LAYMAN'S REPORT

LIFE20 PRE/IT/000007

Remote sensing oriented nature based solutions towards a

NEW LIFE FOR DRYLANDS

Institute of Atmospheric Pollution Research
National Research Council of Italy

Hellenic Society for the Protection of Natur

ISPRA
Italian Institute for Environmental Protection and Research

National Research Council of Italy
Institute of BioEconomy
Department of Biology, Agriculture and Food Science

CREAF

Dipartimento di Biologia Ambientale
Sapienza Università di Roma

Natural History Museum of Crete
University of Crete

With the contribution of the EU LIFE financial instrument.

This project has received funding from the *European Union's LIFE 2020 Program for the Environment and Climate Action* under grant agreement No LIFE20 PRE/IT/000007
https://www.newlife4drylands.eu/en/about/

Introduction

The goal of the NewLife4Drylands (NL4Dl) project was to counteract the soil degradation leading to desertification, by using Nature-Based Solutions (NbS). NewLife4Drylands aimed to provide a framework, a decision making tool and a protocol for identifying sustainable solutions that could be successfully implemented in degraded drylands, such as land restoration activities aiming to improve vegetation cover and productivity in those areas where desertification processes are ongoing (vulnerable areas). In addition, the project will develop specific techniques to monitor failures and successes of restoration activities.

This project developed a protocol for the identification of dryland characteristics and for the mid and long-term monitoring of restoration interventions in desertified lands through the use of remote sensing techniques. Remote Sensing (RS) can complement the lack of long term, reliable and homogeneous in situ information, more timely and with less cost. The protocol produced by the project is based on high resolution Earth Observation (EO) data and applying remote sensing methodologies. It provides a clear, specific and cost effective assessment of the restoration process useful for further decision-making in interventions.

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Main objectives of the project

The project's objectives were to monitor the application, scalability and replication of Nature-Based Solutions (NbS) for restoration of degraded and desertified drylands. By using Remote Sensing techniques, NewLife4Drylands aims to provide a framework and a protocol for:

- identifying dryland characteristics;
- identifying sustainable solutions that could be successfully implemented in degraded drylands, e.g. to improve vegetation cover and productivity in areas vulnerable to ongoing desertification;
- mid- and long-term monitoring of interventions in desertified lands, to better evaluate restoration effectiveness and improve sustainable soil management.

The NbS protocol is based on high resolution Earth Observation data and Remote Sensing methodologies, compensating for the lack of long-term, reliable and homogeneous local information, and providing a clear, specific and cost free assessment of restoration processes, useful for further decision-making. The project assessed and observed interventions that have been implemented by other LIFE projects such as LIFE PRIMED in Nestos and Palo Laziale and LIFE th Green Link in Tifaracas and El Bruc.

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The six case study areas of the project

LIFE The Green Link, Spain
(LIFE15 CCA/ES/000125)
Tifaracás (ES7010039)
El Bruc (ES5110012)

LIFE PRIMED, Italy & Greece
(LIFE17 NAT/GR/000511)
Palo Laziale (IT6030022)
Nestos Delta (GR1150010)

Alta Murgia, Italy (IT9120007)
Asterousia Mountains, Greece
(GR4310013)

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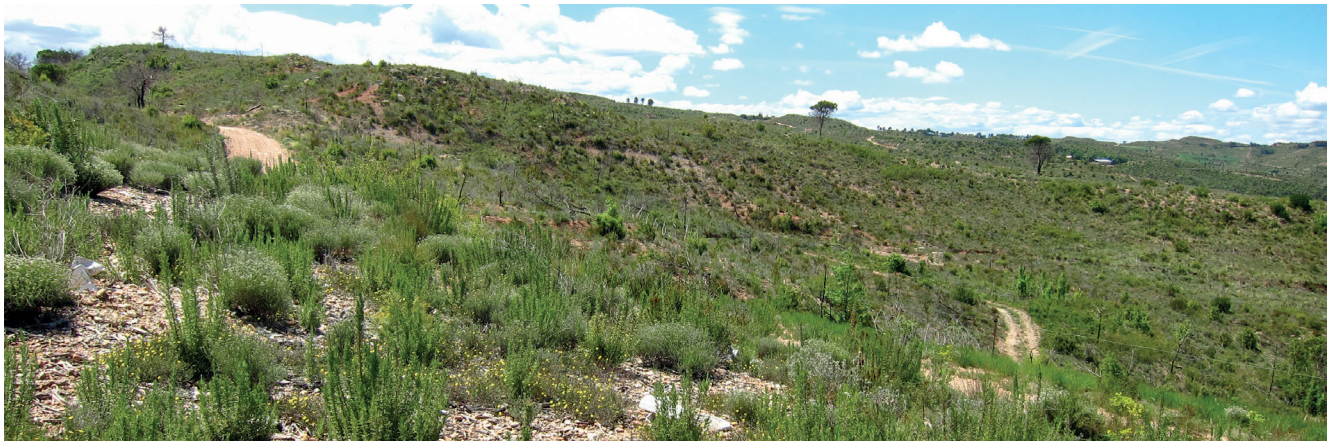
LIFE The Green Link, Spain (LIFE15 CCA/ES/000125)



