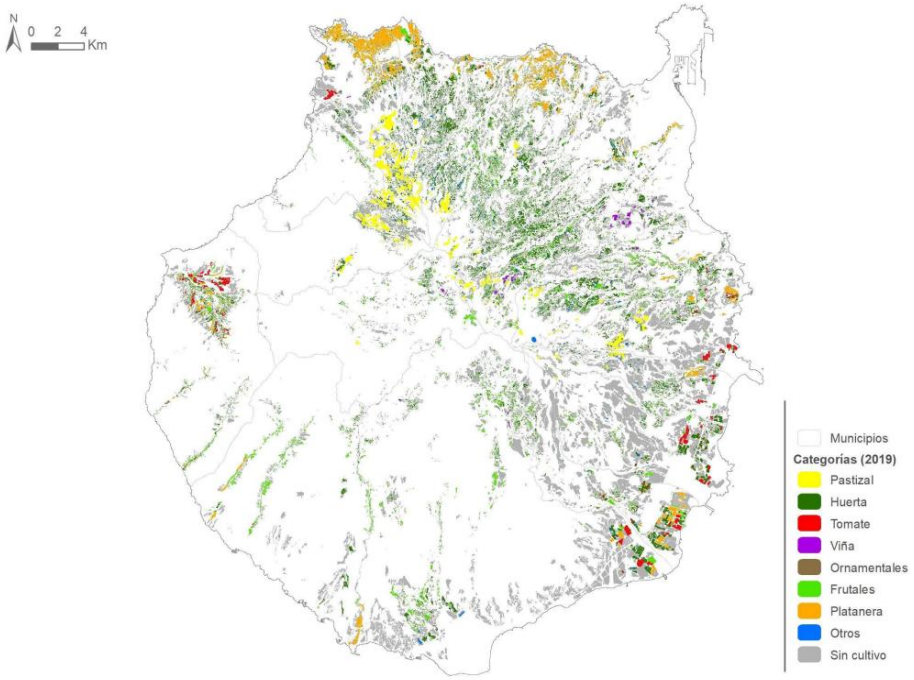

Figure 10 Geographical Distribution of Cultivated and Non-Cultivated Land Categories (2019)

The analysis of agricultural activity in Gran Canaria, which is primarily concentrated in the mid-altitude regions of the island, highlights the significant impact of land use on water scarcity.

The allocation of land for different crop types (herbaceous and woody) plays a major role in unsustainable agricultural practices, which are contributing to a severe depletion of surface water resources. As a result, there is an increasing reliance on groundwater extraction through galleries and wells to meet the water demands of both the population and the agricultural sector.

Given the limited availability of groundwater, particularly in the eastern Canary Islands, and the rising demand exceeding natural supply in major urban centres, alternative solutions have been sought over time (Figure 11). These include:

- Seawater desalination
- Reuse of treated wastewater

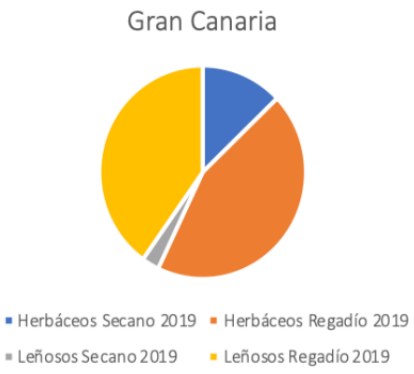

Figure 11 Land Allocation for Each Crop Type (Herbaceous and Woody) in Gran Canaria (2019)

It is evident that subtropical fruit orchards (irrigated woody crops) are the primary agricultural sector in Gran Canaria with high water demand. The water footprint of crops such as bananas, pineapples, and avocados is significantly high, with notable differences between them:

- Bananas require 300 to 400 litres of water per kilogram of fruit produced.
- Avocados, on the other hand, can require over 700 litres per kilogram and may even reach 1,000 litres per kilogram, which is:
    - Almost double the water demand of bananas.
    - Nearly three times the water needed for oranges.
    - Five times the amount required for tomatoes.

Given this high water consumption, fog water collection presents a viable complementary solution for increasing available water resources. Fog collectors, which have demonstrated high efficiency in capturing microdroplets, can serve as a valuable supplement to traditional water sources.

The most effective system, as demonstrated in the project, is the Innovative Fog Water Collector (i-FWC), which offers superior efficiency in harvesting fog water. This natural water source can be utilised for various agricultural and livestock purposes (Figure 12), including:

- Irrigation of crops.
- Refilling agricultural and livestock water reservoirs (cisterns, ponds, etc.).
- Supporting irrigation systems in farming operations.
- Reducing production costs and increasing competitiveness.

Figure 12 Example of a Water-Efficient Orchard Associated with Vineyard Cultivation in Gran Canaria

Throughout the knowledge transfer process, multiple synergies have been established between the Life Nieblas project and the agricultural sector in Gran Canaria, primarily through farmers interested in the functionality, efficiency, and evolution of innovative fog water collection systems. This growing interest has been driven by rising water costs and the ongoing impacts of climate change, which are worsening drought conditions and increasing the need for alternative water sources. In response, it is essential to create a space for discussion and professional support networks within the agricultural sector, allowing stakeholders to address concerns, showcase the benefits of fog water collection technology, enhance intervention efficiency, and improve plantation survival rates through sustainable irrigation solutions. (Figure 13)

Figure 13 Visit of the Life Nieblas Technical Team to Farmers in the Vega de San Mateo Area to Present the Application of a Fog Water Collection Irrigation System

	SWOT Analysis of the Application of Life Nieblas Reforestation and Irrigation Systems in the Agricultural Sector	
	Internal Factors	**External Factor**
	WEAKNESSES *(Challenges)*	**THREATS** *(Risks)*
Negative aspects	- Fog water collection does not fully meet the irrigation needs of high water-demand cultivation systems. - It can only be applied in agricultural areas with consistent fog presence. - It does not guarantee daily fog water collection, as it depends on weather conditions.	- The drought periods intensified by climate change do not ensure reliable irrigation using fog water collection alone, making it necessary to combine it with other irrigation systems. - Infrastructure vulnerability under extreme weather conditions, such as hurricane-force winds that may exceed the structural limits of the fog collectors. - Potential soil-use incompatibility due to legal regulations on land-use planning.
	STRENGTHS *(Advantages)*	**OPPORTUNITIES** *(Potential Benefits)*
Positive aspects	- Assurance of higher crop survival rates through innovative environmental restoration systems. - Significant reduction in carbon footprint and greenhouse gas emissions. - Ease of installation for reforestation systems.	- Cost savings on irrigation system expenses for crops. - Potential for sustainable self-sufficiency in certain crops that do not require high irrigation input. - Higher irrigation water quality compared to other cultivation areas that rely on systems requiring water composition improvements, such as increased nutrient content.

Energy

Every vital function requires energy to operate, from physical exertion and infrastructure development to natural biological processes, transportation, and water generation in arid regions. Achieving optimal energy efficiency that ensures a balanced, environmentally friendly approach without causing degradation remains a significant challenge, particularly in the transition away from fossil fuels.

The Life Nieblas project aims to support the water cycle through energy-efficient solutions, integrating innovative fog water collection systems where territorial conditions allow for their optimal application. By incorporating Life Nieblas technology, the water system benefits from significant reductions in pollution levels, lower carbon footprints, and cleaner, more sustainable environmental restoration techniques.

The island of Gran Canaria, as the pilot territory for Life Nieblas, offers valuable insights into the energy challenges associated with resource management technologies. Over time, energy policies have been shaped by an overreliance on fossil fuels, as seen in:

- High transportation costs due to the importation of fuel to island territories and isolated regions.
- Intensive energy consumption in industrial activities, which continues to drive carbon emissions.
- Growing demand in the service sector, requiring large quantities of consumable resources, further exacerbating carbon footprints.

Despite efforts to transition towards renewable energy, the sector still lacks the maturity needed to fully replace fossil fuels, which continue to dominate energy consumption.

One of the key energy concerns in Gran Canaria is the water-energy dependency. The availability and supply of freshwater are directly linked to energy consumption, particularly in:

- Groundwater extraction (wells and boreholes).
- Seawater desalination.
- Reclaimed water treatment.
- Wastewater treatment plants.
- Water transportation and distribution networks, which are highly energy-intensive.

