

Findings & Policy Recommendations

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Proactive Producer and Processor Networks for Troodos Mountains Agriculture

3PRO-TROODOS (INTEGRATED/0609/061) is an integrated research project funded by the Republic of Cyprus and the European Regional Development Fund through the Research and Innovation Foundation (2019-2023). The project aims to improve agricultural production and food processing in the Troodos Mountains of Cyprus, through social innovation, sustainable natural resource management and climate change adaptation. The project is a cooperation of The Cyprus Institute, Agricultural Research Institute, A.M Filagrotiki Symvouleftiki LTD, Architextonikes kai Perivallontikes Meletes LTD, Sigint Solutions LTD, Troodos Development Company, Cyprus Organic Farmers Association, Niki Agathokleous LTD and Euroagrotikos.

Climate and Water Resources

Troodos Mountain agriculture is an important supplier of fresh fruit and vegetables for Cyprus. The highly dispersed terraced mountain fields with stony soils along steep slopes makes it a challenging agricultural production environment. Observations have shown enormous temperature variabilities and extremes, affecting the development of agricultural crops and trees. Hail and snow events in spring and extreme rainfall events are also causing severe threats to the yields and quality of crops.

European climate simulations with 19 Regional Climate Models under a business-as-usual scenario (RCP 8.3) show an average decrease of 10% in annual rainfall for the years 2031-2060, relative to 1981-2010. The 3PRO-TROODOS Project downscaled three models to 1-km resolution over Cyprus and found a decrease in average annual rainfall up to 11% and an 1,8°C increase in average annual temperature. Hydrologic model simulations show that such future climate conditions could lead to a 30% decrease in surface water resources in Troodos and a 7-13% increase in field-based irrigation water demand.

Troodos voluntary certification label



3PRO-TROODOS project developed the first voluntary certification scheme for fruits and vegetables in Cyprus, under the name Troodos Mountain Agriculture, to support agricultural production in the region. The operational framework of the voluntary certification scheme was founded on two stages. First, a thorough review of voluntary quality systems in the European Union was performed. Second, a set of criteria was established following a series of meetings with Troodos farmers. The formulated quality system implementation criteria for Troodos Mountains are based on three pillars: consumer health and food safety, social and entrepreneurial commitments, and environmental responsibility. A number of these criteria are aligned with the new agri-environmental measures and investment schemes of the 2023-2027 Rural Development Programme of Cyprus. In its current pilot phase, the Troodos Mountain Agriculture label products are available for sale in a Nicosia supermarket.

The impact assessment indicates that the quality label adds value to local agricultural products and Troodos economy. Indicatively, for every 5-10% increase in the price of certified mountain fruits, the gross output and employment of the local economy increases by 0.3-0.6% and 23-45 new jobs, respectively. The success of the quality label depends on its consolidation and visibility in the market. For these to be achieved local farmers need to be supported in forming organized groups to monitor and implement this scheme and its criteria.

Medicinal and aromatic plants of Troodos

Ethnobotanical interviews in more than 30 villages of the Troodos Mountains showed a wealth of traditional knowledge on the use of medicinal and aromatic plants. More than 160 plant species were reported in the survey, with the main families being Lamiaceae, Rosaceae, Asteraceae and Apiaceae. The most popular local uses for these plants were medicinal and culinary. The study led to the inscription of the traditional uses of medicinal and aromatic plants in the Troodos region on the 2022 UNESCO National List of Intangible Cultural Heritage. This acknowledgement provides the basis for supportive measures that preserve the traditional knowledge and promote the protection and conservation of plant diversity. Furthermore, this distinct cultural element can be utilised to enhance the identity of the Troodos region and add value to traditional products for the betterment of local livelihoods and future generations.



A field experiment using the endemic *Origanum majorana* var. *tenuifolium* Weston and the indigenous *Origanum dubium* Boiss was performed to assess the effect of deficit irrigation on the growth, production and composition of the essential oils. It was found that deficit irrigation during the reproductive stage increased the yield of essential oil for *Origanum dubium*, while it did not significantly affect the production of biomass or the composition of the essential oil. The lessons learnt from this experiment indicate the important potential for new products and processing innovations of high added value. These innovations can be combined with smart irrigation technologies that can adapt the use of irrigation water considering the impacts of climate change.

Smart technologies for irrigation scheduling

Monitoring of soil moisture and meteorological conditions in farmers' fields in Troodos has shown that 10-30% of irrigation water can be saved with sensor-based irrigation scheduling. The deployment of Internet of Things (IoT) loggers with environmental sensors in farmers' fields provides real-time insights in the field conditions, including soil moisture, temperature, and solar radiation levels. The Argus Agro System, which was developed with support from the 3PRO-TROODOS project, consists of a solar-powered IoT logger and a web-based data analysis and visualization platform. The online platform provides continuous irrigation advice and let farmers monitor their fields from any location. The successful deployment of this system has demonstrated the potential for smart farming technologies to help farmers adapt to climate change, increase efficiency, reduce waste, and improve crop yields.



It is recommended that policy makers consider the development of support measures and regulations to encourage the widespread adoption of smart farming technologies. Farmer-participatory research should also be strengthened to develop regulated deficit irrigation schedules that optimize product quality and improve irrigation water use efficiency under the highly variable and changing climate conditions in Troodos. Such research will benefit greatly from IoT technologies such as the Argus Agro system, which provides farmers and researcher with the same information at the same time. Further investments in agricultural technology and innovation research can improve the economic efficiency and environmental sustainability of the agricultural sector.

Protective nets for sustainable fruit production

Experimental research on the effects of protective nets in a sweet cherry orchard in the Troodos Mountains showed that favourable microclimate conditions under protective nets have a positive effect on fruit productivity and quality. The nets protected the orchard against hail and rain during fruit developmental stages. The nets could also reduce orchard water loss and moderate the impact of extreme temperatures. Yield, fruit quality and tree canopy traits were observed and Internet of Things technologies (e.g., smart sensors) were deployed in the orchard for sensing environmental parameters. The adoption of protective nets and the application of IoT technologies by farmers in Cyprus can be recommended as environmentally friendly techniques for mitigating climate change effects, reducing water losses and achieving higher productivity and improved fruit quality.



Maintaining terraced mountain landscapes



A series of hands-on workshops were organized with Troodos communities to support the maintenance and rehabilitation of dry-stone agricultural terraces. The continuation of these activities is facilitated by the publication of an illustrative manual on the construction and maintenance of terraces. Although the drystone art has been inscribed to the UNESCO Global List of Intangible Cultural Heritage in 2018, mountain terrace abandonment is still a persistent issue. What is lacking and could reverse this trend is the formulation of a national strategy for the preservation and use of drystone terraces, starting with the documentation and mapping of drystone terrace environments and the establishment of a registry of drystone crafts people and experts. In addition, the drystone knowledge should be institutionalised and transmitted to the new generations by introducing specialised theoretical and practical modules and courses in technical schools and university curricula. Furthermore, the subsidised amount for the construction and maintenance of drystones needs to be increased in line with the cost of the work to support their preservation and sustainable agriculture in the Troodos Mountains.