Fires and agroforestry landscapes

Key words: *forest fire risk, fire prevention, agroforestry*

Gavriil Xanthopoulos

Research Director, HELLENIC AGRICULTURAL ORGANIZATION
"DEMETER", Institute of Mediterranean Forest Ecosystems
Terma Alkmanos, Ilisia, 11528, Athens, Greece
gxnrtc@fria.gr

© Gavriil Xanthopoulos | Fire of Northern Evia in August 2021

THE EVOLUTION OF FOREST FIRES

In recent decades, forest fires have become increasingly difficult to control and the destruction they cause is also intensifying, despite the significant strengthening of forest firefighting mechanisms globally. Greece, as well as other neighbouring countries, is no exception (Xanthopoulos and Nikolov 2019). It is predicted by the entire research community studying the phenomenon that the problem will worsen due to climate change, fuel accumulation caused by rural abandonment and reduced forest management, as well as residential establishment within or near forests (Rego et al. 2019). In fact, the temporary avoidance of fires thanks to strengthened suppression forces causes further biomass accumulation, a fact that will certainly lead to more destructive fires in the near future. This phenomenon, called the “fire paradox” has been experienced by many countries around the world, including Greece (Arévalo and Naranjo-Cigala 2018). Strengthening forest fire prevention is proposed as an essential pillar to reduce the incidence of disasters and limit costs, as its efficiency is much higher than the cost of fire suppression.

Agroforestry, in addition to its many economic and environmental benefits, can play an important multifaceted role in forest fire prevention

FOREST FIRE PREVENTION

Forest fire prevention is defined as the set of actions taken before a fire starts aiming to:

- Reduce or eliminate the likelihood of fires
- Reduce the possibility of unhindered spread of any fire that occurs
- Reduce the damages in the event of a fire
- Ensure the existence of a mechanism capable and ready to rapidly detect new fire outbreaks and to respond without delay with the necessary forces to immediately put it under control.

Forest fire prevention is a multidimensional activity which includes a technical/technological part (risk forecasting, fire planning, roads, reservoirs, hydrants and other technical works) and a social dimension (information, awareness and organisation of citizens, policy, legislation). However, none of these can ultimately prevent disasters if the forest area is not properly prepared, keeping the risk from flammable material at a manageable level. The statistics on forest fires in Greece offer tangible evidence: during the decade 1960-1969, when fires were under the responsibility of the Forest Service, which had neither aerial resources nor forest fire-fighting vehicles but had on its side the contribution of human populations living near the forests, the average annual burnt area was 123,770 hectares. In the period after the transfer of fire suppression responsibility to the Fire Service (1998-2022), the annual average was 437,460 hectares, despite the availability of many hundreds of fire engines and dozens of aerial firefighting resources. The increase in the amount of living and dead biomass in the countryside, but also the creation of horizontal and vertical fuel continuity, due to abandonment of activities by the continuously declining population (Xanthopoulos and Nikolov 2019), are the main reasons for this change; they are probably more important than the adverse meteorological conditions favoring wildfires and occurring with higher frequency due to climate change. In that sense, it is important to note that the proportion of the rural population within the total population of Greece decreased from 44.06% in 1960 to 20.61% in 2019. This has reduced the use of wood for heating and cooking, while many agricultural cultivations that in the past acted as breaks of the continuity of fuel were abandoned, and extensive livestock grazing, that helped to control the quantity of fuel, declined.

The state's response to this major problem, especially after the disastrous fire season of 2021, is to increase funds for fire suppression and prevention. Prevention funds are largely allocated for fuel reduction works, primarily by removing the understory of tall forests, but also by creating new firebreaks. However, at an annual cost of more than €70 million, this high expenditure is difficult to maintain in perpetuity, while the treated vegetation will recover in a few years. It is clear that a policy change with a focus on 'smart' prevention is needed (Moreira et al. 2020).

When applied to large areas, agroforestry gives a real opportunity to firefighting operations to stop large fires

Returning the population to the countryside is a reasonable goal that would help rebuild fire and climate change resilient landscapes, but is generally difficult to achieve. A more realistic objective, however, may be to retain the population already there and attract younger residents as far as possible. This requires policies for their economic viability and ensuring some minimum living standards. Local conditions (climate, soil type and condition, size of plots, production and marketing conditions, etc.), together with the existence of modern knowledge and the ability to organise production and marketing, play an important role in achieving this sustainability. One of the promising options in this direction is agroforestry.

AGROFORESTRY AND FOREST FIRES

The term agroforestry describes land management systems where forest or agricultural trees are intercropped with herbaceous species on the same piece of land. In scientific terms, these systems are divided into silvo-agricultural, silvo-pastoral, or agro-silvo-pastoral systems. In any case, they are a practice that has been applied since ancient times in Greece and in many other countries of the world, as it has many economic and environmental advantages. Among the advantages offered by agroforestry is the role it can play in preventing forest fires. This role is multifaceted. Firstly, agroforestry can help to keep human populations in the countryside as it can provide improved income, stability in terms of the effects of climate change and income opportunities from parallel activities such as agrotourism, beekeeping, etc. In addition, these populations can be an aid to fire prevention.