A restoration plan was applied using a new planting technology, the **"Cocoon"**, to increase seedling survival. **El Bruc (Catalonia)**, is a site with Mediterranean climate, burnt in 1986 and 2015, and suffering from soil erosion and land abandonment. Restoration included the planting of agricultural and forest species.

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Tifaracás (Gran Canaria) is an arid area inside El Nubloll (ES7010039), with an average rainfall of 200mm, affected by desertification, wildfires and severe grazing by feral goats. Restoration included planting of endemic shrubs and trees, fenced against the goats.

Partners:

CREAF SEVERO OCHOA EXCELLENCE Center for Ecological Research and Forestry Applications (CREAF), Spain

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LIFE PRIMED, Italy and Greece (LIFE17 NAT/GR/000511)

Restoration measures were applied for the recovery of Mediterranean coastal habitats (temporary ponds and riparian forest) affected by drought, inefficient forest and water management, shrub expansion, and invasive alien species.

Palo Laziale is a 50ha area including an oak floodplain forest, temporary ponds, high Mediterranean scrub and a meadow, at the core of the "Bosco di Palo Laziale" (IT6030022), now in serious decline.

Partners:

Department of Environmental Biology - Sapienza University of Rome (SAPIENZA), Italy

Italian Institute for Environmental Protection and Research (ISPRA), Italy

Institute of Atmospheric Pollution Research - National Research Council of Italy (CNR-IIA), Italy

Institute of BioEconomy - National Research Council of Italy (CNR-IBE), Italy

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In the **Nestos Delta** (GR1150010) temporary ponds are disappearing, and the remnants of riparian forest are threatened by invasive species encroachment, inappropriate forest and water management, expanding human activities, and eutrophication.

Partners:

Hellenic Society for the Protection of Nature (HSPN), Greece

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Alta Murgia, Italy (IT9120007)

Alta Murgia in Apulia is characterized by diverse ecosystems hosting endemic and threatened grassland species. It is threatened by transformation of grasslands into agricultural land, soil erosion, sediment deposition in aquifers, illegal waste and toxic mud dumping, contamination of soils and aquifers, increased legal and illegal mining, wind farm installations and below-average precipitation for many years.

Partners:

Department of Environmental Biology - Sapienza University of Rome (SAPIENZA), Italy

Italian Institute for Environmental Protection and Research (ISPRA), Italy

Institute of Atmospheric Pollution Research - National Research Council of Italy (CNR-IIA), Italy

Institute of BioEconomy - National Research Council of Italy (CNR-IBE), Italy

Asterousia Mountains, Greece (GR4310013)

In the **Asterousia Mountains (Crete)** the soils are highly degraded due to erosion. Overgrazing in winter prevents vegetation succession to higher forms. The long, dry summers and high evapotranspiration rate favour desertification due to water scarcity and droughts, aided by over-extraction from aquifers and salination.

Partners:

University of Crete - Natural History Museum of Crete (UoC - NHMC), Greece

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The two restoration plans of the project

Asterousia Mountains, Greece (GR4310013)



The **Asterousia area** faces intense land degradation and soil erosion, due to extended dry periods, excessive groundwater extraction, high salinity and over-grazing. Considering old practices based on natural solutions that were abandoned in the last 50 years, adding new ones, and taking into account the results of the Protocol and Monitoring Model of the project, the NewLife4Drylands Restoration Plan indicatively proposes the following NbS:

- Afforestation/reforestation.
- Agroforestry by combining trees with crops and/or livestock systems.
- Changing the direction of plowing and cultivating along the lines.
- Soil erosion control structures i.e., traditional dry-rock walls.
- Reducing or eliminating tillage.
- Soil management practices: composting, mulching.

