Sustainable Strategies for the improvement of seriously degraded agricultural areas: The example of *Pistachia vera* L.

Layman’s Report

With the support of the Region of Attiki-Regional Union of Islands, the Agricultural Association of Aegina, the Agricultural Cooperative of Aegina’s Pistachio Producers
Objective and Innovations

The Main Objective

Development of sustainable cultivation practices at Mediterranean areas under desertification risk, which include sustainable management of soil, water and nutrients, valorization of agricultural waste streams and reduction of cultivations’ environmental footprint.

AgroStrat Innovations

• An Integrated Management Scenario for intensively cultivated areas to address specific issues (e.g. waste management at field, soil erosion) or as holistic approach to support regional plans.
• A set of soil indicators suitable for pistachio cultivation practices and wastes disposal for the determination of soil quality, degradation and desertification risk.
• A composting methodology for pistachio waste with very high electrical conductivity with the addition of natural zeolite as additive to the feedstock.
• A unique system for land evaluation for waste landspreading, which considers soil physical and chemical properties, geological and hydrological characteristics.
• A Cultivation Management Software (CMS) that provides consultancy to farmers for soil and water quality, fertilization according to soil properties and crop needs, evaluation of the soil suitability for waste/organic materials landspreading or use for fertilization.
• A Central Management and Monitoring Tool (CMMT) that allows network development between farmers and local authorities and establishment of a center of monitoring/management cultivated areas.
• Construction of a practical, easy to use, field equipment for rapid measurement of soil pH, moisture and electrical conductivity which could be used by individual farmers.
• Analysis of pistachio production sustainability considering the three pillars of sustainability (environmental, economic and social)-Life Cycle Analysis of pistachio production

A project co-funded by the European Commission and implemented in Greece

| Total Budget           | 1,026,509 € |
| EC contribution        | 509,504 €   |
| Beneficiaries contribution | 517,005 € |
| Pilot areas            | Aegina Island, Attica and Kilkis, Macedonia |
| Duration               | 1/10/2012-30/9/2017 |
Soil Thematic Maps
Land Suitability Maps

AgroStrat developed a system for assessing soil quality as regards physical and chemical properties and an evaluation system for land suitability for waste distribution or reuse for nutrients valorization.

After a two years soil characterization, sampling and analyzing campaign, and by using Aegina island as pilot area, a series of GIS soil thematic maps were developed (e.g. soil depth, texture, nutrients content, erosion risk).

Thereafter, soil properties and areas characteristics were evaluated according to FAO land evaluation system. The GIS soil thematic maps were also exploited in order to develop Land Suitability Maps for agricultural waste distribution on soil.

Four such maps were developed, i.e. for distribution of solid pistachio waste; wastewater from pistachios processing; solid olive mill waste and olive mill wastewater.

The Maps were included in the Cultivation Management Software and into the Central Management & Monitoring Tool to provide consultancy on fertilization and waste reuse on soils.

Land Suitability Maps

Pistachio wastes

Olive Mills wastes
The project developed a software that can be used in the entire Mediterranean region and promotes sustainable agricultural practices for *Pistachia vera* L. cultivation but also to other cultivations. The software provides consultancy on:

- Quality of soil, irrigation water, composts and waste
- Mineral fertilization in combination with organic materials
- Use of composts and wastes for fertilization
- Use of composts for soil improvement

**EVALUATION**

By inserting results of the chemical analysis, the software provides a fast evaluation of the quality of soil, irrigation water, composts or organic wastes.

**CONSULTANCY**

The end-user indicates the exact position of the cultivated field of interest by inserting field coordinates or by finding the field on Google Earth. In case of Aegina island, the software considers the results of the chemical analysis of soil, water and composts provided by the user and in case of missing soil properties, data from the thematic maps are automatically inserted. Fertilization consultancy and sustainable use of composts and organic waste are provided. For other areas, the software considers the results of the chemical analysis.

**CONNECTION WITH THE REGIONAL AUTHORITY**

This unique software feature connects farmers with the Regional Authority via Internet. The farmers may receive additional consultancy by the scientists of the Authority. It also supports networking between farmers, authorities and citizens.
Central Management & Monitoring Tool-CMMT

Field monitoring, measurement, spatial analysis and visualization

CMMT system is a web app for the management and monitoring of cultivation fields using soil, water and organic waste parameters, integrated within a Geographical Information System (GIS).

The Central Management & Monitoring Tool supports the establishment of a Monitoring Centre, which could be located, for instance, at the premises of a Regional Service/Agency, farmers’ association or of a Municipality, and enhances the continuous monitoring of cultivated areas or areas where wastes are disposed.