The Canary Islands, like many other regions worldwide, face a severe water crisis, driven by:

- Overpopulation and high-demand economic sectors.
- Desertification and extreme climate change effects.
- Declining natural water resources, requiring high-energy water extraction and treatment methods.

Given these challenges, improving the efficiency of the water-energy cycle is crucial to enhancing human well-being while reducing the water footprint.

The current territorial context necessitates energy savings in water-related processes for the following reasons:

- Desalination and purification require large amounts of energy to make water suitable for human consumption. Wasting water means wasting energy.

- Water transportation to homes, farms, hotels, and industries relies on electricity. Higher water consumption directly increases energy demand.
- Heating water for cooking, irrigation, and storage tanks consumes additional energy, making efficient water use essential for energy conservation.

Currently, Gran Canaria relies on two primary sources of drinking water:

1. Desalination plants.
2. Groundwater resources.

These water sources are distributed among different sectors, including:

- Thermoelectric cooling systems.
- Public services.
- Bottled water production.
- Agricultural irrigation.
- Residential, commercial, and industrial sectors.

In remote communities, there is growing attention towards clean energy projects aimed at reducing the energy consumption of desalination plants and groundwater pumping systems, which have high operational costs.

Encouraging energy sustainability among citizens and professionals is essential. Policy measures must prioritise infrastructure that:

- Utilises clean energy sources for essential services like water supply.
- Reduces carbon footprints and mitigates climate change impacts.

Life Nieblas: A Sustainable Water-Energy Alternative

The Life Nieblas project offers a unique solution by providing complementary water technology that is entirely independent of traditional energy processes. It functions as a standalone system, capable of capturing fog water, which can then be reused for:

- Irrigation systems.
- Reforestation projects.
- Water supply for sustainable infrastructure.

These innovative fog collection systems generate minimal pollution and contribute to reduction in CO_2 emissions, particularly after successful reforestation efforts, making it a relevant climate change adaptation tool.

SWOT Analysis of the Application of Life Nieblas Reforestation and Irrigation Systems in the Energy Sector		
Internal Factors		**External Factor**
	WEAKNESSES *(Challenges)*	**THREATS** *(Risks)*
Negative aspects	- Fog water collection using Life Nieblas techniques does not fully meet the total water demand required for the survival of an entire population at present, making a minimum reliance on fossil fuel-based energy consumption necessary. - Its application is limited to areas where fog exposure is consistent and dependent on meteorological conditions, although it helps reduce fossil fuel consumption for certain essential needs.	- Prolonged drought periods caused by climate change do not guarantee a continuous, independent, and sustainable supply of fog-collected water, making it necessary to combine this system with other water sources that rely on both fossil fuel and renewable energy consumption. - Infrastructure vulnerability to extreme weather events, such as hurricane-force winds. - Potential land-use incompatibility due to territorial planning and regulatory restrictions. - Public policies continue to prioritise other water extraction processes that rely on fossil fuel consumption.
	STRENGTHS *(Advantages)*	**OPPORTUNITIES** *(Potential Benefits)*
Positive aspects	- Gradual reduction in fossil fuel consumption, beyond the initial energy required for the installation of fog water collection systems. - Reduction of the carbon footprint and greenhouse gas emissions.	- Ahorro de costos en gastos de energía para la obtención de agua - Posibilidad de autoabastecimiento de manera absolutamente independiente de energías externa - Versatilidad del binomio energía-agua más sostenible con el territorio para entidades públicas y privadas que suman ante el avance del cambio climático y los procesos de desertificación

Water Management

Gran Canaria offers excellent conditions for the implementation of fog water collection systems, requiring close attention to key reference areas such as Pinar de Tamadaba, Pinos de Gáldar/Llanos de Constantino, and Cruz de los Llanos/Presa de Cuevas Blancas, among others. These locations form part of the north-northeastern axis of the island, where fog-affected zones are prevalent.

This meteorological phenomenon is linked to the 'sea of clouds', which reaches the surface of the island's windward slopes under the influence of the trade winds (the northern region of Gran Canaria). The affected area extends from the Tamadaba Massif to the Caldera de los Marteles, covering elevations between 900 and 1,500 metres above sea level. The upper boundary of fog exposure is located in the central massif of the island, reaching its highest point at Pico de las Nieves (1,950.5 metres above sea level). Additionally, the ridge of small mountains and ravines in the petrified Tejeda Caldera also influences fog formation and capture potential.

This geographic context, which is replicable in other regions with similar geographic and climatic conditions, presents physical conditions that make fog water collection a feasible alternative for securing water resources.

Currently, despite the severe water crisis affecting much of the Canary Islands, Gran Canaria remains exempt from an official water emergency. While some islands have better geographical conditions for water availability, they are highly affected by droughts and climate change-related impacts, including:

- Lack of rainfall.
- Increased frequency of wildfires.
- More frequent and intense Saharan dust storms (calimas).
- Absence of snowfall, which in the past contributed to natural water recharge.

Despite this, Gran Canaria's water supplies for human consumption remains secure and unrestricted, thanks to desalination technologies. However, the agricultural sector is significantly more vulnerable, requiring alternative water solutions due to severe drought conditions. Currently, island reservoirs are operating at only 6% of their total capacity, storing just 1.4 million cubic metres out of a total 23.5 million cubic metres.

The combination of declining rainfall, rising temperatures caused by climate change, and the weakening of the trade wind system has led to a reduction of 46 hectometres^3 (127,000 cubic metres per day) in Gran Canaria's available water resources.

This situation primarily affects the agricultural sector, which relies on traditional water resources for 78% of its supply. The drought has had the greatest impact on:

- High-altitude regions of the island, which are directly affected by fog formation.
- The Las Tirajanas basin (southern and southeastern areas of the island), which is larger and drier and relies heavily on reservoir water for irrigation.

Reservoirs, whether managed by the Cabildo de Gran Canaria or other entities, are currently at only 6% capacity.

Water distribution in Gran Canaria is as follows:

- 47% for human consumption.
- 41% for agricultural supply.

- 5% for industrial use.
- 7% for other purposes.

Water availability for human consumption, including tourism-related demand, remains secure, as it is primarily sourced from desalination (Figure 14).

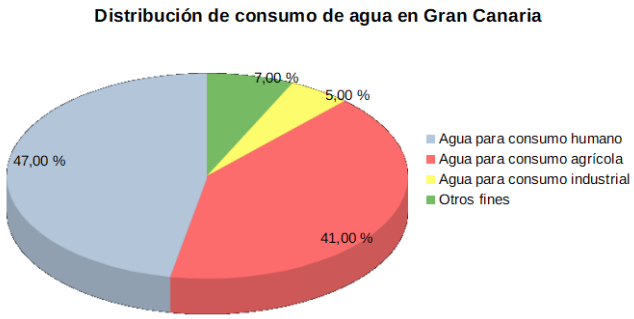

Figure 14 Water Consumption Data in Gran Canaria According to the Cabildo Insular de Gran Canaria (First Quarter of 2024)

Desalination remains the most widely used method for obtaining drinking water across the Canary Islands and in many other regions worldwide that share similar geographic and climatic conditions to Gran Canaria.

By 2020, desalinated water accounted for 94% of the total water supply, reflecting a 20.76% increase compared to 2018. This data is highlighted in the 2022 Environmental Situation Report for the Canary Islands, prepared by the Climate Change and Environmental Information Service of the Government of the Canary Islands and Gesplan.

The report identifies Gran Canaria as the island with the highest reliance on desalination, producing a total of 309,391 cubic metres of water per day, followed by Lanzarote (Figure 15).

