BACKGROUND PAPER

CLIMATE CHANGE ADAPTATION IN AGRICULTURE AND FORESTRY IN THE MEDITERRANEAN REGION – STATE OF THE ART

1. Introduction

Over the past decades, Europe has experienced many summer heat waves, droughts and forest fires characterised by lasting conditions of high temperatures and low precipitation, in particular in southern Europe.[1] The most severe risks are projected for urban areas in southern Europe and for the Mediterranean coast.

According to several experts, future climate change could critically undermine efforts for sustainable development in the Mediterranean region. In particular, climate change may add to existing problems of desertification, water scarcity and food production, while also introducing new threats to human health, ecosystems and national economies. The most serious impacts are likely to be felt in North African and Eastern Mediterranean countries, including EU countries.

Climate change is a fundamental threat to global food security. As in many other regions of the world, Mediterranean agriculture is being adversely affected by the climate change impacts. Observed effects are rising temperatures, increased temperature variability, changes in levels and frequency of precipitation, a greater frequency of dry spells and droughts, increased intensity of extreme weather events, rising sea levels, salinisation of arable land and freshwater, and pest and disease outbreaks.

While most of the above factors related to agriculture also affect Mediterranean forests, the latter are facing a major threat in the form of fires. Forest fire risk depends on many factors, including climatic conditions, vegetation, forest management practices and other socio-economic factors. The burnt area in the Mediterranean region has significantly increased since 1980. It is expected that, in a warmer climate, the fire-prone areas will expand northwards and longer fire seasons are projected in southern Europe.

Following the Fifth Assessment Report of the IPCC, Climate change 2014, Adaptation is defined as "*The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects*[2]."

[1] EEA Report No 15/2017

[2] Reflecting progress in science, this glossary entry differs in breadth and focus from the entry used in the Fourth Assessment Report and other IPCC reports.

Adaptation does not mean the simple persistence of the current situation. It refers to changes in processes, practices and structures to moderate potential damages or to benefit from opportunities associated with climate change.

A broad range of adaptation measures is being tested to support farmers and foresters in introducing climate-smart production methods in the EU's Mediterranean regions. The purpose of this platform meeting is to bring together beneficiaries of relevant projects funded by the EU's LIFE Programme (http://ec.europa.eu/environment/life/), competent authorities and other stakeholders, from the public and private sectors, to discuss and further develop best practices, identify key lessons and inform policy-making and resource allocation at EU and national levels.

2. Adaptation in agriculture in the Mediterranean region

2.1. Climate change impact on Mediterranean agriculture

Climate change affects phenological stages of crops, thus causing alteration of crop evapo-transpiration pattern, irrigation requirements and crop geographical distribution. For example, a study using climate models has estimated that the potentially cultivable areas for olive growing are expected to extend northward and at higher altitudes, so increasing by 25% in 50 years. At the same time, effective evapo-transpiration of rainfed olives could decrease in most areas due to an expected reduction of precipitation and increase of evapo-transpirative demand, thus making it impossible to keep rainfed olive production as it is at present[3].

Another similar study explains that potentially cultivable areas of winter wheat and tomato will be extended prevalently in the northern Mediterranean countries, and the use of supplemental irrigation for winter wheat could become more widespread in the northern part of the Mediterranean region[4]. Furthermore, given the predicted changes in precipitation and the increasing number of extreme weather events, soil erosion processes are likely to be intensified in Mediterranean vineyards. This is also linked to the fact that vineyards are more susceptible to erosion processes, as they are typically grown on bare soils with altered profiles, lower organic matter content, poor structure and low infiltration capacity[5].

