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# Assessment of the impacts of Climate Change on the Agriculture Sector in the Southern Mediterranean:

FORESEEN DEVELOPMENTS AND POLICY MEASURES



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## February 2019

Authors: Matto Bocci and Thanos Smanis with support of Nouredine Gaaloul.

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# Executive summary

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This report provides a comprehensive assessment of climate change and its impacts on agriculture<sup>1</sup> in the Eastern (Egypt, Israel, Jordan, Lebanon and Palestine) and Western (Algeria, Morocco and Tunisia) countries of the Southern Mediterranean, as well as the policy measures currently in place, as identified from publicly available data. The sector, on average, currently represents about 7.3% of total GDP in the region (ranging from about 1% in Israel up to over 13% in Morocco)<sup>2</sup> and is projected to increase by about 1.5% per year, mainly through productivity improvements<sup>3</sup>. Similarly, agriculture is a relevant source for employment in the region (13.2% of jobs in the region ranging from about 1% in Israel to over 13% in Morocco) and an essential source of food for many local communities. Agriculture is therefore an essential economic activity, as well as a source of food and jobs<sup>4</sup> for all the countries of the Southern Mediterranean assessed as part of this study. Both at present, and potentially in the future, the sector is an essential source of both subsistence (e.g. pastoral farming systems) and economic returns across the region – see Table 1. The quantity and quality of cultivated crops, as well as basic water availability, are fundamentally impacted by local weather variables, thus making agricultural outputs particularly susceptible to a number of pressures resulting from climate change.

The sector is expected to experience a range of negative impacts from climate change that are projected to increase exponentially in the near future with a consequent rapid acceleration of pressures on agricultural systems. There are a series of farming system types in the region (irrigated, highland, rain-fed, dryland, pastoral, coastal artisanal fishing and urban-based) that will all be differently impacted by climate change. Agriculture dependent on rainfall (rain-fed and highland) employs the greatest number of people in the region, which is likely to witness decreased yields and cropping intensity with climate change, as well as an increased demand for irrigation. Irrigated agriculture is also essential (especially along the Nile basin and Fertile Crescent). Impacts on this system will be similar to rain-dependent farming systems, but these more advanced farming systems are also exposed to indirect impacts including higher costs for access to fuel, fertilisers and actions required to adapt to such challenges. Further, the intensive use of land and water<sup>5</sup>, both of which are significantly affected by increasing droughts and high variability of weather parameters as a consequence of climate change. Pastoralists are highly vulnerable, especially to desertification, which may reduce the carrying capacity of grazing lands severely. Deterioration of soil condition, biodiversity and water scarcity, expected to persist and accelerate through time, will therefore negatively affect the sector in different ways depending on the specific farming systems. Countries with more advanced farming practices dependent on higher water quantity for irrigation, are facing an increase in direct production costs. Nevertheless, pastoral and rain-fed system farmers will also struggle. Lack of access to financial resources and limited capabilities will in fact result in a limited response capacity in

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<sup>1</sup> The focus of this report is on crops and livestock, but the impact assessed may also be relevant for fisheries and forestry.

<sup>2</sup> See Country Fiches and the Annexes for an overview of the relevance of the sector across countries assessed.

<sup>3</sup> FAO statistics for the broader MENA region (FAO, *Agricultural Outlook, 2018*, p. 16).

<sup>4</sup> [www.iemed.org/publicacions/historic-de-publicacions/policy-studies/the-water-energy-food-security-nexus-in-the-western-mediterranean](http://www.iemed.org/publicacions/historic-de-publicacions/policy-studies/the-water-energy-food-security-nexus-in-the-western-mediterranean)

<sup>5</sup> *Ibid.*

addressing the increasing challenges posed by drier soils and decreasing and unpredictable access to basic water needs. In the absence of immediate policy action, they might soon abandon their regions.

Policy support to adaptation is therefore key to minimise and mitigate the negative effects of climate change on the agricultural sector and address emerging risks across the countries considered<sup>6</sup>. Measures required will differ substantially depending on the type and mix of farming systems characterising the agricultural sector. Although a range of measures exist across the countries assessed, the evidence presented in this study suggests the need to enhance national technical capacity to assess, plan and integrate the specific needs of local farming systems into sectoral development plans and sectoral policies. This is in fact an area where a range of international practices are available, including more general actions against desertification<sup>7</sup>, and greater support should be offered by regional organisations to enable exchanges of expertise across countries in the Mediterranean. It is nevertheless essential for policymakers to duly reflect and address the varying challenges and risks faced by the specific mixes of farming systems and how impacts in the agriculture sector will have socio-economic ramifications throughout the economy unless managed effectively. This necessitates an examination of the needs at the farm level, but also at the economic level in terms of balancing domestic and international food supply chains.

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<sup>6</sup> Note that a recent FAO report suggests similar issues for fisheries and aquaculture, that “[...] can be particularly vulnerable as there is a lack of farmer’s adaptability to climate change and resilience to natural disasters and socioeconomic risks.” (FAO, *Agricultural Outlook, 2018*, p. 82)

<sup>7</sup> <http://www.fao.org/3/a-av133f.pdf>

# Setting the stage for this study

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## Scope and objectives of the study

This study assesses the extent to which the effects of climate change are impacting the agricultural sector across the Southern Mediterranean Countries and the relevant policy measures addressing these challenges across the region. Promoted as a part of the support actions for the Climate Change Expert Group (CCEG) within the Union for the Mediterranean (UfM), this study aims to facilitate the UfM Member States of the ENI South Region in their discussions on future challenges of climate change and on concrete joint actions to address gaps and improve the policy measures currently in place.

The study reviews the degree of exposure and vulnerability of the agricultural sectors of the ENI South Countries to impacts from climate change and discusses their national policies and measures to address such impacts. The ENI South Countries are: Egypt, Israel, Jordan, Lebanon and Palestine in the east, and Algeria, Morocco and Tunisia in the west. This study builds on preliminary review of policies/measures in each country and discussions with the UfM Climate Change Expert Group Members during a dedicated ad-hoc meeting held at the UfM premises, and the follow-up actions and recommendations from this meeting.

## Background and challenges

The UfM recognises the importance of agriculture as an essential economic activity for all countries assessed in this study, both as a direct source of subsistence (e.g. pastoral farming systems) and a relevant economic sector in the region (more advanced systems particularly), notably in western countries<sup>8</sup>. The sector is already facing a number of challenges, and it is essential to foster the policy support needed to ensure food security and the development of resilience within the sector in the region<sup>9</sup>.

In this context, the effects foreseen from climate change could further affect agricultural regions, their competitiveness and sustainability, through a range of direct and indirect impacts:

- *Direct impacts* - climatic impacts, including geographic and seasonal redistribution of climatic resources for agriculture, and changes in operating costs (heating-cooling degree days, insurance premiums).
- *Indirect impacts* - including climate induced environmental changes (such as water shortages, biodiversity loss, increase in vector-borne diseases, damage to infrastructure).
- *Broader impacts* - to agricultural competitiveness such as increase of fossil fuel prices and chemical fertilizers and impacts resulting from mitigation measures.

As discussed above, such impacts are already being felt and are anticipated to intensify in the coming years, thus there is a need to mobilise stakeholders and influence decision makers to ensure that current challenges are turned into opportunities. The UfM can play a facilitating role in furthering these goals in the Mediterranean region, by acting as a regional platform to coordinate and promote sustainable agricultural initiatives and help the relevant stakeholders in sharing know-how and practical understanding amongst sectoral actors across the region as part of their core activities.

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<sup>8</sup> <http://ufmsecretariat.org/wp-content/uploads/2015/04/CIDOB-Study-The-Impact-of-Food-Price-Volatility-FINAL.pdf>

<sup>9</sup> <http://www.fao.org/news/story/pt/item/285430/icode/>

## Methodological overview

The study makes use of publicly available secondary sources of information from across the ENI South Countries and the specific insights provided by the national Focal Points of the UfM-CCEG. It also reflects upon the discussion and feedback received during the UfM-CCEG meeting held in Barcelona on the 24<sup>th</sup> and 25<sup>th</sup> of April 2018.