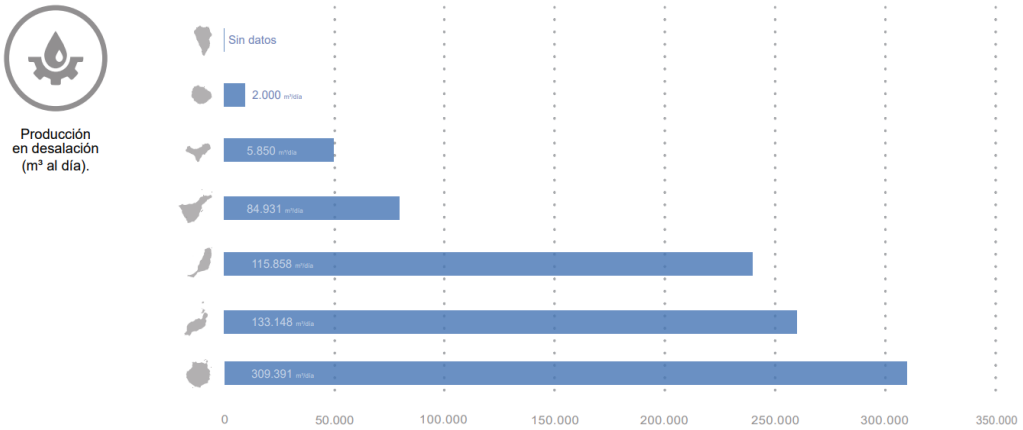

Figure 15 Desalinated Water Production by Island as Recognised in the Third Cycle Hydrological Plans (2021–2027)

The energy consumption and carbon footprint of new-generation desalination plants, such as those currently being implemented in Gran Canaria, are significantly lower than in previous decades. Today, these plants consume approximately three kilowatt-hours (kWh) of electricity per cubic metre of freshwater produced (3 kWh/m³)—a substantial reduction from the 20+ kWh/m³ recorded in the

1960s. These advances are the result of energy-efficient desalination processes that aim to reduce environmental impact, particularly on marine ecosystems, as highlighted by industry experts.

Despite these improvements, the use of primary energy for reverse osmosis desalination in Gran Canaria still has a notable environmental impact, as energy consumption remains a key contributor to the island's carbon footprint. According to 2015 data, desalination accounted for 11% of the island's total final energy consumption. Although this percentage has decreased with the adoption of reverse osmosis and other energy-efficient technologies, desalination still poses significant sustainability challenges.

In parallel, the overexploitation of aquifers and groundwater sources in Gran Canaria—which originate from rainfall, snowmelt, or horizontal precipitation processes—has resulted in long-term water sustainability concerns. Over the years, the construction of hydraulic infrastructure has contributed to poor groundwater management, further exacerbated by climate change-related effects.

The cascading environmental consequences of climate change can be observed in major wildfires that have severely affected Gran Canaria in recent years. Since 2000, more than 33,428 hectares of land have been destroyed by fire.

One critical consequence of these wildfires is the reduction of natural water infiltration into the subsoil and aquifers, leading to significant water loss from rainfall, snow, and horizontal precipitation.

During the devastating 2019 wildfires, 80,000 trees were lost, marking one of the most significant environmental damages to Gran Canaria's natural fog collection systems (Figure 16).

Figure 16 Example of Desertification in the Mid-Altitude Region of Gran Canaria Following the 2019 Wildfire That Devastated a Large Part of the Northeastern Forested Area

In addition to the loss of natural water capture by trees and the desertification of forested areas, Gran Canaria has historically faced a significant problem of aquifer overexploitation. This has led to severe consequences, including:

- A significant drop in the water table.
- Premature drying of numerous natural springs and water sources.

While natural springs, water sources, and streams were never abundant in the Canary Islands, centuries ago, they were more prevalent, particularly in Gran Canaria, Tenerife, La Gomera, and La Palma.

During the 1950s, 60s, and 70s, a range of hydraulic interventions—including water diversions, over-extractions, boreholes, re-drilling, and deep excavations—were carried out extensively. These methods were used to extract groundwater, significantly impacting the mid-altitude and summit regions of Gran Canaria.

Historically, and continuing into the present, these hydraulic works have contributed to a higher carbon footprint, primarily due to the extensive infrastructure required to access deeper water levels as the piezometric level continues to decline (Figure 17).

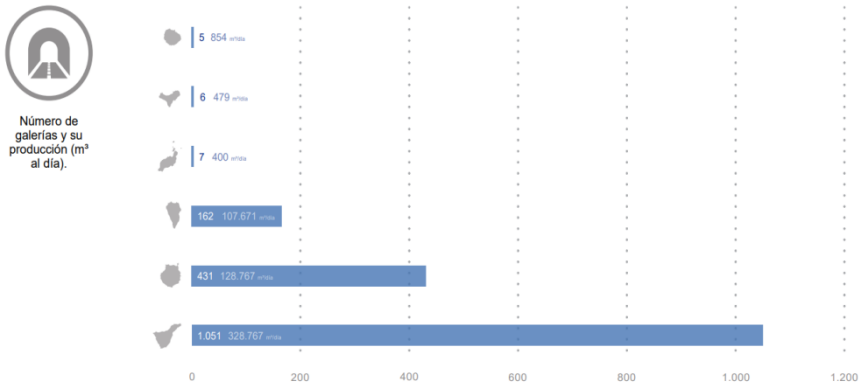

Figure 17 Groundwater Extraction from Galleries and Wells by Island as Recognised in the Third Cycle Hydrological Plans (2021–2027)

The overexploitation of aquifers, combined with persistent drought conditions and increasingly severe water stress episodes, has exacerbated desertification processes driven by climate change. In response, the Life Nieblas project has put forward a proposal for environmental managers and public administrations at all levels of water governance to adopt alternative water solutions.

This proposal advocates for the implementation of atmospheric water collection systems and environmental restoration techniques as a means to:

- Enhance water reserves.
- Support irrigation systems.
- Facilitate reforestation in areas affected by desertification.
- Introduce innovative technology to curb carbon emissions and promote sustainable, fossil fuel-free solutions.

Unlike groundwater extraction, desalination, or wastewater treatment, fog water collection provides an alternative that avoids high energy consumption costs. Traditional methods, such as wells, water galleries, and desalination plants, have historically been associated with substantial energy requirements, leading to higher water prices for both public and private sector management.

By integrating fog water collection systems, Life Nieblas aims to reduce dependence on conventional high-energy water extraction methods, fostering a more sustainable and cost-effective water management approach.

	SWOT Analysis of the Application of Life Nieblas Reforestation and Irrigation Systems in Water Management	
	Internal Factors	**External Factor**
	WEAKNESSES *(Challenges)*	**THREATS** *(Risks)*
Negative aspects	- Fog water collection using Life Nieblas techniques does not fully meet the total water demand required for the survival of an entire population at present, necessitating some level of reliance on other water management systems, which may have a higher environmental impact. - Its application is limited to areas with continuous fog exposure, where favourable meteorological conditions allow it to function as a complementary water source alongside other water supply systems.	- Prolonged drought periods caused by climate change do not guarantee a continuous, independent, and sustainable supply of fog-collected water, making it necessary to combine this system with other water sources that rely on both fossil fuel and renewable energy consumption. - Infrastructure vulnerability to extreme weather events, such as hurricane-force winds. - Potential land-use incompatibility due to territorial planning and regulatory restrictions. - Public policies continue to prioritise other water extraction methods, such as wells and water galleries, which rely on fossil fuel consumption and contribute to a higher carbon footprint.
	STRENGTHS *(Advantages)*	**OPPORTUNITIES** *(Potential Benefits)*
Positive aspects	- Gradual reduction in fossil fuel consumption, beyond the initial energy required for the installation of fog water collection systems. - Redution of the carbon footprint and greenhouse gas emissions. - Increase in water reserves through expanded forest cover, which also functions as a natural fog water collection system.	- Cost savings on energy expenses related to water extraction. - Potential for self-sufficiency, reducing dependence on external fossil fuel-based energy sources and water management systems that generate CO_2 emissions. - Greater synergy between energy and water sustainability, allowing public and private entities to contribute to climate change adaptation and desertification mitigation. - Institutional promotion of techniques that strengthen water management, particularly in response to water emergencies.

5. Other Socio-Economic Sectors for the Implementation of Innovative Fog Water Collection Techniques

The implementation of innovative fog water collection techniques should not be limited to the previously mentioned socio-economic sectors.

While these sectors may experience significant benefits, there are direct opportunities for applying this technology in other socio-economic fields, such as:

- Tertiary activities (service sector).
- Tourism-related businesses and services.
- Industrial applications.
- Water use in infrastructure.
- Private and public use in residential areas, community spaces, educational centres, and healthcare facilities.

