

## ***How to combat wildfires in Mediterranean mountains? Maintain active agriculture and forestry***

*Mountain landscapes in Portugal and other Mediterranean regions in Europe have changed considerably over the last decades. Changes, driven mostly by socioeconomic factors (e.g., demography, agricultural policy) lead to depopulation and land abandonment in many rural areas, favouring ecological succession and the replacement of perennial crops by forests and agroforestry systems. Shrubland and forests (planted and natural) have expanded at the expense of farmland. Shrubland also dominates forest areas after wildfires. Very recently in the Bragança region (Northeast of Portugal), sweet chestnut orchards have increased in area, replacing agriculture crops and recovering previously abandoned farmland.*

Changes in landscapes affect ecological processes and ecosystem services (ES). In the mountains of the Bragança region, an increasing supply and value of provisioning and regulating ecosystem services has been observed over the last decades. Although agriculture area and products decreased in the region, other provisioning ES<sup>1</sup> () increased mainly due to higher water yield and forest production. Regulating ES<sup>2</sup> () increased considerably. It has been estimated also that the supply and value of ES in these mountain landscapes will grow in the near future. The reverse of the medal is that these same changes are also responsible for increasing fire hazard in these and other Mediterranean mountains, threatening the current and future supply of ecosystem services given the high fragility of these systems and the irreversibility of the impacts caused by wildfires. In 2017 alone, wildfires consumed around 500 000 ha of forests and shrubland in Portugal, killing 109 people. Most of these catastrophic fires happened in mountain areas in the center of the country where forest expansion has been very fast in recent decades. The ecological, economic and social impacts of these fires, including long term effects on the ability of ecosystems to supply ES, are yet to be evaluated. In addition to the already dramatic situation these areas face, climate change is also expected to impact strongly fire regimes through higher air temperatures, higher plant productivity (biomass) and longer dry seasons in Portugal and other Mediterranean regions.

Landscape change in Mediterranean mountains requires, therefore, a serious analysis of causes and consequences but, more importantly, it calls for urgent action to reduce fire risk in order to maintain sound ecosystems and landscapes and the ES they supply. Possibly the best (and only) way of addressing this complex problem is the maintenance of moderately intensive human activity in mountains, chiefly agriculture and forestry. Agriculture creates discontinuities on otherwise continuous very high fuel load shrubland/forest cover. Particular agriculture systems such as hay meadows and other High Nature Value farmland (HNVf) systems, currently threatened in Portugal and elsewhere in Europe, have played that role in higher elevations. HNVf are themselves able to supply many important ES and their maintenance in mountains must be encouraged. Forest management also affects the spatial distribution of fuel in the landscape being able to reduce the probability of catastrophic fires. Through principles and practices based on fire preventive silviculture, e.g. addressing tree species selection, stand size, tree density, rotation length, harvesting configuration, and other aspects at the

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<sup>1</sup> Benefits to people from goods obtained from ecosystems such as food, energy and materials

<sup>2</sup> Benefits for people resulting from regulation functions of ecosystems such as carbon sequestration or nitrogen and sediment retention

stand and landscape level, forest management must be a significant part of the solution for the growing fire risk in mountain areas. However, for agriculture and forestry to be maintained, mountain areas should be socially and economically attractive for people, in particular young people, to live and work in. This refers not just to health, education and cultural services and facilities, and transportation and communications infrastructures, but also to businesses able to create jobs and demand for agriculture and forest products, and nature-based industries to produce highly valued mountain products for national and international markets. Many ES that currently are not marketed are also foreseen opportunities for the socioeconomic development of mountain communities, based on the establishment of fair schemes for their payment.

Large catastrophic forest fires are favoured by the same landscape changes that increase the supply and value of ES in Mediterranean mountains. Through their role in reducing fire risk, agriculture and forestry are indispensable components in mountain systems, assuring that the overall society benefits from essential ES. For this to happen, however, it requires socioeconomic development of mountain areas to stop depopulation and attract newcomers. Farmers and foresters, old and new, are possibly the only ones who can save the day.

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