Similarities and differences amongst the UfM Member States are highlighted, in terms of both the evolution of climate change induced impacts on the sector, as well as the existing policy measures addressing those, as a basis for a SWOT analysis. The data and analysis provided are aggregated at the sub-regional level to facilitate the identification of any features, strengths and challenges both at the regional level and between the eastern and western ENI South countries. A number of strategic conclusions and subsequent action-points are identified, as discussed with the UfM-CCEG Members, to strengthen the response capacity of the agricultural sector across the region. These conclusions represent a basis for the UfM and the CCEG to continue to build upon in the future.

The information provided is proposed as a “starting point” for further scientific and policy dialogue on this important, yet relatively neglected area of discussion in the field of climate change (i.e. impact and adaptation needs for the agricultural sector), and it aims to encourage national and regional action and further improvements, rather than providing an extensive assessment on the current and future state of play. The study focuses on cross-regional and sub-regional analysis, while further country-specific details are provided in the annexed Policy Fiches.

## Contents of the chapters in this study

The study is structured into the following sections:

- **Chapter 1** - Sets the background of this study
- **Chapter 2** - Provides an overview of findings on the impacts on agriculture across countries;
- **Chapter 3** - Reviews the existing policy measures across countries and provides some examples;
- **Chapter 4** - Offers an overview of the areas where further actions are needed to sustain capacity;

- **Chapter 5 -** Provides conclusions and a list of recommended actions with concrete next steps.

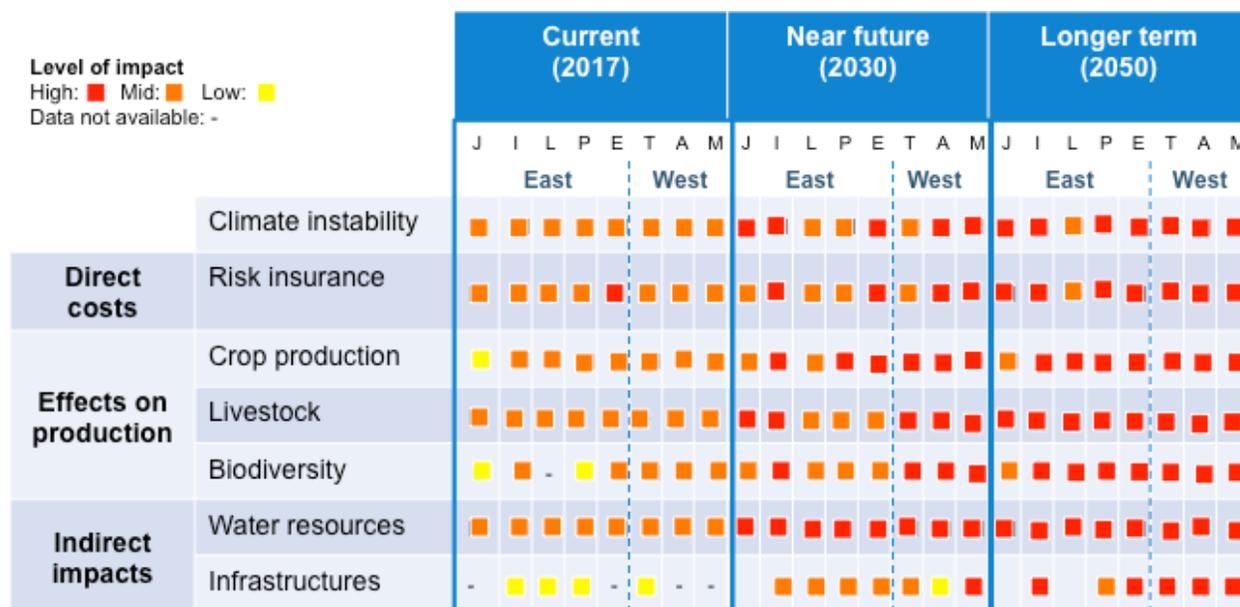
# Climate Change impacts on Agriculture in ENI South Countries

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## Overview of impacts and threats for the Agriculture sector

This chapter provides initial evidence on the extent to which climate change impacts on the agricultural sector in the Southern Mediterranean are expected to increase in the near and long-term future, as a basis for the development of more effective adaptation measures for the sector across the region. The analysis in this chapter is provided with an overview of the differences and similarities across the Eastern (Egypt, Israel, Jordan, Lebanon and Palestine) and Western (Algeria, Morocco and Tunisia) ENI South Countries. The assessment is based on the most recently available and relevant secondary sources of information, as well as expert judgment for the possible evolution towards the mid- (2030) to long- (2050) terms.

*Figure 1. Overview of the impact of climate change on the agriculture sector in each country (J = Jordan; I = Israel; L = Lebanon; P = Palestine; E = Egypt; T = Tunisia; A = Algeria; M = Morocco).*



Source: Country Policy Fiches

## The effects of increasing climate variability are already broadly perceived

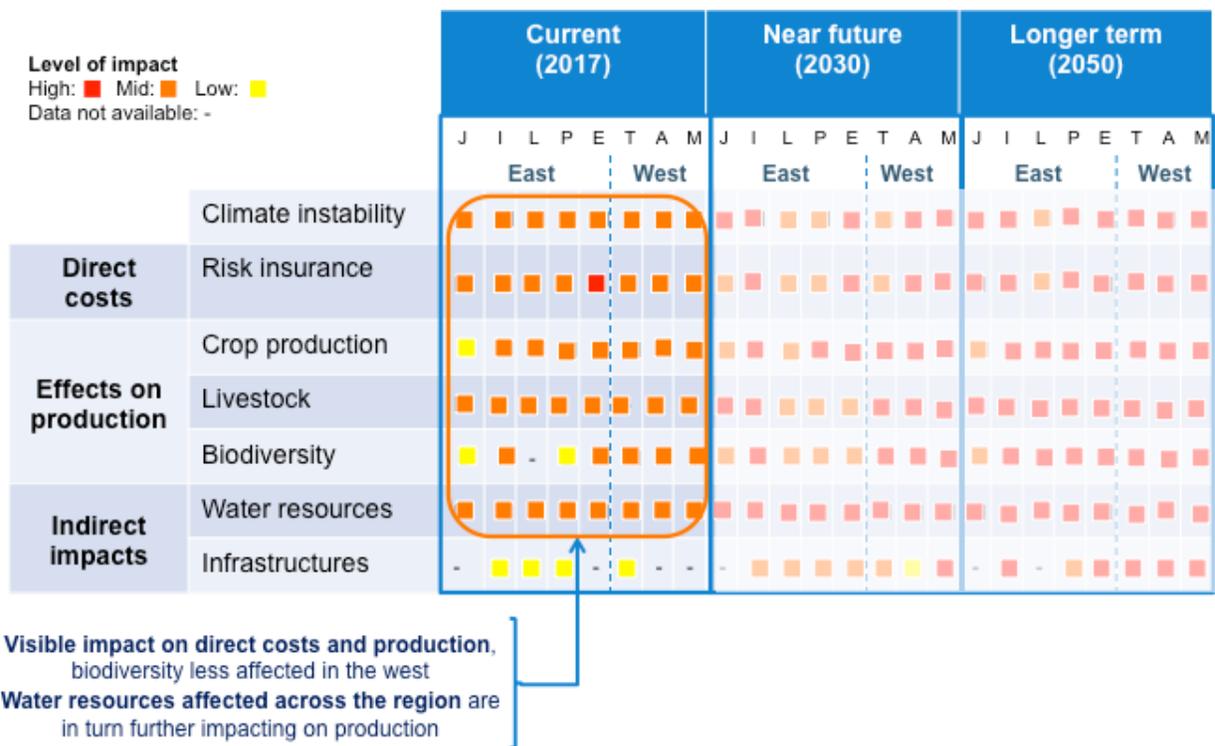
As illustrated in the figure above, climate change is already affecting agriculture in the region in a number of ways. The changes in temperature and precipitation patterns predicted by general atmospheric circulation models for all Southern Mediterranean Countries, are already affecting the sector through greater exposure to risks of extreme droughts and floods throughout the year. In addition, a general decrease in biodiversity and importantly soil moisture – particularly in western countries – is making droughts more frequent and more intense. The interplay of those factors, depending on country specificities, is in turn bound to increase the costs for public schemes aimed at risk mitigation – as well as private insurance costs, for those more advanced businesses able to pay for such services available today or in the future (in line with developments in the “Loss and Damages” concept promoted by UNFCCC<sup>10</sup>).