The territorial demonstration in Gran Canaria, where the Life Nieblas project has been developed, highlights the potential for replication in other regions with favourable meteorological and geophysical conditions for fog formation and collection.

Like in many global regions, this economic sector has become a dominant force in Gran Canaria's economy, to the extent that it now represents the primary sector contributing to the Gross Domestic Product (GDP) of the Canary Islands.

The island's economy is now largely focused on the service and tourism industry, with less reliance on traditional sectors such as agriculture.

Among the establishments operating in fog-affected zones in Gran Canaria, approximately 240 businesses in the restaurant and service industry could potentially benefit from fog water collection by reducing water stress through access to an alternative water source.

Additionally, the tourism sector continues to diversify, particularly with the rise of rural accommodations and holiday rentals, where the nature-leisure model is gaining popularity. In fog-affected areas of Gran Canaria alone, there are around 280 hotel and non-hotel accommodation establishments.

Given the high water demand in these industries, fog water collection systems have been proposed as an alternative water source in suitable locations where fog and wind conditions allow efficient water capture. The collected water could be used to:

- Fill supply tanks for business operations.
- Support irrigation systems for gardens, shared spaces in rural guesthouses, holiday accommodations, hotels, and restaurants.

Implementing these systems would contribute to:

- Reducing water consumption from less sustainable sources.
- Lowering operational costs in tourism and service-related businesses.
- Providing an eco-friendly water alternative, aligning with sustainability goals and lowering economic burdens.

On the other hand, accommodations located outside fog-affected areas can still contribute to carbon footprint reduction by economically supporting the green transition. This sustainable initiative involves reinvesting financial resources into the development of fog water collection projects aimed at the service and tourism sectors in fog-affected areas. While their involvement is not geographical, their community-based participation plays a crucial role in reducing overall water consumption within the economy.

This approach facilitates the study, transferability, and replication of fog water collection systems in key economic sectors that can directly benefit from fog harvesting and environmental restoration. By

providing indirect support, businesses in non-fog-affected areas can contribute to the gradual reduction of the overall water footprint in the region.

The industrial sector can also adopt fog water harvesting for self-sufficient water use, although it would be limited to low-consumption applications, as large-scale industrial water needs cannot be met solely through fog collection.

However, commercial fog water collection prototypes have already been developed, demonstrating the feasibility of producing and selling fog-harvested water for human consumption, with notable characteristics and potential benefits.

Infrastructure and Public Facilities

Public institutions have a sustainable opportunity through the Life Nieblas project, which offers two key approaches to fog water collection:

1. Integration of fog water collection systems for use in public infrastructure located in mid-altitude and highland areas of Gran Canaria—the region where the Life Nieblas project has been developed. This model is scalable and transferable to other geographical areas worldwide that share similar fog exposure conditions.
2. Implementation of fog water harvesting in public facilities, including:
    - Educational institutions.
    - Healthcare and social care centres.
    - Community buildings (e.g., neighbourhood associations, multi-purpose public spaces).
    - Other public infrastructure requiring water supply.

Many of these facilities already have water storage systems for washrooms, showers, irrigation, and other public services. Complementing these systems with fog water collection would result in significant cost savings for local administrations by reducing investment in water supply infrastructure and operational costs for public services (Figure 18).

Figure 18 Example of Fog Water Collection System Utilisation for Public Use

In Gran Canaria, under the guidance of the Life Nieblas project, practical examples of fog water collection systems are already in operation in fog-affected areas.

One notable case is the world's first military base fully supplied by fog water. This facility produces approximately 200,000 litres of fog water per year through 12 Traditional Fog Collectors (FWC), ensuring complete self-sufficiency for all domestic water needs of the Air Surveillance Squadron (EVA 21).

Additionally, public green spaces, such as plazas, gardens, and parks, can also benefit from fog water collection systems. These systems provide sustainable irrigation solutions, improving:

- Plant growth and reforestation efforts.
- Soil fertility.
- Reduced maintenance costs for public spaces.

The Life Nieblas project has actively encouraged public administrations to consider the integration of fog water collection as a low-cost, short- and medium-term investment. These initiatives not only offer efficient water management solutions but also provide optimal results in public sector sustainability efforts.

Housing and Citizen Use of Fog Water Collection

The domestic application of fog water collection can also be extended to households and residential areas. Several projects worldwide share similarities with the Life Nieblas initiative, demonstrating the feasibility of fog harvesting for private use.

One example is a study conducted by researchers at the Swiss Federal Institute of Technology (ETH Zurich), which has shown that a specially coated metal mesh can be used not only to collect fog water but also to filter out contaminants. This technology offers a potential solution for people living in arid regions with frequent fog, such as Gran Canaria.

In countries like Peru, Bolivia, and Chile, it is common for residents in fog-prone areas to hang mesh nets to collect water droplets. Similar practices are found in Morocco and Oman, where fog condensation systems allow water to drip down the mesh into collection containers for use in drinking, cooking, and washing.

With a fog collection net measuring just a few square metres, it is possible to harvest several hundred litres of water per day. In regions where rainfall and natural water sources are scarce but fog is abundant, this technology provides an effective alternative for securing water resources.

6. Participatory Process Involving Professionals, Scientists, Policymakers, and Citizens to Provide Feedback on Life Nieblas Procedures, Methodology, Results, and Potential

The Life Nieblas project has incorporated a participatory approach through multifunctional working groups, data collection, and active stakeholder engagement. Participants include social actors, water resource managers, technicians, professionals, businesses, and public administrations.

This participatory process has been structured into a series of activities aimed at:

1. Enhancing understanding, analysis, diagnosis, and evaluation of the natural environments used as models in Life Nieblas.
2. Discussing and refining the innovative systems for environmental restoration and water management applied in Gran Canaria.
3. Sharing project results with the public, emphasising their role in climate change mitigation and water conservation.
4. Providing sector-specific feedback to guide the potential implementation of fog water collection systems in various fields, including agriculture, civil engineering, energy management, water management, and domestic use.

5. Ensuring that experts and professionals actively participate in shaping the future development of the project.

The participatory phase of Life Nieblas has been structured into the following categories:

- Workshops with professionals and experts at major conferences.
- Individual and group synergy sessions with professionals and experts.
- Discussion and feedback spaces focused on outreach tools used by Life Nieblas.

Workshops with Professionals and Experts at Major Conferences

On 2–3 February 2023, the Life Nieblas project was actively presented at the International Ecoislas Forum, promoted by the Cabildo de Gran Canaria and held on the island. This international event provided a platform for discussion, proposals, and policy initiatives aimed at accelerating the transition towards a greener, more profitable, self-sufficient, and environmentally sustainable socio-economic model, using the island-based approach as a transferable model. The Life Nieblas project participated through:

- Debate sessions with attendees.
- Synergy events connecting professionals, socio-economic stakeholders, and the public.
- A multifunctional workspace, facilitating discussion on the application of innovative fog water collection and environmental restoration techniques.

This international engagement helped build a broad collaboration network, enabling the exchange of needs and potential solutions related to fog water collection. Additionally, it provided valuable feedback on the advantages, challenges, and limitations of these techniques from professionals across sectors such as energy, water management, forestry, cooperatives, and businesses.

Creation of a Professional Support Network and Ongoing Communication

The two-day event also led to the establishment of a professional support network, connecting specialists from various fields with the Life Nieblas technical team. As a result, an advanced communication channel was created through periodic newsletters, which have been used to gather input on new operational processes for Life Nieblas (Figure 19).

Some of the key companies and institutions that contributed to this participatory feedback process include:

- Oficinas Verdes de Canarias
- Canarias Renovables Solas, SL
- APE Estrategias Ambientales
- Ayuntamiento de Pájara (Fuerteventura)
- Universidad de Las Palmas de Gran Canaria
- ACCIONA Agua
- VonRoll Hydro
- IES Felo Monzón
- Morcal Ingeniería
- Gobierno de Canarias
- IES San Matías
- ONG Trib-arte
- Satocan Turismo

- Island Innovación
- Various independent professionals and experts

Figure 19 Participation and Working Space of the Life Nieblas Project at the 2023 International Ecoislas Forum

The Life Nieblas project actively participated in a collaborative process at the XI Congress on Plant Conservation Biology, held in Gran Canaria from 17 to 21 July 2023, and promoted by the Spanish Society for Plant Conservation Biology.