2.2. EU Climate Action Policy on adaptation to climate change

The European Union is part of the Paris Agreement on Climate Change, and the overall EU Climate Action Policy is consistent with the goals of the 2030 Agenda on Sustainable Development[6]. The EU Strategy on Adaptation to Climate Change is currently mainstreamed into key EU policies and strategies, including those for critical infrastructure protection, environmental protection, financial

[3] Tanasijevic L.*et al.* , 2014
[4] Saadi S. *et al.*, 2014
[5] Ramos, 2016
[6] Communication from the Commission (2016) 739

instruments of the Cohesion Policy and the EU Structural and Investment Funds (ESIF), agriculture, food and nutrition security, and integrated coastal management.

The strategy has three main priorities:

- Priority 1: Promoting action by Member States (development of national strategies/plans);
- Priority 2: Better informed decision making (research and climate services);
- Priority 3: Key vulnerable sectors (sector-specific policies addressed by the Strategy).

The EU Strategy on Adaptation is supported by the **European Climate Adaptation Platform (CLIMATE-ADAPT)**, which is a partnership between the European Commission (DG CLIMA, DG Joint Research Centre and other DGs) and the European Environment Agency (EEA). CLIMATE-ADAPT aims to help users to access and share data and information on:

- Expected climate change in Europe
- Current and future vulnerability of regions and sectors
- EU, national and transnational adaptation strategies and actions
- Adaptation case studies and potential adaptation options
- Tools that support adaptation planning.

Under Priority 1, Member States are at present at different stages of preparing, developing and implementing national adaptation strategies and plans (also including measures for the agriculture sector), as foreseen by Regulation (EU) No 525/2013.

Adaptation measures and solutions for agriculture are specifically addressed under Priority 3 of the Strategy, through the Common Agricultural Policy (CAP), financed by the European Agricultural Guarantee Fund (EAGF) and the Rural Development Programmes (RDP) of the Member States, and co-financed by the European Agricultural Fund for Rural Development (EAFRD). The CAP provides with direct payments to farmers who, in return, have to apply a number of good land management practices in their farms, which are likely to improve the resilience of the agro-ecosystem against extreme weather events. Moreover, the RDPs always comprise actions targeted to combating climate change (agro-climatic measures).

2.3. Planning and implementing adaptation approaches

For the formulation and implementation of a **long-term adaptation strategy**, four elements are identified by the UN Framework Convention on Climate Change (UNFCCC).[7] This methodological approach is developed for a (national/regional) multi-sector adaptation plan, but it is here tailored to the agriculture sector.

[7] This approach has been specifically devised for the Least Developed Countries group, but it is a valid working scheme suitable for developed countries as well.

a) Lay the groundwork and address gaps. It consists of identifying the relevant institutions and stakeholders involved in the agricultural supply chains; the non-governmental sector along with available financial support (public/private). During this phase, synthesis of available data and knowledge and gap analyses need to be carried out as well.

b) Preparatory aspects. They consist of:

- Analysing current and future climate change scenarios;
- Assessing the vulnerability[8] of the target farming system and identifying adaptation options (after consultation with stakeholders);
- Reviewing and appraising adaptation options (in full participation with stakeholders), including economic, ecosystem and social costs and benefits, and possibilities for unintended impacts of these measures.

c) Implementation strategies. They are:

- Integrating and prioritising climate change adaptation options into regional agricultural planning (e.g. the Rural Development Plans);
- Developing a long-term adaptation implementation strategy for the agricultural sector (in full participation with stakeholders);
- Enhancing capacity for planning and implementation of adaptation.

d) Reporting, monitoring, reviewing and disseminating. Under this stage, the implemented adaptation strategy is continuously monitored to check its progress and effectiveness. Feedback is received from stakeholders, which allows to review and update the strategy. Outcomes from the strategy's implementation in a specific territory are disseminated among stakeholders.

Adaptation planning in agriculture builds on a strong knowledge base composed of the latest available research findings from various branches of science, such as agronomy, soil science, animal breeding, genetics, socio-economics, food processing, etc.

Wide dissemination of research outcomes about practical and innovative solutions for improving resilience of agro-ecosystems among end users, namely farmers, is also a crucial component of a sound adaptation plan/strategy.