As indicated in the figure below, increasing water scarcity is already negatively impacting farmers in the region, and exposing water resource managers to the dilemma of ensuring the sustainability of resources while maintaining the strategic agricultural, social and environmental targets for the countries. As indicated in the recent FAO report for the broader MENA region, “policies in the region support grain production and consumption, with the result that 65% of cropland is planted with water-thirsty cereals, in particular wheat” (FAO, Agricultural Outlook, 2018, p. 16). Notably, such production is also “projected

<sup>10</sup> <https://unfccc.int/topics/adaptation-and-resilience/the-big-picture/introduction-to-loss-and-damage>

to increase by about 1.5% p.a., mainly through productivity improvements.” (Ibid.). As a result, agriculture in the region is largely based on water-intensive production. Water availability is therefore critically shaping the patterns of future agricultural development, and water scarcity resulting from climate change effects may severely affect the growth rate estimated for the sector. Additional indirect pressures have also been identified in this report, besides water issues, such as the pressure on public infrastructure due to floods and rising sea-levels, but their effects on agriculture production appear to be limited for the time being. Such impacts appear to be limited for the time being, as also indicated in the figure below.

Figure. 2. Areas of impacts of climate change affecting agriculture



An overview of the current pressures across the assessed countries is provided in the box below.

### **Overview of relevance of the sector and current pressures on assets and services across countries**

Data from the different countries are often heterogeneous in format and quality, and it is difficult to suggest relevant and representative examples across the entire region. Nevertheless, some examples can be provided as an indication of the challenges discussed in this section, with additional details provided in the Annexes.

Agricultural activities linked to both crop production and livestock seem to be similarly affected in most of the countries as in general they both depend on fresh-water.

For Algeria, the agricultural sector contributes about 12% of GDP (2017) and employs 20% of the population in rural areas. As Algeria has about 8.4 million hectares of arable land water scarcity is a major issue. To combat drought, the Ministry of Agriculture is developing projects to increase the amount of irrigated land by 2 million hectares by 2020. The government's vision is to orientate agriculture towards intensive models, particularly in the cereals sector, and to develop modern agricultural complexes.

In Egypt, the agricultural sector contributes to about 1% of the GDP (2017), and consumed ca. 80% of the fresh water resources. However, water shortages, soil degradation and pollution have created a crisis that has undermined agriculture, especially in the Delta area, which is struggling to support millions of impoverished farmers. At the same time rising sea levels in the Mediterranean have increased the salinity of ground water and the soil. Population growth has put more pressure on the existing water resources, while the mass 'disposal' of industrial waste into irrigation canals has polluted waterways. The national government launched a crackdown against rice-growing areas where cultivation of the water-intensive crop was restricted, to ensure that only 750,000 acres of land are planted with rice, less than half the estimated acreage from the previous year (Financial Times 4/9/2018).

In Israel, the agricultural sector only contributes a low level of about 1% of the GDP (2017). Reduced rainfall and increased extreme weather events are reducing the replenishment of water storage, enhancing the chronic water shortage that has recently developed into a crisis (MFA Israel). As water is considered as a national resource of the utmost importance for the population's well-being and to preserve the rural-agricultural sector, water allocations to the agricultural sector had to be reduced drastically resulting in a reduction in the agricultural productivity (Israel Ministry of Foreign Affairs).

For the Hashemite Kingdom of Jordan, the agricultural sector contributes 4% of the GDP (2017). Population growth has significantly reduced the average amount of fresh water available, more than 90% of rainfall evaporates or runs off and agriculture consumes 50% of the water supply, making the reuse of treated wastewater in agriculture a strategic decision.

In Lebanon the agriculture sector contributes 3.5% of the GDP (2017). Although Lebanon has many rivers and water sources, and is water-rich compared to neighboring countries, the available resources cannot meet the expectations following the refugee crisis. Excessive use of ground water resources, seawater intrusion into aquifers and coastal areas, and climate change impacts on snow coverage are making water scarcity a serious prospect.

Similarly, Morocco's agricultural sector accounts for 13% of GDP (2017) and depends heavily on the weather, which presents a more erratic and overall declining volume of precipitation. Population increases, and the

decrease of rainfall have pushed production into fragile and degraded land, where crop production is primarily rainfed (87%) and is highly vulnerable to increased rainfall variability.

Palestine's agriculture sector contributes about 3% of the GDP (2016). The country is facing serious drought and at the same time has restrictions on their water supplies that further exacerbate conditions. Groundwater represents the main source of water for Palestinians and about half of the water extracted from groundwater wells is used for agriculture. Climate change affects water resources through changes in precipitation and temperature levels, and interactions between the two factors. Drivers, such as rapid population growth, industrial development, urbanisation, and increasing demand for irrigation exert additional pressures on already limited water resources.

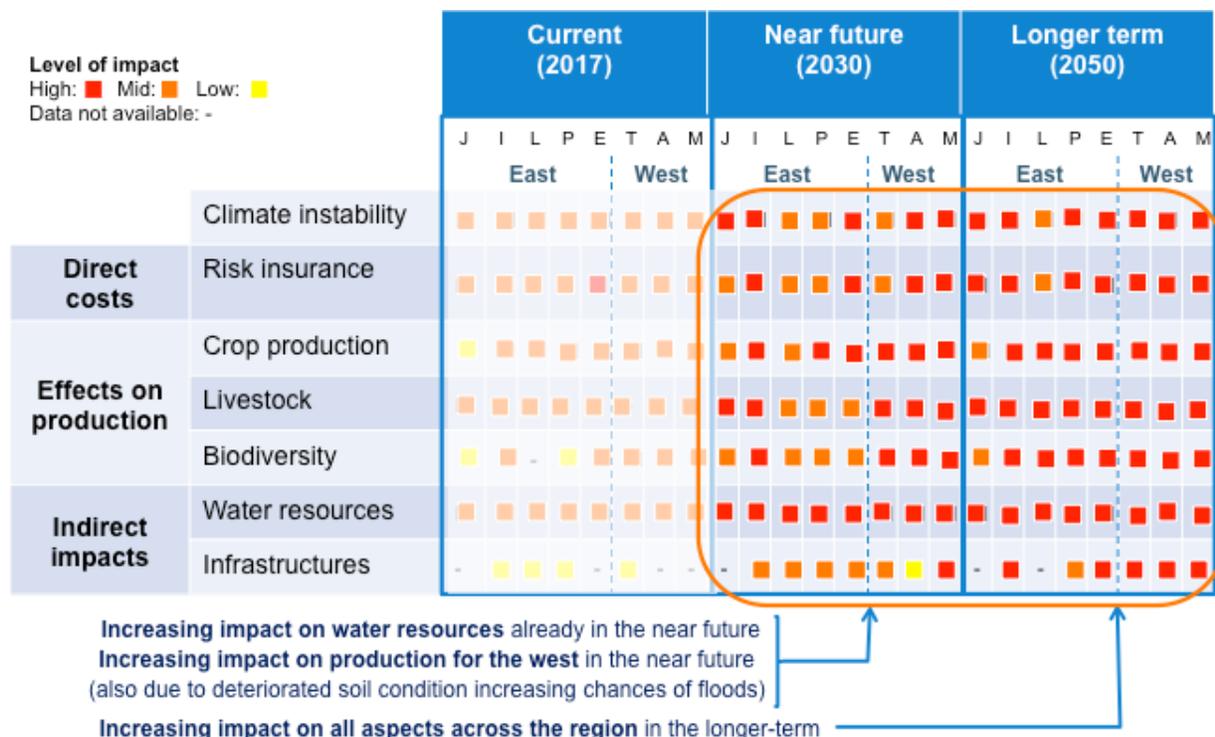
Finally, the agriculture sector of Tunisia makes a significant contribution of 9% of the GDP (2016) to the country's economy. However, water resources in Tunisia are characterized by scarcity and a pronounced irregularity. As most of the water tables are mainly located on the coast the deterioration of water resources in quantity and quality is directly affected by sea level rise and its impacts in terms of coastal degradation, land submersion and saline intrusion of coastal aquifers.

*Source: Country Policy Fiches*

## Increasing impacts are expected in the near future (especially in the west) and over the longer term

The effects of climate change on the agricultural sector are expected to increase over time, as illustrated in the figure below. Although pressure on the sector due to water scarcity is expected to increase rapidly across the region, impacts of climate variability on production will also depend on soil permeability affected by biodiversity decline, which is expected to be greater in the west than the east. As it is based on more advanced systems, agricultural production in the west is also more highly exposed to indirect impacts of climate change, including higher costs for access to fuel, fertilisers and mitigation measures to address enteric fermentation (the digestive process resulting in release of methane from livestock). Pressure on public infrastructure is also expected to grow, although less rapidly in the near future. The short-term impact of the lack of water resources on costs and productivity for the sector should not be neglected, as it is likely to significantly impact a range of businesses across the region – see also the different impacts on farming systems discussed in the next section of this chapter.