As part of a dedicated working space, the project engaged with professionals, scientists, and technicians from the fields of biology and environmental sciences. This interaction facilitated the development of joint strategies and collaborative actions, primarily through synergy activities conducted in a fog-affected field area.

During these sessions, participants focused on:

- Understanding the prototypes used in the Life Nieblas project.
- Assessing their benefits and sector-specific applications.
- Collecting proposals and experimental feedback to enhance and adapt fog water collection systems and reforestation methodologies.

The involvement of a diverse and multidisciplinary team of professionals, coupled with Life Nieblas' co-organisation of this highly regarded congress, contributed significantly to the data collection process and the overall maturation of the Project (Figure 20).

Figure 20 Participation and Working Space at the XI Congress on Plant Conservation Biology

Given the high level of technical interest and active participation from professionals, the Life Nieblas technical team has proposed a second edition of a professional interpretation and synergy event, aiming to engage a wider audience of experts, scientists, businesses, and social stakeholders. This initiative was realised through the International Congress on Innovation in Atmospheric Water Collection and Environmental Restoration Techniques – Life Nieblas, held on 17–18 October 2024. The event successfully brought together internationally recognised professionals, technicians, and scientists, with an attendance of over 180 participants from 14 countries across 4 continents, representing a diverse range of technical and professional backgrounds.

The primary objective of this congress was to strengthen efforts in climate change adaptation and mitigation by:

- Advancing the development of innovative technologies and methodologies for atmospheric water collection.
- Enhancing the success of environmental restoration projects in areas affected by desertification.

The event was structured to foster collaboration and knowledge exchange, featuring:

- synergy sessions.
- Poster exhibitions.
- Field visits to demonstration sites.
- Experience-sharing panels among international experts.

The congress saw participation from leading professionals, researchers, and industry experts, whose contributions played a vital role in shaping the future of atmospheric water collection and environmental restoration practices.

Sinergy spaces	Representative entities	Cities and Countries of Origin
• Life Nieblas introduction	• GESPLAN	• Canary Islands, Spain
• Innovation in fog water collectors in Life Nieblas	• ICIA	• Italy
• Innovative reforestation methods in Life Nieblas	• CREAF	• Chile
• Meteorology influence in Life Nieblas	• ITC	• United States
• Laurisilva forests as carbon sinks in Life Nieblas	• Universidad de La Laguna	• Cape Verde
• Application of fog wáter collectors in sustainable buiding desingn	• Polytechnique of Milan	• Valencia, Spain
• Fog water: What is its constribution as a new hydric resource?	• Pontificia Universidad Católica de Chile	• Catalonia, Spain
• Development and optimization of the AWG: Efficiency improvement	• GENAQ	• Spain (general representation)
• The importance of horizontal precipitation an ecosystem service	• Cabildo de Gran Canaria	
• AMARU: Advective for model for (semi-)arid regions under climate change	• Centro UA Atacama Desert (Pontificia Universidad Católica de Chile)	
• Making in rain: An experimental approach to test the fog-catching fuctionality of cloud forest epiphytes	• Universidad de Helsinki	
• Zero-emission water-distribution networks to assist the ecological recovery of mediterranean forest ecosystems impacted by extreme weather events	• Jardín Botánico de Roma (Universidad Sapienza de Roma)	
• History and implementation of fog collection in the Valles Crucenos Regio in Bolivia	• Departamento de agricultura, alimentación, merio ambiente y forestal DAGRI (Universidad de Florencia)	
• Implementing nature-based solutions to combat hydroclimatic risk in Brava, Cabo Verde	• Biodiversity Conservation Association Biflores	
• Improving the aerodynamic collection efficiency of fog wáter collectors through numerical simulations and laboratory experiments	• Universidad de La Serena	
• The experience of a fog water collector network on the mediterranean coast of the Iberian Peninsula	• Universidad de Valencia	
• Organic amendments-base technosols for environmental restoration	• Catalonia Waste Agency	
• Adaptive land management strategies in mediterranean ecosystems under climatic and desertification risk: the LIFE Desert adapt project	• Universidad de Campania Luigi Vanvitelli	
• A catalogue of adaptation measures for land management in areas under desertification risk proposed by Life Desert-adapt: focus on plant growing aids	• Universidad de Palermo	
• Surikat product Open Web Tool	• Surikat	
• Cryto-ecology and ecosystems: overlooked interactions and their importance in the restoration ecology of islands	• Agro-biology and Natural Products Institute (CSIC)	
• Bioislet Systems as an experimental model for hábitat restoration in arid land	• Universidad de La Laguna	
• GENESIS-Geologically enhanced nature-based solutions for climate change resiliency of critical water infrastructure	• La Palma Research Centre	
• Bioislets systems-cultivating arthropods refugees for biodiversity	• Universidad Sapienza de Roma	
• Innovative Approaches for the Restoration and Conservation of Mediterranean Temporary Ponds: Integrating Ecological Studies and Practical Applications	• Asociación Zabalketa de Cooperación y Desarrollo	
• History and implementation of fog collection in the Valles Crucenos Region in Bolivia	• Nieblagua SL	
• Atmospheric Water Harvesting Devices Installations carried out by Nieblagua S.L.		

These sessions have successfully fostered an ongoing collaboration network with technicians, professionals, and experts from renowned institutions and organisations, including Politecnico di Milano, the Institute of Geography at the Pontifical Catholic University of Chile, GENAQ, various technical departments of the Cabildo de Gran Canaria, the UC Atacama Desert Centre at the Pontifical Catholic University of Chile, the University of Helsinki, the Botanical Garden of Rome at Sapienza University of Rome, the Department of Agriculture, Food, Environment, and Forestry at the University of Florence, the Biflores Biodiversity Conservation Association in Cape Verde, the University of La Serena, the University of Valencia, the Agència de Residus de Catalunya, the Università degli Studi della Campania Luigi Vanvitelli, the University of Palermo, the Surikat company, the Spanish National Research Council (CSIC), La Palma Research Centre, the Department of Biology, Soil Science, and Geology at the University of La Laguna, Nieblagua S.L., and the Zabalketa Association for Cooperation and Development, among others. Additionally, numerous independent professionals and technical experts actively contributed to these sessions, strengthening the exchange of knowledge and advancing innovative approaches in atmospheric water collection and environmental restoration (Figure 21).

Figure 21 Participation and Working Space at the International Congress on Innovation in Atmospheric Water Collection and Environmental Restoration Techniques – Life Nieblas

Individual and Group Synergy Processes with Professionals and Experts

These synergy processes were structured through 52 multifunctional working groups, including data collection, active participation, and discussion forums involving professionals, academics, and policymakers from fields related to environmental management, agriculture, livestock, and water governance.

The activities included:

- Individual participation sessions with scientific-technical presentations analysing scaled models of the methods implemented in the Life Nieblas project.
- A dedicated space for technical discussions, allowing participants to engage with the Life Nieblas technical team and address specific questions.

The synergy sessions with agriculture and livestock professionals, including cooperatives, irrigation communities, farmers, hunters, and livestock breeders, focused on:

- Materials used in fog collection systems.
- Assembly techniques and installation processes.
- Product costs and economic feasibility.
- Absolute and seasonal efficiency data.
- Advantages of innovative systems in terms of sustainability, cost savings, and resource reuse.

This sector-specific process began on 31 August 2023 and concluded on 24 November 2024, with the participation of approximately seven professionals from the sector.