Connection with the Monitoring Authority

This unique web application provides the option for the farmers to inform the Monitoring Authority for their field and cultivation status by uploading soil, water and wastes analysis on CMMT Server and may receive additional consultancy afterwards by the scientists of the Authority.

The cultivated fields or the waste disposal areas are presented on maps. The user may select which soil property wishes to monitor and for which period. The results are presented on the maps, while special features provide the authorities with the potential to screen all data sent by the farmers as well as to assess statistical evaluation of the collected data at regional scale.

The Central Management Monitoring Tool (CMMT) of AgroStrat is a unique web GIS-based application that will assist local and regional authorities to monitor soil quality and agricultural practices at local and regional scale.

The CMMT enhances authorities to screen cultivated areas rapidly, identify potential risky conditions and proceed to detailed monitoring, if necessary. The tool strongly promotes the implementation of resources monitoring at field, municipal or regional scale.

Data can be uploaded by local farmers through the Cultivation Management Software or by the Authorities through the CMMT. Therefore, the CMMT can collect, store and process soil and cultivation data allowing short and long term evaluation of the agricultural environment as well as, the development of strategies and plans at local or regional scale.
In the case of the sequential system, wastes are not separated after production. Instead, they are collected into the five reservoirs. The solid part is left to precipitate and then used for composting. Wastewater is left to evaporate.

**Sequential Collection Reservoirs**

The system was constructed by exploiting a former, almost destroyed, pig breeding area.

**Shallow evaporation ponds**

Wastes are separated into solid and wastewater immediately after their production by using a simple separation equipment. The solid part is composted while wastewater is collected into three shallow ponds and left to evaporate. The ponds can be permanent or temporary. Protective media (geotextiles) must be used to prevent infiltration of wastewater into soil.

The five stall places were reconstructed to form a sequential system of five reservoirs for waste collection.
Life Cycle Analysis (LCA) – Environmental Risk Assessment

**LCA** was carried out to determine the consumption of raw materials i.e. fertilizers, pesticides, irrigation and processing water, energy and agricultural waste, as well as to calculate emissions of pollutants (CO₂, CH₄, VOCs, NOx, SO₂ etc.) to air, water and soil in relation to pistachio production.

**RESULTS**
LCA identified that fertilizers production, irrigation system and cultivation operations were the most impactful phases. Impacts of critical importance were also ascribed to waste management, mainly attributed to the uncontrolled disposal of the pistachio waste and the unavoidable surface runoffs to ground- and/or surface water.

**BENEFITS**
- Application of LCA to evaluate the environmental impacts caused by pistachio cultivation can be extended to other tree cultivations in similar arid and semi-arid environments, in the Mediterranean region and elsewhere.
- The LCA results can be also used by several end-users (i.e. farmers, agronomists), policy makers and other stakeholders for developing eco-friendly and goal-oriented sustainable strategies for similar tree cultivation systems.

**AN INTEGRATED ENVIRONMENTAL RISK ASSESSMENT** was carried out to:
- assess the improvement of environmental quality of the pilot area due to the developed and applied strategies (IMaS) during the project.
- assess the risk for water bodies due to agricultural waste disposal and agricultural practices, and
- evaluate the environmental impact of pistachio production in the Mediterranean countries using suitable environmental indicators.
Five years close to farmers and policy makers
AgroStrat is continuing…

An INTERREG BalkanMed project, with the title “Towards farms with zero carbon, waste- and water-footprint. Roadmap for sustainable management strategies for Balkan agricultural sector-BalkanROAD” started its activities on 8 September 2017. The project foresees, among others, the development of fertilization consultancy for grapes, vegetables and apples based on the already developed software of AgroStrat and also the development of a software that will record and estimate the environmental footprint of the marketable agricultural products, considering all production steps (from field to the market). The estimated footprint can be then indicated on products’ label increasing their value compared to other similar products found in the market.

BalkanROAD and ClimaMED will boost and communicate AgroStrat results in the Balkan Peninsula and in the Mediterranean Region.

A new LIFE project under the title “Innovative technologies for climate change mitigation by Mediterranean agricultural sector- ClimaMED” (LIFE17 CCM/GR/87) will start on 1st July 2018. One of the main objectives of the ClimaMED project is the establishment of an Operational Central, similar to the CMMT of AgroStrat, for recording and monitoring Greenhouse Gases emissions and Changes in Soil Organic Carbon in the Mediterranean agricultural sector.
We remain on the Web!
Visit us at:
http://www.agrostrat.gr

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