*Figure. 3. Areas of impacts of climate change affecting agriculture in the future*



Selected examples of the future pressures foreseen across countries are provided in the box below.

### Examples of future pressures and related impacts expected across selected countries

Climate change is currently, and over the near and long-term future, one of the main factors of concern for decision makers in the agricultural sector in Southern Mediterranean countries. Publicly available evidence suggests that climate change will continue to impact water availability through lower and less predictable precipitations levels and higher temperatures, both of which directly affect agriculture.

For example, in Jordan precipitation projections suggest an overall decrease from 60 to 15 percent in the period from 2011 to 2099. Such a forecast will lead to a decline in surface water systems and pastureland for drinking water and grazing and will result in higher rates of livestock illness and death, which will be reflected as a loss of income and nutrition due to a decline in livestock herds. At the same time water scarcity will decrease the availability of soil moisture for crops in the rainfed areas that dominate Jordan and will decrease the river flow, which will lead to shorter growing seasons with increased crop/weed competition for water resources.

Similarly, for Tunisia an increase in the frequency of extreme events and the regression of vegetation cover, soil loss by erosion, and decrease in surface water of 5%, will directly affect crop production (e.g. olive production will decline by 50%). Livestock numbers are expected to decline by 80% in the most affected areas (south and central Tunisia) and by 20% in the north because of the loss of grazing routes.

These examples offer some indications of the seriousness of the potential impacts of climate volatility for the sector in the absence of adequate sectoral policies and responses from the industry. They emerge from our

preliminary assessment and as such should be further discussed and expanded in future UfM activities with all the relevant national and regional stakeholders.

*Source: Country Policy Fiches*

## Vulnerability of the sector also changes with respect to the specificities of farming systems

A number of vulnerabilities have been discussed so far, resulting from the increasing pressure of climate change on the agricultural sector, which will increasingly affect local farming systems over time. Although most of the assessed countries appeared to already be experiencing a range of negative effects to some extent, the sector across the whole region is expected to struggle in the longer-term, with some countries expected to be more rapidly impacted in the short-term. Nevertheless, it is important to highlight that the actual impact on the agricultural sector is highly dependent on its internal composition and the type of farming systems that characterise the sector across and within each country.

In fact, the agricultural sector represents a very diverse ecosystem, based on very different farming systems, each with their own specificities and varying levels of response and adaptation to the new challenges and needs posed by the evolving climatic conditions. Given the actual sectoral composition in each county and even regionally within each country, some regions and sub-sectors may be more vulnerable than others to increasing climatic pressure. While some regions or sectors or even businesses might be able to cope with increasing challenges, other models may become untenable and may be forced to relocate or terminate operation. A general classification is presented in the table below – based on the exchanges with sectoral and regional stakeholders held during the UfM CCEG workshop in Barcelona, including an assessment of potential exposure (to climate change impacts) and sensitivity (vulnerability to such impacts) of each system.

*Table 1. Overview of exposure of farming systems to climate change and expected impacts*

System	Exposure	Sensitivity/Effects
Irrigated	<i>Increased temperatures Reduced supply of Surface irrigation water Dwindling of groundwater recharge</i>	<i>More stress on water resources. Increased demand for irrigation and water transfer. Reduced yields when temperatures are too high.</i>

		<i>Salinization due to reduced leaching capacity of the soil.</i> <i>Reduction in cropping intensity</i>
<b>Highland mixed</b>	<i>Increase in aridity</i> <i>Greater risk of drought</i> <i>Possible lengthening of the growing period</i> <i>Reduced supply of irrigation water</i>	<i>Reduction in yields.</i> <i>Reduction in cropping intensity.</i> <i>Increased demand for irrigation.</i>
<b>Rainfed mixed<sup>11</sup></b>	<i>Increase in aridity</i> <i>Greater risk of drought</i> <i>Reduced supply of irrigation water</i>	<i>Reduction in yields.</i> <i>Reduction in cropping intensity</i> <i>Increased demand for irrigation</i>
<b>Dryland mixed</b>	<i>Increase in aridity</i> <i>Greater risk of drought</i> <i>Reduced supply of irrigation water</i>	<i>A system very vulnerable to declining rainfall.</i> <i>Some lands may revert to rangeland.</i> <i>Increased demand for irrigation.</i>
<b>Pastoral</b>	<i>Increase in aridity</i> <i>Greater risk of drought</i> <i>Reduced water for livestock and fodder</i>	<i>A very vulnerable system, where desertification may reduce carrying capacity significantly.</i> <i>Non-farm activities, exit from farming, migration.</i>

Source: FAO<sup>12</sup>

Although a detailed analysis of such micro-economic differences across the region is beyond the scope of this study, an overview of the distribution of those systems across the countries assessed in this report is provided by the FAO and presented in Figure 4 below. An analysis of the impacts of climate change on each of these farming systems within countries in the MENA region has also been conducted by FAO (2018)<sup>13</sup>. The distribution of farming systems across the region is as follows<sup>14</sup>:

- **Irrigated Systems** are found throughout the region, although occupying very limited portions of land in the countries assessed. Large-scale systems are common in Morocco and Egypt, while small-scale systems are scattered in small areas throughout Morocco, Algeria and Tunisia.
- **Highland Systems** are particularly relevant in Morocco, based on transhumant livestock. They are also prevalent in Lebanon. Poverty within this system is extensive, as markets are often distant, road infrastructure is poorly developed, and the degradation of natural resources is a serious problem.
- **Rainfed Systems** are concentrated in Morocco, Algeria and Tunisia, covering large portions of agricultural land in those countries.
- **Dryland Systems** are found in dry sub-humid areas across all countries assessed. Population density tends to be lower than in the other main arable systems and average farm size is larger. These are the areas where poverty is higher amongst farmers. Risk of drought is high and there is considerable risk to food security, while livestock interact strongly with the cropping and fodder system.

<sup>11</sup> Although the system is by definition principally rainfed, an increasing area is now benefiting from the availability of new drilling and pumping technologies, which have made it possible to use supplementary winter irrigation on wheat and full irrigation on summer cash crops.

<sup>12</sup> [http://www.fao.org/farmingsystems/MNA\\_leg\\_en.htm](http://www.fao.org/farmingsystems/MNA_leg_en.htm)

<sup>13</sup> <http://www.fao.org/3/CA1439EN/ca1439en.pdf>

<sup>14</sup> [http://www.fao.org/docrep/003/Y1860E/y1860e05.htm#P294\\_33596](http://www.fao.org/docrep/003/Y1860E/y1860e05.htm#P294_33596)

- **Pastoral Systems** are also common across all countries assessed. They mainly involve sheep and goats but also include some cattle and camels and are based on seasonal migrations. Where water is available, in rare cases, small areas of crop production have been developed to supplement the diet and income of pastoral families. Poverty within the system is extensive, although these more basic systems are less exposed to indirect impacts (costs of fuel, fertilisers and mitigation measures to address enteric fermentation).

A visual overview of the different system across the region is provided in the figure below.