Agricultural Sector Professionals, Irrigation Communities, Coorperatives, and Related Stakeholder.
•Ecohuertas Canarias **•Cooperativa Agrícola Faneque** **•José Báez, Agricultural Professional** **•Heredad de Aguas de Arucas y Firgas** **•Roque Manuel López González, Independent Farmer** **•Pilar Sánchez Ferrer, Independent Farmer** **•Mario Sosa Martín, Independent Professional**

The group and individual working sessions with professionals from engineering, construction, architecture, forestry, and NGOs focused on key aspects such as materials used in fog water collection systems, challenges of different collection methods, assembly techniques, and efficiency analysis in absolute and seasonal terms, including survival rates, water usage, and carbon footprint reduction. Additionally, discussions explored the advantages of innovative systems in terms of sustainability, resource reuse, cost savings, and occupational risk management. This sectoral engagement process began on 5 July 2024 and continued until 25 November 2024, with multiple working sessions. Over 44 professionals from these sectors actively participated, contributing valuable insights into the optimisation and applicability of fog water collection technologies.

Professional Sectors: Engineering, Construction, Architecture, FOrestry, NGOs, Environmental, Organisations, Businesses, and Independent Professionals
• Gerardo Álvarez, Consultor Ambiental Autónomo • EBV Consulting • Servicios Funerarios Alma 21 • Virginia Molina Estevez, Diseñadora Autónoma • Federación de Pescadores Artesanos • Samuel Miguélez Álvarez, Veterinario Autónomo • IPD, Investigación, Planificación y Desarrollo • Asociación Ben Magec • Asociación Foresta • Elittoral S.A. • Andrés Poch Barrera, Ingeniero civil Autónomo • Macrocarbón S.A. • Artlocation S.A. • Universidad de La Laguna • Botanical Garden of Rome • CREAF • GENAQ • Politecnico di Milano • Pontificia Universidad Católica de Chile • ONG Biflores • Universidad de Valencia • Universidad de Florencia • Asociación Zabalketa de Cooperación y Desarrollo • Universidad de Helsinki • La Palma Reserch Centre • CSIC Universidad de Sapienza • Agencia de Residus de Catalunya • Universidad de Palermo • Nieblagua S.A • Surikat • Universidad de La Serena • Stiching duurzame Innovatie • Universidad de Las Palmas de Gran Canaria • Colectivo Ecologista Turcón • SOCAN • Colegio Oficial de Ingenieros de Gran Canaria • Home in Paradise Tenerife SL • Asociación de la Almendra de Gran Canaria • Cruz Roja Española en Las Palmas • Asociación Alborinco • CIFP Felo Monzón • Ayagaures Medio Ambiente, S.A. • Cuvedo SRL • GMR Canarias

Political groups involved in water management and environmental public policies, along with technical representatives from various public administration sectors, participated in working group sessions to discuss key environmental and socio-economic topics. These discussions highlighted the importance of preserving forests, protecting endemic and native species, and the advantages of fog water collection for biodiversity in island ecosystems. However, the primary focus was on how these elements translate into socio-economic benefits that directly impact citizens, such as soil retention, flood reduction, and wildfire prevention.

The sessions also explored how different planting methods can improve agricultural productivity and reduce costs for the farming and livestock sectors. Additionally, discussions addressed how groundwater infiltration enhances ecosystem services, aligning with a socio-economic framework tailored to policymakers and public administration officials. This process took place between 5 July 2024 and 18 October 2024, with the participation of more than 14 local and regional institutions.

Water, Energy, and Environmental Managers, and Public Administrations
•Technicians and Political Representatives from the Cabildo de Gran Canaria •Department of Environmental Affairs, La Aldea de San Nicolás Town Council •Department of Environmental Affairs, Santa Brígida Town Council •Department of Environmental Affairs, Tejeda Town Council •Department of Environmental Affairs, Valleseco Town Council •Department of Environmental Affairs, Arucas Town Council •Technicians from the Association of Municipalities of Northern Gran Canaria •Technicians from the Island Energy Council of the Cabildo de Gran Canaria •Department of Environmental Affairs, Telde Town Council •Government of the Canary Islands •Green Offices of the Canary Islands •Technicians from the Cabildo de Lanzarote •Department of Water and Environmental Affairs, Frontera Town Council •Island Water Council of El Hierro

In summary, the participants showed strong interest in the topic, actively engaging in the proposed discussions and activities, contributing ideas, and sharing insights with other attendees. While most participants did not have prior specialised knowledge on the subject, the sessions helped raise awareness about environmental conservation and the importance of habitat restoration. As a result, many have expressed openness to incorporating innovative methods, such as fog water collection and conservation techniques, into climate change mitigation efforts, soil retention, flood prevention, and wildfire risk reduction. Additionally, participants recognised potential benefits in agricultural and livestock sectors, including increased productivity and cost reductions.

Among the most frequently asked questions were those related to the placement and location of fog water collectors and innovative reforestation systems. Participants were also particularly interested in understanding cost factors and the water collection capacity per square metre of the fog harvesters. Furthermore, private sector professionals and businesses often expressed the need for a technical advisory service to guide the implementation of these systems in their operations.

Finally, the diverse range of stakeholders involved, from public administration to private sector professionals, enriched the individual and group discussions. However, for future engagement, some participants highlighted the importance of including additional sectors, such as culture, arts, and citizen science, in Life projects. They suggested involving these sectors not only in the feedback phase, as in this case, but also in the project's early stages, where their expertise and perspectives could contribute throughout all phases of development (Figure 22).

Figure 22 Examples of Individual and Group Actions in Scientific, Technical, and Working Group Sectors

Discussion and Feedback Spaces on Life Nieblas Outreach Tools

The development of outreach tools and resources has played a crucial role in enabling professionals, technicians, and the general public to acquire knowledge about the results and potential adaptations of fog water collection systems and environmental restoration techniques employed in the Life Nieblas project. Additionally, these tools have facilitated feedback and proposals from various stakeholder sectors, enriching the project's development.

The outreach materials include:

- Audiovisual content on the design, installation, and field implementation of fog collection systems, available on Life Nieblas' digital platforms and social media channels (Website, YouTube, Instagram, and Facebook).
- Quarterly newsletters distributed between February 2023 and December 2024.
- Printed and edited materials, such as:
    - The Layman Report, providing a general project overview.
    - The Life Nieblas Technical Manual, distributed among professionals during working sessions for further data validation and feedback collection.

These resources are fundamental not only as informational and educational materials but also as key tools for fostering discussions, providing visible data that support:

- Analysis and evaluation of project methodologies.
- New proposals for adaptation across various sectors.

- In-depth engagement with professionals, technicians, and citizens participating in working group sessions.

To support these efforts, 150 copies of the Layman Report and 50 technical manuals have been distributed, helping to develop sector-specific adaptation strategies for:

- Agriculture and livestock.
- Civil engineering and architecture.
- Water management and public administration.

These outreach efforts have contributed to enhancing sectoral knowledge, facilitating a wider implementation of Life Nieblas technologies, and supporting sustainable adaptation strategies (Figure 23).

Figure 23 Technical Debate Spaces Using Life Nieblas Information Tools

7. Catalogue of Recommendations for the Application of Life Nieblas Prototypes in Socio-Economic and Technical Sectors

As established in Action C.5, following the evaluation of Life Nieblas objectives and results, and the development of collaborative networks with professionals, farmers, public administrations, water managers, and scientists, a recommendation report has been compiled. This catalogue serves as a practical guide, ensuring a realistic approach tailored to the needs, opportunities, and challenges identified by different sectors regarding the implementation of atmospheric water collection systems and environmental restoration techniques.

While the Life Nieblas project initially focused on developing fog water collectors, these prototypes have evolved in response to efficiency assessments and effectiveness data. Similarly, various Laurisilva reforestation systems have been tested, demonstrating high plant survival rates. Although this research has primarily targeted the environmental sector, the importance of cross-sector dialogue and feedback has been recognised to:

- Identify benefits and limitations of the fog collection prototypes.
- Conduct a sector-specific assessment of quality, cost-effectiveness, and natural conditions for replication.
- Explore applicability in sectors such as agriculture, water management, energy, livestock farming, housing self-sufficiency, tourism, and environmental actions.