Agroforestry, applied over large areas, results in reduced total amount of biomass per unit area, giving a real opportunity to suppression mechanisms to stop large fires. However, even relatively narrow strips, a few tens of meters wide, can contribute substantially to breaking the horizontal continuity of fuel, offering fire suppression opportunities either by direct attack or by applying backfire or burn-out, starting from such strips. An agroforestry zone with a width of 50 or even 200 meters has no negative ecological impact, provides income, and does not require annual maintenance by the government, while being extremely useful in forest firefighting. This is in contrast to a firebreak zone cleared to the ground, that cannot be of the same width, has a negative ecological footprint as it is exposed to erosion, and does not provide any income while having significant annual maintenance costs.

If properly supported and integrated into fire prevention planning, agroforestry can greatly contribute to the improvement of the quality of life of rural populations, especially those living close to forests, both financially and in terms of security

Technically, the tree vegetation in the above systems is quite sparse, with a crown cover of less than 30-40%. As a result, it is not possible for a crown fire to spread, and therefore fire behavior is dependent on spread in the herbaceous understory vegetation. The use of trees that are relatively resilient further helps to prevent the occurrence of crown fires. The presence of shade delays the drying of herbaceous vegetation in summer. When crown cover is relatively high (30-40%) this effect can be significant. This vegetation, often remaining green until early July, depending on the area and conditions, reduces the duration of peak fire risk during the summer months. Furthermore, where irrigation is applied, even if limited (e.g. in tree crops, vineyards, etc.), the flammability of the vegetation is reduced. In general, the creation of a mosaic of forest and agricultural vegetation involving agroforestry systems results in a mild pattern of damages in case of a fire, reduces the risk of secondary effects such as erosion and flooding, and enables faster recovery (Figure 1).

Figure 1. *Agroforestry landscape North of the bridge of Tsakona in Messinia. On the left, a satellite image (Google Earth) from 15-5-2020 (before the fire); on the right, a photo taken on August 13th 2021, a few days after the big fire. The burnt mosaic, the variable fire intensity, and therefore the relatively reduced environmental footprint due to the existence of agroforestry systems is evident. © Gavriil Xanthopoulos*

Figure 2. *A photo from the foothills of Parnis Mountain where agroforestry vegetation was not utilized appropriately to stop the spread of the fire that started in Varybobi on 3-8-2021 and eventually burned 8,370 ha. © Gavriil Xanthopoulos*

In order to make agroforestry systems more efficient in contributing to fire prevention, herbaceous vegetation must be reduced and be intermittent during the summer months. Intensive grazing, ploughing of some strips of land, sowing and irrigation of strips with herbaceous vegetation that remains green during the summer period can effectively increase the function of agroforestry systems as fire control sites. At the same time, however, the firefighting organization should be aware of these sites and should include them in their planning in advance, i.e. the sites must be mapped and included in fire planning so that they can be used appropriately. Otherwise, the effectiveness is drastically reduced (Figure 2). The next logical step is for the state to favour or even subsidize the establishment of agroforestry systems in selected locations as part of fire planning, partially replacing fire zones (Figures 3-4). The incentives and implementation framework should be studied in depth, substantially influencing rural policy and empowering the rural population (Goldammer et al. 2019; Moreira and Pe'er 2018; Rego et al. 2018; Tedim et al. 2016), starting with pilot implementation.

Figure 3. *Fire of Mati, in eastern Attica, 23 July 2018. The flame front stopped at places were there were properly maintained vineyards. © Gavriil Xanthopoulos*

CONCLUSIONS

Agroforestry can clearly play a key role in managing the problem of wildfires at the landscape level If properly supported and integrated into fire management planning, agroforestry can contribute substantially to the well-being of the rural population, particularly of people living in proximity to forests, both in terms of livelihoods and safety. At the same time, the need for extensive fuel management programmes can be reduced, achieving significant savings while reducing the ecological footprint of such fuel reduction. Thus, the country will see significant improvement in overall landscape fire management at a substantially lower cost.

With a relatively small investment, agroforestry can largely replace extensive fuel reduction programs, achieving significant cost savings while reducing the ecological footprint of such programs

Figure 4. *The fire of Northern Evia in August 2021 stopped in many places at the border of vineyards and olive groves where the herbaceous vegetation had been removed in advance. © Gavriil Xanthopoulos*

Acknowledgements

This paper was prepared in the framework of the ResAlliance project “Landscape resilience knowledge alliance for agriculture and forestry in the Mediterranean basin”, funded by the European Commission and the European Research Executive Agency (REA), under the Horizon Europe Framework Programme (Project 101086600).