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Alta Murgia, Italy (IT9120007)

As part of the NewLife4Drylands project, a restoration plan is being implemented in the Alta Murgia site for the natural and semi-natural grassland ecosystem that hosts EU Habitats Directive priority habitats (62A0, 6210*, 6220*) and numerous endemic and regionally rare plant species. The ecosystem has been exposed over the past 30-40 years to enormous impacts and accelerated processes of habitat degradation and fragmentation.

Other experiments in restoring natural and semi-natural grasslands have been carried out in Italy, but not in the Mediterranean environment, much less in ecosystems subject to stonecutting and rock graining such as the Alta Murgia.

Here restoration techniques were tested by setting up several experimental and control plots applied to both a fallowed and a plowed field, harvesting seeds/hay nearby and sowing fresh or dry materials.

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Facts and highlights

What is desertification?

Desertification is the process by which fertile land becomes desert, typically as a result of various factors, including prolonged drought, deforestation, inappropriate agricultural practices, and the effects of climate change. This degradation of land in arid, semi-arid, and dry sub-humid areas results in the loss of biological productivity and ecosystem services.

What are Nature Based Solutions?

Nature-based solutions (NbS) are strategies that involve using natural processes and ecosystem services to address various environmental, social, and economic challenges. These solutions aim to protect, sustainably manage, and restore natural or modified ecosystems in ways that benefit both biodiversity and human well-being. NbS can play a crucial role in addressing issues such as climate change, disaster risk reduction, water security, food security, and human health.

Land degradation monitoring by remote sensing

Indices and sub-indicators to be integrated for the SDG 15.3.1 computation for assessing land degradation status in the six study sites have been developed from remote sensing satellite data.

They were selected based on the pressures and threats affecting each study site for long- and short-term assessment.

The main sub-indicators, according to UNCCD, such as trend in land cover, primary productivity and soil organic carbon, have been integrated with burn area severity, soil salinity, hydroperiod and climatic surveys.

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The advisory board of the project

Corrado Battisti
Rome Municipality - Protected areas Unit

Nektarios Chrysoulakis
Foundation for Research and Technology Hellas (FORTH)

Carmelo Dazzi
Universita' di Palermo

Domenico Nicoletti
Alta Murgia National Park

Nikolaos Nikolaidis
Technical University of Crete (TUC)

Nicola Pirrone
CNR-IIA

Giovanni Quaranta
University of Basilicata

Luca Salvati
Macerata University

Riccardo Santolini
Urbino University

Gustavo Viera
GESPLAN (public company of the Government of Gran Canaria)

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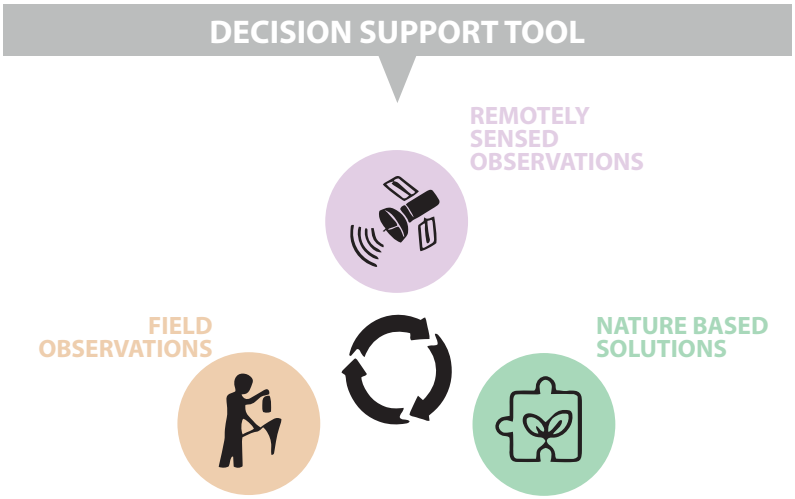
Decision Support Web Tool

This tool has been designed in the framework of the project to guide end users for the planning of degraded site monitoring and restoration activities. As monitoring indicators come from case studies and general indicators come from literature, it can be useful to evaluate the available Nature Based Solutions that fit each specific case, as well as restoration and interventions tailored for each degradation process.