This catalogue summarises the main insights and contributions from the participatory process carried out during the initial phase of Life Nieblas' social implementation:

Key Sector-Specific Recommendations

- Public Administration and Environmental Management
    - Meetings with technical and political representatives from the Cabildo de Gran Canaria confirmed the viability and replication of Life Nieblas' fog water collection systems in protected areas and degraded reforestation zones impacted by human activity. These applications were primarily endorsed by environmental, territorial, water management, and agricultural departments.
    - Institutions have prioritised integrating Life Nieblas results into environmentally fragile areas under municipal jurisdiction, demonstrating institutional collaboration for system replication.
    - Replications of fog water collection and restoration techniques have already been implemented in other environmental projects, highlighting the growing commitment to expanding these techniques in the short and medium term.
    - Plans are in place to use fog water collectors in mid-altitude and highland areas to supply water for livestock grazing projects, confirming successful adaptation for the livestock sector by reducing reliance on conventional water sources.
- Local Governments and Water Management
    - Meetings with municipal authorities, environmental technicians, and water management representatives identified fog-affected areas where Life Nieblas' techniques could support reforestation efforts, irrigation of public parks and gardens, and water storage for municipal, tourism, and community use.
    - However, the high cost of acquiring efficient fog collection systems remains a limiting factor for public budgets. To scale up adoption, local governments require supramunicipal funding sources to procure materials, hire technical experts for system installation, and research more affordable, reusable, and vandalism-resistant materials.
- Technical and Scientific Perspectives
    - Multidisciplinary technical experts recommended adopting a more human-centred approach to system replication. While the current prototypes have proven efficient, experts proposed alternative materials (e.g., bamboo or wood) to reduce costs and improve sustainability and accessibility.
    - Incorporating artistic and anthropological perspectives into system design could drive innovation by exploring eco-friendly materials for fog collector fabrication.
- Civil Engineering and Architecture
    - Professionals in civil engineering and architecture expressed interest in studying the impact of fog collection systems on water consumption and domestic supply.

- As a complementary project challenge, participants highlighted the opportunity to study the mineralisation of fog-harvested water for wider applications.

- Agriculture and Livestock Farming
  - Farmers and cooperatives involved in the discussions identified fog water collection as a complementary water source for irrigation in mid-altitude and highland regions affected by fog.
  - While fog collection alone cannot provide full irrigation for large-scale crops, it can serve as an additional water source for irrigation reserves. However, irregular fog conditions and climate variability present challenges to achieving complete water self-sufficiency in agriculture.
  - The cost of acquiring fog collectors remains a key barrier, prompting calls for public subsidies.
  - In environmental restoration, the Autonomous Fluid Discharge System (AFDS) was highlighted as an effective tool for improving irrigation independence and optimising water supply management.

- Marine and Coastal Applications
  - Professionals from marine and coastal sciences explored potential fog water collection applications in low-altitude coastal areas, where fog exposure may provide viable water harvesting opportunities.
  - The use of Autonomous Fluid Discharge Systems (AFDS) was identified as a potential tool for improving water efficiency in coastal restoration projects.

- Environmental Organisations and NGOs
  - Environmentalists and conservation organisations advocated for more accessible and natural materials (e.g., wood and reeds) in fog collection systems to reduce costs and carbon footprints.
  - They also emphasised the importance of incorporating traditional planting techniques, such as charcoal-based soil enrichment and ancient water collection methods, to optimise fog water harvesting and enhance restoration success.

- Sustainable Funeral Sector
  - Companies and professionals from the sustainable funeral industry expressed interest in adapting Life Nieblas' reforestation techniques for eco-friendly burial sites.
  - Their feedback focused on using sustainable materials to reduce costs and integrating restoration methodologies into future studies on environmentally conscious burial practices.

8. National and International Actions to Strengthen the Life Nieblas Project Replication Synergy hub

In alignment with the specific objectives of the Life Nieblas project, various national and international actions were undertaken throughout 2023 and 2024 to establish essential synergies between project outcomes and key sectors such as environmental policies, agriculture, water management, energy, scientific research, and social and educational communities. These efforts were aimed at consolidating a replication plan for Life Nieblas.

Key Actions Planned for Project Replication

The following actions were established as fundamental milestones:

1. Organising an international event linked to a significant global climate action observance to highlight environmental restoration and the benefits of fog water collection. The event was intended for representatives of public administrations, organisations, businesses, associations, advocacy groups, agricultural sectors, water managers, energy professionals, and environmental policymakers. This event was initially scheduled for October 2022.
2. Hosting two working sessions in Spain and the region of Viseu Dao Lafoes (Portugal) during the last quarter of 2023, ensuring the participation of at least 20 representatives from public administrations, organisations, businesses, associations, advocacy groups, agricultural and water management sectors, and energy professionals.
3. Holding a session in Brussels (Belgium) during the first quarter of 2024 to create synergies between project results and European public administrations, organisations, associations, advocacy groups, and key stakeholders from the agricultural, environmental, and water management sectors. This event aimed to engage EU policymakers and senior executives in discussions related to environmental restoration and sustainable water management.

Adjustments to Initial Timelines and Implementation Challenges

Due to unexpected circumstances, the initial event schedule was modified to better align with project timelines and ensure the successful execution of all planned activities. Key factors affecting the schedule included:

- The global COVID-19 pandemic (March 2020), which significantly impacted the execution of in-person events, travel logistics, and large gatherings.
- Climate change-driven environmental challenges, which influenced the data collection timeline for Life Nieblas and required additional scientific analysis and diagnostics.
- The necessity of additional time to assess environmental restoration cycles, ensuring accurate results regarding fog water collection efficiency, reforestation success, and long-term sustainability.

Given these factors, the initially planned events were rescheduled for 2023–2024, during which all actions were successfully executed.

Preliminary Dissemination and Stakeholder Feedback Process

Before finalising the international meetings, a preliminary dissemination phase was conducted between February 2023 and November 2024 to:

- Share Life Nieblas project results with relevant sectors.

- Perform a sectoral analysis to ensure practical applications.
- Facilitate knowledge exchange and receive targeted feedback for refining replication strategies.

This extended feedback period justified the rescheduling of key events, ensuring that all stakeholders had the opportunity to contribute meaningfully to the project's final recommendations.

Integration of Feedback and Exportation of Findings

The data collection and sectoral adaptation process ran in parallel with the official synergy events, allowing for a continuous exchange of insights. The validated results and feedback were systematically integrated into the international meetings held in:

- Barcelona (March 2024)
- Viseu Dao Lafoes, Portugal (November 2024)
- Brussels, Belgium (November 2024)

These sessions reinforced the impact of Life Nieblas project methodologies, ensuring their adoption and replication in diverse environmental and policy contexts.

Working Sessions in Spain and the Viseu Dao Lafoes Region (Portugal)

Initially, the working session in Spain was scheduled to take place in Madrid. However, it was later determined that Catalonia would be a more suitable location due to the presence of two project partners, UAB (Universitat Autònoma de Barcelona) and CREAF, as well as the significant environmental initiatives and replication processes taking place in the region.

The decision to hold the session in Catalonia also carried greater strategic value, as the region has already implemented fog water collection systems for the restoration of post-mining landscapes. This allowed for a hands-on demonstration and retrospective analysis of replicated methodologies, providing valuable insights for participating professionals, technicians, and social stakeholders.

Between 22 February and 20 March 2024, knowledge transfer and synergy sessions were held within water management workshops for agricultural estates, organised under *"La Escuela del Paisaje"* by L'Aresta Cooperativa Agroecológica at the Museo Terra de Tarragona. Additionally, Life Nieblas was presented at the 3rd BIT Congress 2024, hosted by the Fundació Universitària del Bages in Manresa.

Through these sessions:

- Life Nieblas engaged with over 62 participants, consolidating its role as a strategic initiative for optimising fog water collection.
- The project's potential was highlighted in the Barberà Basin, where fog collection systems could mitigate water shortages in agricultural estates.
- In Manresa, Life Nieblas expanded its reach across multiple sectors and professions, with discussions focusing on the application of fog water collection and environmental restoration systems in the Central Catalan Plateau, the Coastal Mountain Range, and the Pre-Pyrenees to help counteract the effects of recurrent droughts.