Picture right: LIFE Project: Measuring CO_2 emission after compost application

[8] Vulnerability is the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes.

LIFE Project. Farmers visit a field managed with conservation agriculture techniques

Horizon 2020 Programme. Farmers appraise cover crop management

Depending on their specific circumstances, individual farmers can adopt a suite of "**climate-smart" farming practices**, as encompassed by the identified strategy of adaptation.
Some examples of good practices are:

a) Optimisation of planting schedules;
b) Diversification of the cropping plan, including new species and varieties;
c) Implementation of minimum/zero soil tillage techniques;
d) Practising intercropping/crop rotation;
e) Optimisation of post-harvest practices;
f) Efficient use (and re-use) of water, organic matters, agro-chemicals;
g) Improvement of farm landscape design and drainage measures in the cultivated fields;
h) Adoption of agro-forestry practices;
i) Enhancing natural regulation and strengthening ecosystem services to prevent pest and disease outbreak.

The progressive dissemination of **the "precision farming" approach**, linked to more and more affordable cost of technological devices and software (e.g. decision support systems – DSS), allows to significantly increase the efficiency of natural resources use, thus contributing to strengthening the resilience of the farming system.

LIFE Project. Crop residues from greenhouse cultivation, available for green composting

Deep knowledge of **financing opportunities** for climate adaptation initiatives, at regional, national and international level, is crucial to facilitating farmers' adoption of relevant measures. European farmers may find specific funding for adaptation principally within the Rural Development Programmes (RDP) of the Member States, supported under CAP instruments like the European Agricultural Fund for Rural Development (see above). However, resources for the identification of innovative adaptation solutions can be financed through the LIFE and HORIZON 2020 Programmes.

A precondition for all adaptation planning and action is **climate-related data and climate services**. Climate data is particularly important as it describes past, current and future climate conditions and points to hazards and exposure. Climate information is obtained and provided to farmers through relatively recent innovations in weather and climate monitoring, analysis and forecasting technologies. Parallel advances in computing and cellular telecommunication services have also proven to be cost effective and reliable for climate adaptation and early warning purposes. Climate modelling helps predict impacts, is necessary to know and manage climate risk, and is particularly useful when defining the different climate scenarios to inform the appraisal and prioritisation of the adaptation actions. The European Union's Earth Observation Programme, COPERNICUS[9], among its various purposes, provides a Climate Change service to increase the knowledge base to support adaptation and mitigation policies.

3. Adaptation in forestry in the Mediterranean region

3.1. Climate change impact on Mediterranean forestry

Forests constitute one of the most complex natural landscape units with regard to function, structure and dynamics. The EU-28 has close to 182 million hectares of forests and other wooded land, corresponding to 43 % of its land area (excluding lakes and large rivers)[10].

	Land area, without inland water	Forest and other wooded land, 2015	Forest, 2015	Forest, available for wood supply, 2015	Forest ownership, 2010	
					Public	Private
	(thousand hectares)				%	%
EU 28	424.694	181.918	161.082	134.486	39,7	60,3

Forest area and ownership, 2015 and 2010

They provide multiple ecosystem services to society and a range of products and resources with great economic value. They also play a key role in climate change mitigation acting as carbon sinks. These forests are being affected directly by changes in climate factors, with different and unfavourable conditions creating vulnerable scenarios.

[9] www.copernicus.eu
[10] Eurostat 2017 edition

The foreseeable impact of Climate Change has a particular effect on forest ecosystems. Pests and diseases could play a significant role in the fragmentation of forest areas. This fact, together with those processes affecting biological diversity (e.g. causing species to become rare or extinct), could lead, to severely diminish the structural complexity of forest ecosystems. Changes, simplification and risk of disappearance in biodiversity terms are foreseeable consequences in the short and medium term.

3.2. EU Climate Action Policy on adaptation to climate change

The **EU Forest Action Plan**[11] defines specific steps for dealing with climate change and biodiversity issues. It also addresses the protection of forests facing global warming and other impacts, and proposes to work towards an improved European forest monitoring system. One target of the plan is to increase knowledge about the effects of climate change on forest ecosystems.