https://sites.google.com/view/newlifefordrylands/home-page

- Aridification
- Change in groundwater level / quality
- Decline in vegetation community functioning
- Decline in vegetation cover / biomass
- Habitat loss
- Hydrological modification
- Increase in invasive species
- Increase in weeds
- Landscape modification
- Overgrazing
- Soil erosion by water and wind
- Soil organic matter decline
- Soil salinization
- Soil surface compaction
- Trees encroachment



Features

Guided Identification of the Land Degradation Process from a list of the most common in Mediterranean areas

Insight into the main causes of degradation with examples and Expert Based selection of Indicator and instructions to calculate with Indicators EO Browser

Guided procedure for the assessement of trend and status through selected and ad-hoc remote sensing and in-situ indicators

Nature Based Solutions that fit the selected degradation process can be selected and further monitored

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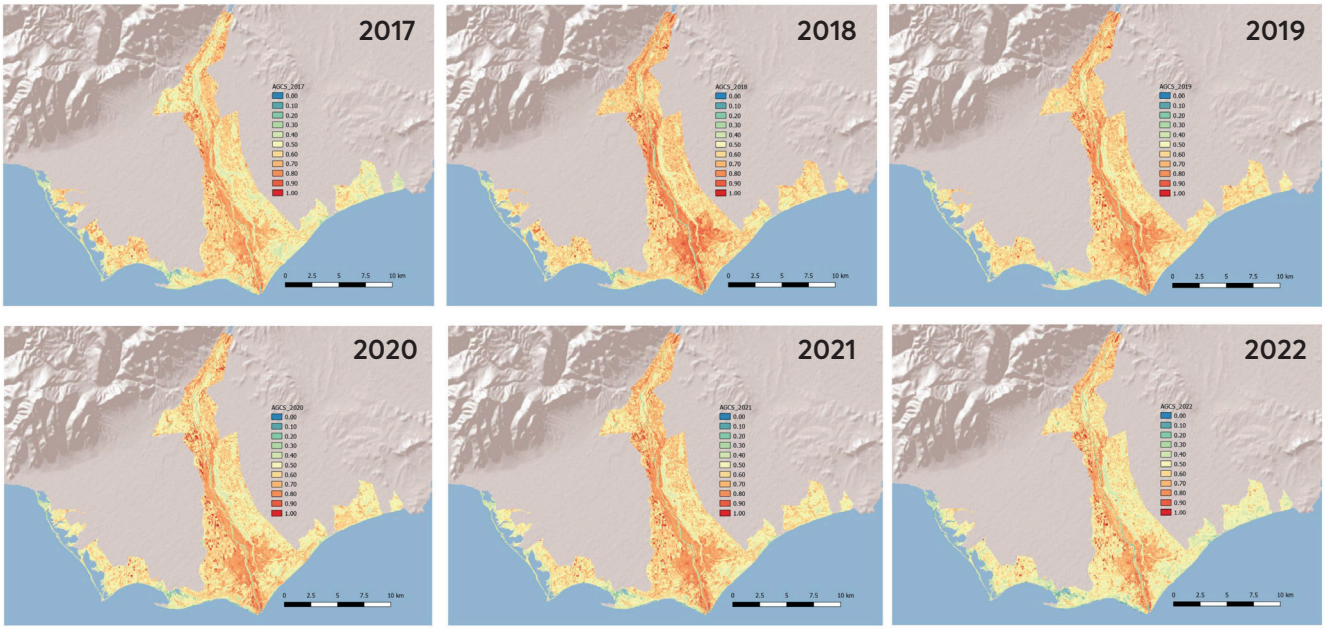
Ecosystem services assessed during the project