Congress list of assistant to El PATT
• Mireia Masalias Canti (Ganadería) • Josep Cabiol Belmonte (Agricultura) • Montserrat Vendrell Parera (Agricultura) • Assumpció Giribets Guàrdia (Agricultura) • María Montserrat Martínez García (Agricultura) • Montserrat Canudas (Agricultura) • David Aguadé Vidal (técnico Agricultura) • Antonio De la Torre López (Técnico de Medio Ambiente) • Pau Montero (Técnico de Medio Ambiente) • Sandra Saura Mas (Investigador Forestal) • Marc Basuldu Tris (Investigador Forestal) • Xavier Navalon Nonell (Trabajador público/otros) • Israel Montiel Armas (Trabajador público área de Agricultura) • Issac Bosch Declair (Trabajador público área de Medio Ambiente) • Marie Eugenia Pizarro Molina (Trabajador público área de Agricultura) • Montserrat Matas (Otros) • Xavier Saez (Otros) • Pere Molist Bover (Otros) • Vicenç Sampera Arimon (Otros) • María Micó Gual (Otros) • Adriana Targarona Salgado (Otros) • Xevi Carbonell Rifá (Otros) • Heribert Vidiella Yagüe (Otros) • Pep Campà Viñeta (Otros) • Francesc Javier Martin Campis (Otros) • Carles Salavedra Platero (Otros) • Roger Farré Dalmau (Otros) • Xavier Domene Casadesús (Otros) • Vicenç Carabassa Closa (Otros) • Michele Curel Curel (Otros) • Josep Matías Santacoloma (Otros) • Alfons Mompeó Cos (Otros) • Raquel Sebastián Ferro (Otros) • Lourdes Cuadrat Benavente (Otros) • Ramón Rullo Vilaró (Otros) • José María Alcañiz Baldellou (Otros) • Montserrat Catasus Asenjo (Otros) • Henk Fonville Salet (Otros) • Eduard Piera Pallàs (Otros) • Mireia Torres Maczassek (Otros) • Ester Perez García (Otros) • Dolors Boté Estrada (Otros) • Lucas Damonte Taroco (Otros) • Gonzalo Herrera Lozano (Otros) • Jordi Soler Sala (Otros) • Josefa Morón Manzano (Otros) • Sara Nadal Sarri (Agricultura) • Glòria Pedro (Agricultura) • Carmé Tomàs Martorell (Medio Ambiente) • Laia Serra Valls (Otros) • Eugènia Vázquez Nacarino (Agricultura) • Oriol Vilardell Candela (Otros) • Montserrat Romaní Draper (Otros) • Marta Ascanio Santamaría (Forestal) • Eudald Franquesa Ninot (Energía) • Manuel Esteban Marín Martínez (Otros) • María Jesús Marsol López (Otros) • Victoria Carrasco Quilez (Agricultura) • Roc Gassó Puig (Otros) • Santi Montserrat Carreño (Otros) • Albert Barbé García (Otros) • Alexandra Farbiarz (Regadío)

On 7 November 2024, the presentation of results and synergy session took place in the municipality of Vouzela, in the Viseu Dao Lafoes region of Portugal, with an audience of over 71 attendees. The event served as a platform to present the objectives achieved and the results of fog water collection models and environmental restoration systems, while also establishing synergies and exploring potential

implementation scenarios for these techniques. Although the recent wildfire in Carregal do Sal (summer 2024) impacted the region, the results of Life Nieblas' implementation and research demonstrated significant benefits for environmental reforestation efforts, agriculture and socio-economic sectors, water management strategies, and integration within public administration frameworks (Figure 25).

Attendance at the Presentatioin of Results and synergy Sessions in Vouzela (Viseu Dao Lafoes Region, Portugal)
•José Batista (Municipio de Carregal do Sal) •Carlos Bastos (Junta de Oliveira do Conde) •Reinero Brandon Fernández (Cabildo de Gran Canaria) •Márcio Pereira (Municipio de Oliveira de Frades) •María Salete Pomar Iopes (Câmara municipal de Sâo Pedro do Sul) •María Luisa Leitâo Silva (Câmara municipal de Sâo Pedro do Sul) •Guilherme Ferreira (ESAV) •Raul Silva (ESAV) •Simão Marques Pedrosa (ESAV) •Diva Rodrigues (ESAV) •Carolina Antunes (ESAV-IPV) •Inês Marques (CTeSP Proteçao Civil) •José Santos (ESAV) •Henrique Valado (ESAV) •Lara Silva (ESAV) •Beatriz Almeida (ESAV - IPV) •Bernardo Espinho (Municipio de Santa Comba Dão) •Adriano Nave (Municipio de Mangualde) •Fábio Lamelas (Guarda Nacional Republicana) •Gustavo Viera Ruiz (Gesplan) •José Lopes Almeida (Vouzelar) •Manuel José Silva Miranda Fernan (Associaçao de Municipios Parque das Serras do Porto) •Teresa Pêra (Associaçao de Municipios Parque das Serras do Porto) •Paulo Gonçalves (Municipio de Vila Nova de Paiva) •José Lopez Almeida (Nenhuma público general) •Sandra Ferreira (Municipio de Carregal do Sal) •António Santos (Municipio de Tondela) •Carlos Magalhães (Municipio de Tondela) •Inês Mendonça (Municipio de Nelas) •Francisco Lima (Bombeiros Voluntários de Vouzela) •Miguel David (ANEPL) •Rafael Santos Almeida (ESAV) •Joana Careulos (ICNF) •Nino Rocha (Municipio de Vouzela) •Daniel Rodriguez (Otros) •29 alumnos (EPV - 11ºA/ 11ºB) •Francisco Marques (IPV-Viseu) •Nino Miguel Benítez (Municipio de Sintras) •Antonio Casas (Otros) •José lino Javares (Tsela Prof. Vouzela) •Joaquin Tabares (EM Vouzela) •Carlos Magalhes (Municipio de Tondesla)

Figure 24 Participation and synergy Space in the Working Session in the Viseu Region (Portugal)

Working Session in Brussels (Belgium)

On 19 November 2024, a synergy session was held at the Delegation of the Government of the Canary Islands in Brussels, aimed at assessing the development of sustainable and innovative fog water collection technology to reduce environmental impact and enhance efficiency, accessibility, and adaptability across various sectors.

During this session, the Layman Report and Technical Manual were distributed to all participants to promote awareness of the project's findings and encourage replication efforts. Additionally, sectoral feedback was gathered to refine implementation strategies based on the insights provided through these materials.

This initiative was designed to engage and exchange knowledge with public administrations, associations, advocacy groups, European Commission bodies, and other relevant stakeholders, ensuring that the results of Life Nieblas contribute to wider policy and technical discussions on sustainable water management and environmental restoration.

Synergy group list at Brussels

Entities	Number of participants
Oficina de La Rioja en Bruselas	1
Oficina de la Región de Murcia en Bruselas	1
Delegación de Canarias en Bruselas	6
Delegación de Baleares en Bruselas	1
Representante de la Comisión Europea	2
CINEA	1
FCURE	1
Delegación de Andalucía en Bruselas	1
Gabinete de Islas Azores en Bruselas	1
Delegación de Castilla-La Mancha en Bruselas	1
Delegación de Castilla y León en Bruselas	1
Delegación de Extremadura en Bruselas	2
Delegación del Gobierno de la Generalitat de Catalunya en Bruselas	1
Universidad Autónoma de Madrid	1
Gobierno de la Región Autónoma de Maidera	1
Representante permanente de España en Bruselas	1
Representante de socios de Life Nieblas (Cabildo de Gran Canaria, ITC, ICIA, Gesplan)	5

The session brought together 29 representatives from various entities and administrations, including the Office of La Rioja in Brussels, the Office of the Region of Murcia in Brussels, the Delegation of the Canary Islands in Brussels, the Delegation of the Balearic Islands in Brussels, representatives from the European Commission, CINEA, FCURE, the Delegation of Andalusia in Brussels, the Azores Office, the Delegation of the Government of Castilla-La Mancha in Brussels, the Delegation of the Government of Castilla y León in Brussels, the Delegation of Extremadura in Brussels, the Delegation of the Generalitat of Catalonia in Brussels, the Autonomous University of Madrid, representatives from the Autonomous Government of Madeira, and the Permanent Representation of Spain in Brussels. Additionally, the Life Nieblas technical team, led by the Cabildo de Gran Canaria, Gesplan, ICIA, and ITC, actively participated in the session (Figure 25).

Figure 25 Participation and synergy Space in the Working Session in Brussels (Belgium)

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