As concluded in the **EU Forest Strategy**[12]**,** an adaptation strategy for forests and the forest sector is necessary since there is no guiding framework for forest-related issues. Since a growing number of EU policies are making increasing demands on forests, there is a need to coordinate sectorial policies. There is also a need for an agreed holistic strategic vision on forest issues, and for ensuring that linked EU policies are fully taken into account in national forest policies. This will strengthen the capacity of forests and the forest-based sector to respond to developments in various policy areas. Currently, the main instrument for implementing forestry measures is rural development policy, in particular the second pillar of the Common Agricultural Policy (CAP). Among the six foci of the EU policy framework outlined in the forest strategy, two are explicitly related to climate change adaptation:

- Respond to the challenges and opportunities that forest-based industries face in resource and energy efficiency, raw materials, climate policy beyond 2020 and information and communication, to stimulate growth.
- Protect forests and biodiversity from the significant effects of storms and fires, increasingly scarce water resources, and pests. These threats do not respect national borders and are exacerbated by climate change.

The FAO addresses “Threats and challenges faced by Mediterranean forests” as a core topic of its Concept Paper “State of Mediterranean Forests[13]“. Further, the LIFE project “Conservation of biodiversity in Western Iberia“ (LIFE 07 NAT/E/000762) developed comprehensive “Guidelines for sustainable Management of Forests”.

3.3. Planning and implementing adaptation approaches

As global climate becomes warmer, the maintenance of the structure and function of Mediterranean forests constitutes a key challenge to forest managers. In order to make timely decisions, they need sound information on e.g. climate change projections and uncertainties, forest health, pests and

[11] EU Forest Action Plan
[12] EU Forest Strategy 2013
[13] State of Mediterranean Forests, FAO, 2011

diseases, tools for running different forest management scenarios, as well as information on successful adaptation measures. Despite the need for forest adaptation, the sector is lacking an overall evaluation of the efficacy of current management strategies. There is a need to bring together and share knowledge and experience.

Managing forests to adapt them to these new climatic conditions is crucial to ensure their future sustainability and, consequently, the forest ecosystem services provisioning. The EIP-AGRI Focus Group on Forest Practices and Climate Change defines **forest resilience** as following: *Forest resilience is the ability of forest socio-ecological systems including the ecosystem, their users and the beneficiaries of forest ecosystem services, to adapt and respond to change and disturbances in a manner that critical interrelations (ecosystem services) between the systems are maintained*.

LIFE project dealing with new techniques in the management of agro-silvicultural ecosystems

In view of the expected changes, an adaptation strategy is highly recommended. **Management actions**, such as:

- cleaning of the underbrush to reduce forest density,
- selective thinning of coppices and transformation into tall forest,
- control and adjustment of harvest cycle and cultivation intensity,
- fire prevention, and other adaptive solutions such as the
- selection of the origins of the seeds in reforestation for appropriate management of genetic diversity,

can reduce, but not eliminate the risks of impacts to terrestrial ecosystems, as well as increase the inherent system resilience, understood as the capacity of ecosystems and their species to adapt to a changing climate.

The adaptation strategies depend on the expected/observed impacts, the autonomous adaptation of the systems and the effectiveness of the mitigation measures adopted. Different LIFE projects have tested or are currently working on the validity of practical actions to adapt to these new circumstances: some are working on identifying the areas at greatest risk of desertification and where urgent application of forest management techniques aimed at increasing resilience are needed; others are working on guidelines for forest managers and a DSS that will help predict when climate change may pose particular types of risks to tree species and appropriate responses, including for early stage prevention. There are projects aiming at reinforcing the resilience of species' habitats that have come under increased fire threat and others that aim to promote sustainable, integrated management of *certain areas*, in order to improve the state of conservation and biodiversity.

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