The choice of how to estimate and map ecosystem service (ES) indicators depends on several factors, which inclide the overall purpose of the ecosystem service assessment, the data availability, the type of measurements needed to quantify the indicators, and the availability of human and financial resources. The purpose of the assessment is to integrate ground data and existing thematic data layers with remote sensing observations to account for temporal variations in ecosystem services supply with reference to a baseline. The proposed approach is tailored to tackle situations with limited or no availability of ground data and relies on the use of existing GIS data from freely accessible web resources and remote sensing indices (RSI) retrieved via Google Earth Engine. The indicators of ecosystem service provision and degradation process estimated and mapped in each of the six study areas have been selected in agreement with the project partners. The proposed methodology has allowed assessement and mapping of the values of the selected ES indicators, along with their relative changes with respect to the baseline years. Integrating of time-dependent predictors from remote sensing in a spatially explicit digital mapping workflow has allowed visualisation of where the changes occur and their relative magnitudes. The methodology proved to be sensitive enough to depict negative changes in ES supply stemming from land degradation processes due to different drivers acting at different scales, such as wildfires and drought, but also positive changes due to ecosystem recovery. The results presented in the report (https://www.newlife4drylands.eu/a2-2_analysis-of-the-selected-regions-and-pilot-sites_v4/) detect yearly changes, but the approach can be easily tailored to finer temporal scales.



Nestos River delta CSA: annual indicator values between 2017 and 2022 for above ground biomass (provisioning service). Due to prolonged drought in 2022, the map shows a decline of ca. 11% with respect to the baseline.

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Protocol

The project adopted a multifaceted approach that involved establishing a protocol for NbS in drylands, encompassing the identification of dryland characteristics and the design of NbS, and overseeing mid-term and long-term restoration efforts. The NL4DI Protocol has primarily adopted the approach and the structure of the International Principles and Standards for the Practice of Ecological Restoration (SER, 2019), Principles and Guidelines for Ecological Restoration in Canada's Protected Natural Areas (Canadian Parks Council, 2008) and Ecological Restoration for Protected Areas (IUCN, 2012), adapting them to the specific needs of ecological restoration of Mediterranean drylands.

In the Protocol, the elements included in the reference documents (SER, IUCN and Canadian Parks Council) are tailored and further elaborated, particularly concerning activities for restoring degraded soils using NbS. The Protocol also explores the integrated use of ground-based and Remote Sensing (RS) data to identify indicators for evaluating the effectiveness of planned solutions. This approach is geared towards fostering adaptive, evidence-based and interdisciplinary management of the ecological restoration process.

The Protocol serves the following main functions:

- it defines a methodology that addresses both the process of restoring soil degradation and the medium- and long-term monitoring of the proposed restoration solutions' effectiveness. The methodology also aims to raise awareness of the needs and opportunities of NbS in drylands;
- it serves as a guide for identifying specific/local NbS for dryland restoration, following the identification of degradation processes through a catalogue of NbS applicable in the Mediterranean context, based on NL4DI project experience;
- it supports restoration practitioners and planners (such as biologists, ecologists, naturalists, engineers, architects, agronomists, foresters, geologists, surveyors, etc.), as well as local decision-makers and administrators (such as Protected Areas staff) in effectively addressing the need for restoration activities in areas with degraded soils.

NewLife4Drylands aimed to provide, by using Remote Sensing techniques, a framework and a protocol for identifying sustainable solutions that could be successfully implemented in degraded land and define mid- and long-term monitoring of interventions in desertified lands, to better evaluate restoration effectiveness and improve sustainable soil management.

Why?

The establishment of a specific protocol for drylands, supporting design, implementation and maintenance of NbS, covers a lack in tools for practical decisions of administrators in drylands areas.

The protocol sets operational standards for preparing drylands restoration plans, supporting application of NbS through adaptive management.

The identification of specific measures for drylands ecological restoration and the information for monitoring the effectiveness of these measures is achieve using an indicator-based monitoring model built on both RS and in situ data.

For Whom?

Decision makers and managers of protected areas, local administrators, experts involved in restoration activities.

For more info check the project's NewLife4Drylands website www.newlife4drylands.eu

Authors: Serena D'Ambrogi, Francesca Assennato, Nicola Alessi, Anna Luise, Valentina Rastelli, Nicola Riitano (ISPRA); Christos Georgiadis (HSPN); Paolo Mazzetti, Rocco Labadessa, Cristina Tarantino, (CNR-IIA); Fabrizio Ungaro (CNR-IBE); Marcello Vitale, Vito Emanuele Cambria (SAPIENZA); Vicenc Carabassa, Cristina Domingo, Pau Montero (CREAF); Michalis Probonas, Eri Antaloudaki, Popi Baxevani (UoC)

Editor: Christos Georgiadis

Editing: Popi Baxevani, Michalis Probonas, Nikos Petrou

The full document can be downloaded at https://www.newlife4drylands.eu/en/outcomes/

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