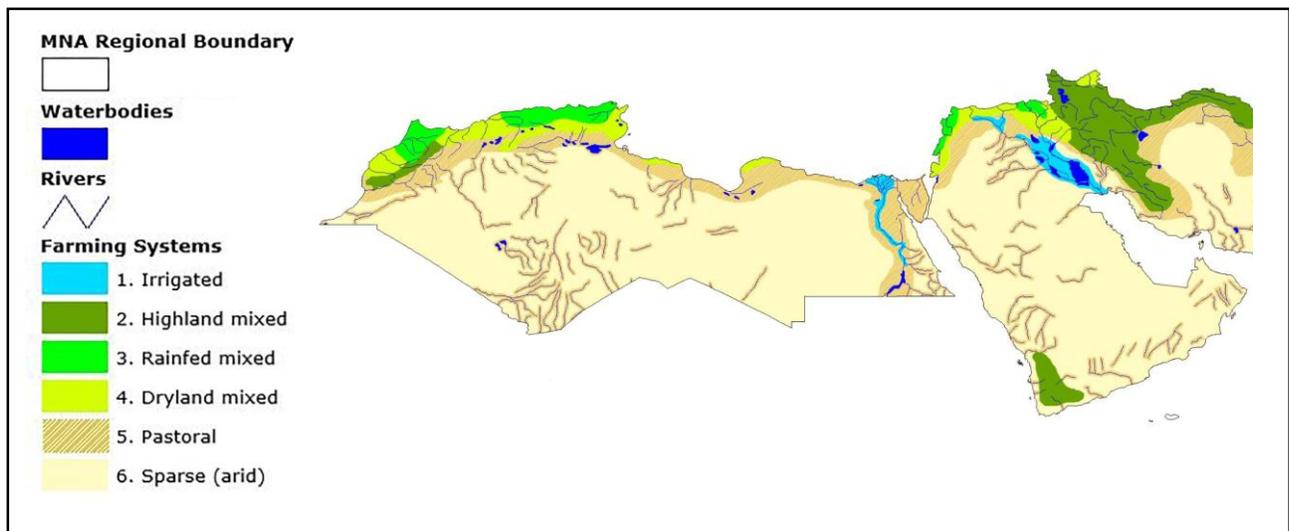


Figure 4. Overview of the distribution of farming systems across Southern Mediterranean Countries  
Source: FAO (Major Farming Systems)<sup>15</sup>

<sup>15</sup> <http://www.fao.org/farmingsystems/FarmingMaps/MNA/01/FS/index.html>

The distribution of systems across the countries assessed in this study reinforces the message of a higher exposure of western countries in the short term, due to a diversified range of farming systems in the area. The distribution also highlights the extreme risks from climate change across the region to which farmers in pastoral areas are exposed. It also highlights the need for specific action-plans to be defined in each country, in order to address the various challenges and needs for adaptation of the different farming systems that characterise their agricultural ecosystems.

## Existing policy measures addressing the emerging challenges

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This chapter reviews the relevant agriculture-related country policies as well as general climate change policies, based on publicly available sources, to understand the extent to which policy measures currently in place are addressing the risks and impacts highlighted in Chapter 2. Given the scope of analysis and the limited time-frame of the study, it has been essential to focus the analysis on a relatively narrow but relevant range of measures and strategic policy documents.

In their national communications to the United Nations Framework Convention on Climate Change (UNFCCC), the Southern Mediterranean Countries provided information on their vulnerabilities to climate change for a wide range of sectors. The main sectoral adaptation options and responses highlighted by developing countries to climate change include both reactive and anticipatory responses. Reactive responses are those which are implemented as a response to an already observed climate change induced impact whereas anticipatory responses are those that aim to reduce exposure to future risks posed by climate change.

As was the case in the previous chapter, the analysis chapter provides an overview of the differences and similarities between the Eastern (Egypt, Israel, Jordan, Lebanon and Palestine) and Western (Algeria, Morocco and Tunisia) countries<sup>16</sup>. An overview of the findings is provided in the figure below.

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<sup>16</sup> The visualisation of individual countries does not follow any specific order, as the purpose is to 'compare' and not 'confront' those practices.

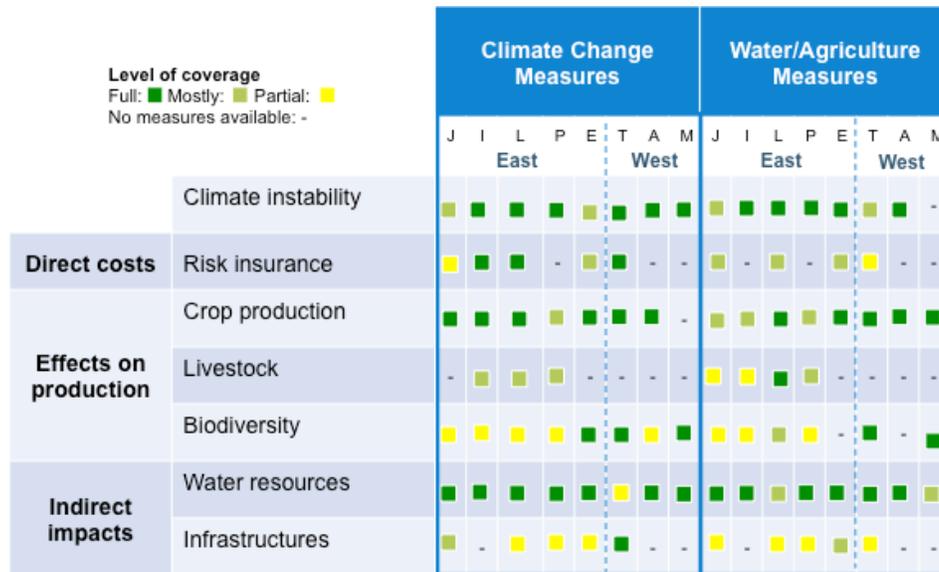


Figure 5. Policy measures addressing the different areas of impacts of climate change on agriculture. Source: Country Policy Fiches

## Relevant measures seem to address general issues of production and water resources

Some of the impacts described in Chapter 2 appear to be addressed by a number of policy measures. These measures seem to be relatively evenly-spread across the countries assessed, as visualised in Figure 6 below. A few countries in the west seem to be less concerned about addressing such issues, possibly due to the limited relevance to the local agricultural sector in the local economies. Nevertheless, the general policy coverage seems relatively good and well-balanced across countries. The extent to which such measures are actually tailored to the specific farming systems active in each country is discussed later in the chapter.

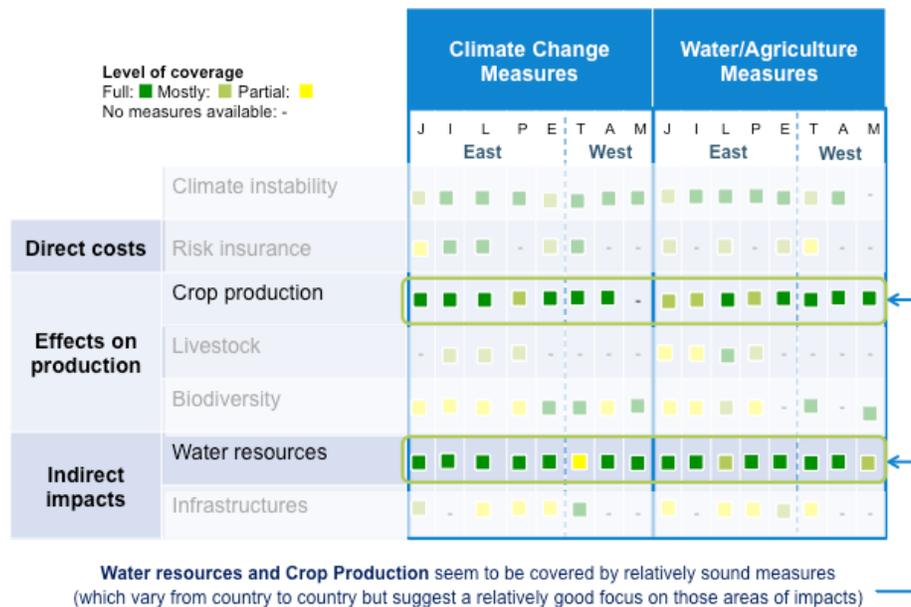


Figure 6. Policy measures addressing effects of climate change on water availability and crop production across countries

Selected examples of such measures across the assessed countries are provided in the box below.

### Examples of measures addressing crop production and water scarcity across selected countries

The scarcity of water resources, as a result of climate change, is often addressed through climate change-specific and sectoral policies across the region. For example, in the Third National Communication on Climate Change for Egypt, water resource management is highlighted for national and regional policies for adaptation. These adaptation measures focus mostly on the construction of infrastructure for water collection in flash flood areas (e.g. Sinai, Red Sea and north and central Egypt), use of renewable energy (solar and wind) for water desalination, storage of drainage and fresh water in coastal lakes, but at the same time they address the importance of public awareness of water scarcity and water shortage.

Similarly, crop production measures are addressing a number of issues expected as a result of increasing severe and unpredictable climate conditions in the region (drought, extreme temperatures, etc.). Amongst those, and as referred to in the Jordanian National Water Strategy for 2016-2025, water use efficiency is shifting to more water-efficient crops in order to optimize yield per m<sup>3</sup> of water using cropping patterns. At the same time the Ministry of Agriculture discourages farmers from planting crops with high-water requirements through the use of market tools by imposing higher water tariffs on irrigated agriculture where highly water-intensive crops are being grown.

Source: Country Fiches

# Gaps in existing measures persists when it comes to areas of strategic relevance in the long-term

A policy gap has emerged in relation to measures addressing the strategic areas of impact for the sector, which although relatively less problematic at present (particularly for eastern countries) are expected to worsen rapidly over time. Measures preventing the effects of climate change on biodiversity, and consequent impacts on the agricultural sector for example, are scattered across the region, but mostly exist in western countries where the perceived pressure is higher. Infrastructure concerns are largely left worryingly unaddressed across the region, therefore exposing the sector to increasing pressure over time (floods, sea level rise, etc.). An overview of those gaps and limitations across countries is provided in the figure below.

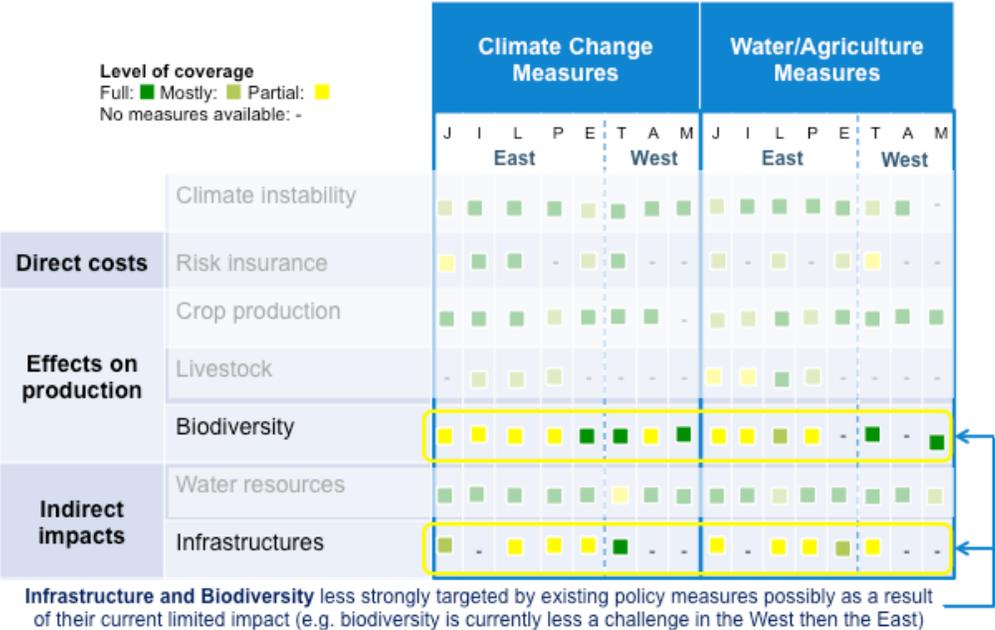


Figure 7. Policy gaps in areas of strategic relevance but which are not under immediate threat

Selected examples of such measures across the assessed countries are provided in the box below.

### **Examples of measures addressing biodiversity and infrastructure impact across selected countries**

Measures aimed at preventing and mitigating impacts on biodiversity are mostly available in Tunisia and Morocco. In Tunisia the National Strategy against climate change proposes the rehabilitation of Mediterranean ecosystems, the development of resilience capacity, and the placement of economic value on the regulatory climate ecosystem functions and services. Similarly, in Morocco the conservation and sustainable use of biodiversity is widely discussed in the National Policies giving significant weight to improving knowledge by promoting scientific research and by investing in awareness and education programmes targeted at specific population segments.

The most significant policy measures addressing impacts to infrastructure exist in Tunisia where climate change was included in the National Urban Development Plan proposing solutions to the effects from climate change in urban development projects, such as establishing early warning systems for natural hazards and strengthening infrastructure such as protection works and drainage systems.

*Source: Country Fiches*

## **Measures addressing impacts to livestock and insurance support are also scattered across countries**

In the eastern countries, there seem to be more specific and proactive measures available, with some exceptions in areas such as biodiversity, as mentioned previously. Measures aimed at fostering the uptake of risk insurance policies by farmers are in fact greater in the east, notably through direct public support. These are introduced as part of more general climate change policies, but often with specific reference to the agricultural sector – possibly building on the reference to insurance services as part of the “loss and damages” response put forward by the UNFCCC<sup>17</sup>. Livestock-related measures are also often part of more general climate change policies. Sectoral policies, in turn, have a more specific focus on crops than livestock. An overview of the gaps and effectiveness of existing measures is provided in the figure below.

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<sup>17</sup> <https://unfccc.int/topics/adaptation-and-resilience/the-big-picture/introduction-to-loss-and-damage>

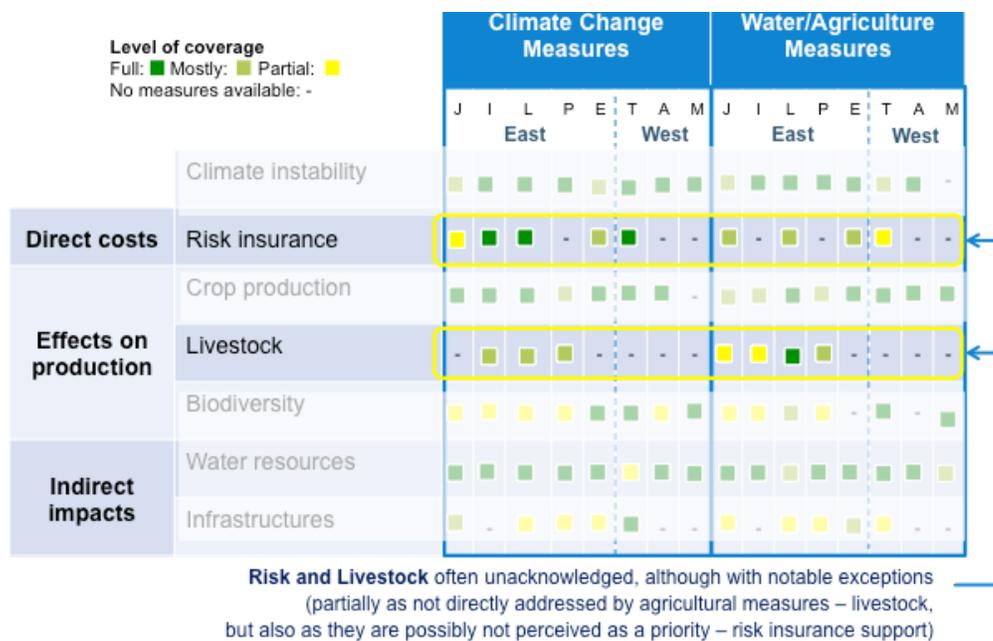


Figure 8. Policy measures and related gaps in addressing impacts to livestock and risk insurance

Selected examples of such measures across the assessed countries are provided in the box below.

### Examples of measures targeting impacts to livestock and risk insurance across selected countries

Measures aimed at fostering the uptake of insurance from agricultural risks amongst farmers are discussed for example for Lebanon in the Agriculture Strategy 2015-2019 but also in the 3<sup>rd</sup> National Communication to the UNFCCC, as anticipated changes in climate will reduce Lebanon’s agricultural production by increasing temperatures and reducing precipitation levels, harmful to both crops and livestock. This will happen through the mobilisation of the adequate financial resources and enhancing the cooperation of stakeholders and the public administration in the implementation of the strategy.

In parallel, the most significant policy measures addressing impacts to livestock are also promoted in Lebanon. Policy measures on livestock often refer to addressing impact of agriculture to climate change, rather than climate change impacts on the sector, but nevertheless may can also support the efficiency of the sector in becoming less resources-dependent and therefore more resilient and adapted to the challenges posed by climate change. Similarly, Lebanon also introduced certain limits for water consumption in agriculture (expressed in maximum m<sup>3</sup>/per type of production), to prevent the spread of agricultural production with excessive water requirements.

Source: Country Fiches

## Greater support is needed to foster reactive and anticipatory adaptation across farming systems

Adaptation to climate change must also occur through the prevention and removal of maladaptive practices. Maladaptation refers to adaptation measures that do not succeed in reducing vulnerability but increase it instead. Examples of measures that prevent or avoid maladaptation include: better management of irrigation systems and the removal of laws that can inadvertently increase vulnerability such as relaxation of building regulations on coasts and in floodplains. Reduced water availability and increased frequency and intensity of heat waves will render ecosystems more vulnerable, since climate change is occurring too rapidly to allow ecosystems to adapt. Particularly affected are traditional crops (wheat, olives, grapes), because there is less time available for biomass accumulation and because of higher temperatures and increased water stress on crops.

An essential distinction, when it comes to adaptation support, is that of “anticipatory” vs “reactive” measures<sup>18</sup>: i) **anticipatory adaptation** refers to action that is taken in advance of impacts becoming observable, whereas ii) **reactive adaptation** is applied after observing initial impacts of climate change. An overview of the reactive and anticipatory adaptation measures to be considered by policymakers in all the countries assessed as part of this study, are illustrated in the table below. To boost the uptake of such adaptation measures - both reactive but moreover anticipatory ones - policy support is pivotal, including through the support for **capacity building** and uptake of proven technologies and innovation.

Note that the table below also suggests impacts on coastal areas, which could be a hint for addressing potential challenges of climate change pressure for fisheries and aquaculture farming in those areas. Although those sectors were not specifically addressed in this study, in fact, pressures could be relevant for these activities as well, and an affective policy response is to be put in place.

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<sup>18</sup> <https://climatepolicyinfohub.eu/node/92/pdf>

Table 2. Adaptation measures in vulnerable sectors for agriculture across the countries assessed

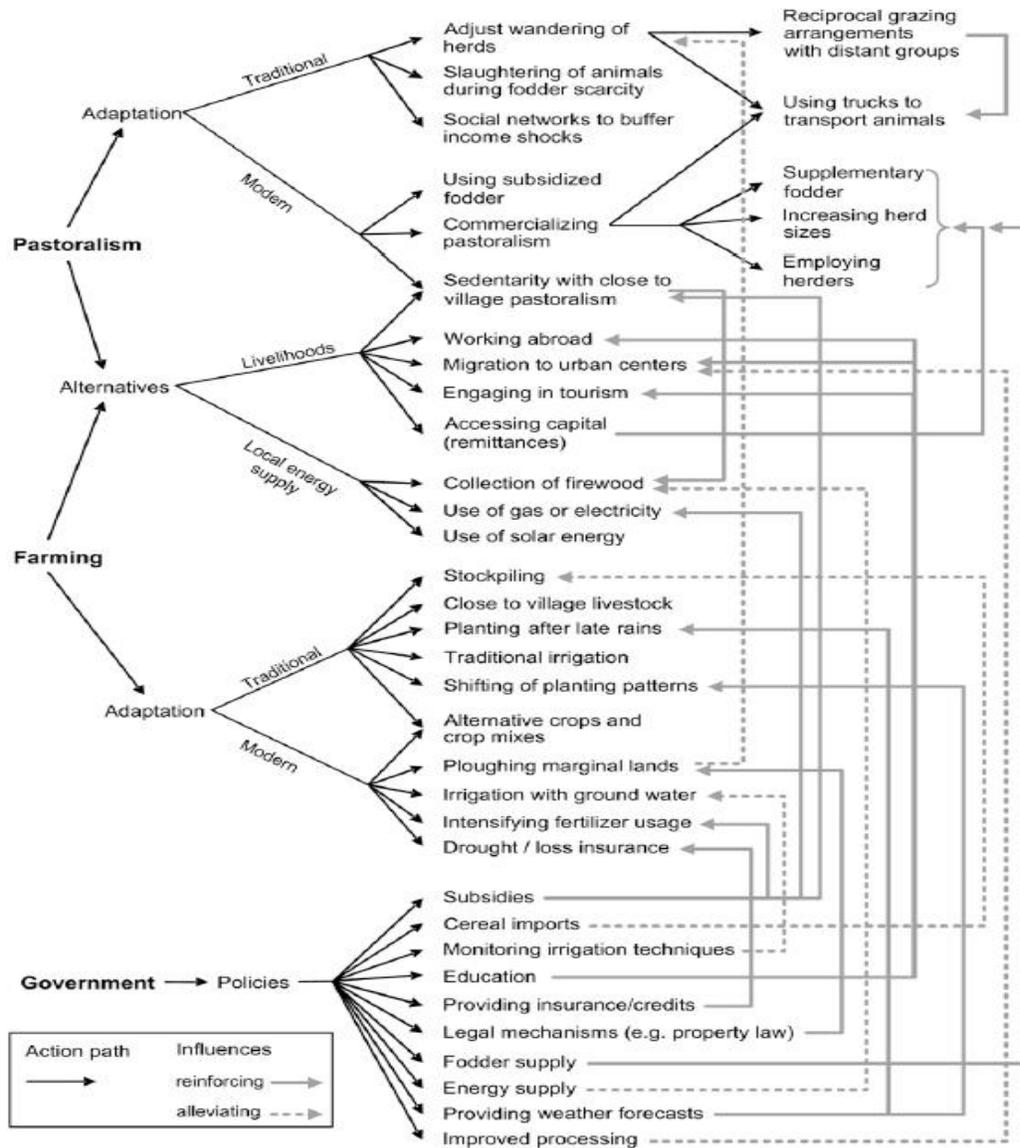
	<b>Reactive adaptation</b>	<b>Anticipatory adaptation</b>	
<b>Water resources</b>	Protection of groundwater resources	Better use of recycled water	
	Improved management and maintenance of existing water supply systems	Conservation of water catchment areas	
	Protection of water catchment areas	Improved system of water management	
	Improved water supply	Improved efficiency of agricultural water use	
	Groundwater and rainwater harvesting and desalination	Development of flood controls and drought monitoring	
<b>Agriculture and food security</b>	Erosion control and dam construction for irrigation	Development of tolerant/resistant crops (to drought, salt)	
	Changes in fertilizer use and application	Research development and improved crop management practices	
	Introduction of new crops	Soil-water management	
	Soil fertility maintenance	Diversification and intensification of food and plantation crops	
	Changes in planting and harvesting times	Policy measures, tax incentives / subsidies, free market	
	Switch to different cultivars	Development of early warning systems	
	Educational conservation and management of soil and water		
	<b>Terrestrial ecosystems</b>	Improvement of management systems	Creation of parks, protected areas and biodiversity
		Promoting agroforestry to improve forest goods and services	Identification/development of species resistant to climate change
		Development/improvement of national forest fire management plans	Better assessment of the vulnerability of ecosystems
Improvement of carbon storage in forests		Monitoring of species	
		Development and maintenance of seed banks	
<b>Coastal zones</b>		Including socioeconomic factors in management policy	
	Protection of economic infrastructure	Integrated coastal zone management	
	Public awareness to enhance protection of coastal and marine ecosystems	Better coastal planning and zoning	
	Building sea walls and beach reinforcement	Development of legislation for coastal protection	
	Protection and conservation of coral reefs, mangroves, sea grass and littoral vegetation	Research and monitoring of coasts and coastal ecosystems, uptake of coral reef varieties, protection/enhancement of mangrove areas	

As discussed throughout this chapter, many of these measures are often available 'on paper', although with notable differences from country to country, but it is not entirely clear the extent to which these are actually adopted by farmers in each country. Moreover, it is not evident the extent to which the measures are adapted to the specificities of local farming systems, as discussed in Chapter 3 (Figure.4).

Although a full assessment goes beyond the scope of this study, our review highlights a lack of clear diversification in the proposed adaptation measures aimed at addressing the specific challenges and developing the most suitable options in response to climate change across farming systems. As part of this diversification, consideration of food import policy is key. All countries in the region are highly food import dependent, especially for staples. This is only set to increase. Therefore, given the inherent aridity of the region, a focus on the local production of horticultural crops and continued import of staple crops (notably wheat) must be a key consideration in diversification strategies.

An overview of the different policy approaches amongst pastoral and other farming systems is illustrated below in Figure 9 and is intended as a reference for further action to be promoted by the UfM amongst the relevant countries.

*Figure 9. Overview of options in adaptation measures and farming alternatives across farming systems*



Source: Schilling, Janpeter & Freier, Korbinian & Hertig, E & Scheffran, Jürgen. (2012)<sup>19</sup>

Pastoral farming systems are available throughout the region, with peaks of presence in the Atlas Mountain, and are the systems that lack the necessary resources and capacity to adapt to or mitigate the effects of climate change. Yet, it is often challenging for policymakers to identify effective measures to allow the adaptation of these forms of agriculture. As pastoral production is not particularly relevant for the overall national GDPs (although essential for the subsistence of local farmers), there is a very high risk that such communities would be forced to migrate to urban centres once the impact on their production

<sup>19</sup> Climate change, vulnerability and adaptation in North Africa. Agriculture (Ecosystem, Environment. 156. 12–26. 10.1016/j.agee.2012.04.021)

system makes their basic subsistence at risk (in the longer term). There are serious issues that need to be discussed and addressed across all countries assessed in this report, if a more sustainable option to relocation is to be identified.

Other forms of more advanced farming – most common in western countries – might have more opportunities to adapt and/or diversify in response to the challenges posed by climate change, including higher indirect impacts due to the rising costs of fuel prices and chemical fertilizers – which may require greater support in terms of state subsidies or greater efficiency of the production systems. It is the most advanced farming systems might be most affected by climate change mitigation policies (e.g. for enteric fermentation), for which again more efficient production systems should be developed in order to balance rising production costs. In this area, targeted actions are essential and should be discussed within and across countries.

The measures taken, aimed at reducing the vulnerability of agricultural areas, depend on the resources and features of each area, as indicated so far. There will be a need to shift from certain crops to others that are more resistant and better adapted to the 'new' climate, or to abandon agricultural production in the more exposed areas in favour of other economic activities. In the latter case, the management of diversification off-farm needs to be managed as part of a broader economic transition. Each country must focus on the dissemination of information, management of water demand and provision of the infrastructure necessary to sustain private initiatives, with a clear focus on the specific needs of the farming systems that make up the sector in the country. More specific assessments of impacts and adaptation have been undertaken for flooding, water allocation, agricultural and forest land use, each taking account of cross-sectoral interactions. These assessments have found that impacts from flooding will generally increase in the future, especially due to sea-level rise, and that impacts during more extreme scenarios can only be reduced to current levels by implementing major adaptation measures. Water resource shortages may result from climate change, which could trigger significant socio-economic change in the Eastern and Western Southern Mediterranean Countries.

# More targeted measures should address specific challenges of farming systems

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## Impacts are accelerating and are different across countries and their farming systems

As discussed in Chapter 2, **the impacts of climate change** are substantial for the agriculture sector and are **expected to grow rapidly through time across Southern Mediterranean countries, first in the west and then in the east**. The exposure of the sector to specific challenges is in part similar across countries (e.g. scarcity of water resources) but has also some differences between western and eastern countries, with the former growingly exposed to pressure on livestock and biodiversity in the near future.

Important to notice, is that the **different farming systems characterising the sector in the east and the west of the region will reflect different degrees of vulnerability and capacity to adapt** to the challenges posed by climate change over time. Pastoral farmers seem particularly exposed to the challenges posed by climate change and this has to be more consistently addressed throughout the region. Other farming systems characteristic of western countries, although more exposed to indirect impacts (costs of fuel and fertilisers, as well as climate mitigation measures) might have greater ability and options to adapt to climate pressure, and yet more specific measures are needed to support such adaptation capacity through time.

### Policy response remains relatively general and should be better tailored to farming systems' needs

A number of valuable measures are already in place through climate-change and sectoral policies across the countries assessed, and yet greater support for more effective policy measures should be fostered:

- **Making existing subsidies and funding more “climate-friendly”** for example building on the current debate<sup>20</sup> on the need for more effective and efficient financial support in this respect.
- **Sharing of technical know-how on the actual options to support pastoral farmers across the region** is essential to foster tailor-made responses within countries, and greater cooperation and sharing of know-how on the support to an economic segment which is common to all countries assessed – and the most exposed and vulnerable to climate change impacts.
- **Further understanding on the actual uptake and improvement of measures to foster adaptation and diversification for both advanced farming systems and rainfed lands is required** building on ongoing actions<sup>21</sup>, so to assess the potential for technological development/adaptation across the

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<sup>20</sup> <http://documents.worldbank.org/curated/en/734701543906677048/Realigning-Agricultural-Support-to-Promote-Climate-Smart-Agriculture>

<sup>21</sup> <http://www.fao.org/neareast/perspectives/water-scarcity/en/>

value-chain (including post-harvesting activities, food loss and waste management), ensure robust and reliable sectors, and accelerate capacity to foresee/adapt to the challenges ahead.

- **Advanced technical advice and exchange of knowledge on success/failure stories in the uptake of agricultural risk insurance** is also essential to foster more tailored measures throughout the region, particularly but not exclusively in western countries where near future pressure is expected to accelerate.
- **Finally, it is worth investigating how to strengthen synergies between National Adaptation Policies (NAPs)<sup>22</sup> across relevant sectors**, in order to maximise diversification opportunities for farmers, cross-subsidise certain infrastructure, support soil quality and biodiversity in existing ecosystems, collect and model (big) cross-sectoral data, foster cross-sectoral capacity building, etc. – and maximise access to resources.

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<sup>22</sup> <https://www.undp.org/content/undp/en/home/librarypage/climate-and-disaster-resilience-/integrating-agriculture-in-national-adaptation-plans.html>

# Conclusions and recommendations

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The assessment of relevant publicly available sources confirms that:

- **Agriculture is an essential activity** for all countries assessed, at present and potentially in the future – as a source of subsistence (e.g. pastoral farming systems), employment, as well as economic returns in the region (the latter for more advanced systems particularly relevant in western countries).
- **A range of negative impacts from climate change is foreseen for the sector and expected to grow exponentially** in the future, with a strong acceleration of pressure on water resources and agricultural systems in the near future (2030) expected particularly in western countries where diversified farming systems exist.
- **Support for adaptation and diversification across specific farming systems is therefore a strategic option** to avoid dramatic effects on local farmers that can result in them abandoning their small production and relocating to other regions or nearby urbanised areas, and drastic impacts on the sector as a whole, with negative repercussions at economic and societal level (food-supply). In cases where the displacement is already occurring (and there are many), creating sustainable (peri-)urban livelihoods will be essential to avoiding social unrest.
- Although a range of policy measures have been identified in our analysis, both sector specific and for addressing climate change in general, **greater attention should be put on the specific needs of farming systems** within and across countries – so to maximise the uptake and the impact of such measures.
- It is **also important that existing lessons learnt** – both in terms of success and failures– are **shared more consistently across the region**, with the purpose of maximising collective knowledge and identifying more effective and tailored policy actions across countries; attention should also be given to sharing lessons from existing international practices<sup>23</sup> in fighting desertification at large, including those promoted by FAO<sup>24</sup> and UNCCD<sup>25</sup> in Sub-Saharan Africa.

It is therefore pivotal for the Union for the Mediterranean (UfM) to foster greater exchange and more concrete actions involving local and regional sectoral stakeholders across the Mediterranean. The main recommendations for the UfM follow-up are therefore the following:

- **Valorise and disseminate the findings of this paper** and other emerging sources of information and good practices throughout the region, as a basis for in-depth and fine-tuned analysis.
- **Promote a regional partnership with other Mediterranean institutions (e.g. CIHEAM) and dialogue through a Regional Workshop** with experts, practitioners and planners, as well as policy-makers at the local, national and regional levels – inter alia, with the aim of collecting a “regional

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<sup>23</sup> <http://www.fao.org/3/CA2710EN/ca2710en.pdf>

<sup>24</sup> <http://www.fao.org/in-action/action-against-desertification/countries/africa/en/>

<sup>25</sup> <https://www.unccd.int/actions/great-green-wall-initiative>

portfolio” of existing good practices, as well as emerging ideas and suggestions to improve the quality, efficiency and effectiveness of policy-making across the Mediterranean.

- **Engage more actively with decision-makers and media** in the region– including through the exchange amongst sectoral and country data-collection bodies, in order to assess more carefully the differences and commonalities across the region, the sector value-chains (including post-harvesting and waste management), as well as cross-sectoral policy (to make the most of available knowledge and financial resources and strengthen National Adaptation Policies across the region).
- **Support specific studies, demonstration initiatives and business cases** on technology innovation/adaptation across sub-sectors, farming systems and value-chains (including mobilization of funding/financing mechanisms to foster technological innovation in the area<sup>26</sup>), identify and disseminate proven technologies and management practices, and discuss the most effective technical recommendations to be implemented at the regional level (including an assessment of the extent to which insurance schemes in line with the UNFCCC<sup>27</sup> approach are viable across the region).

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<sup>26</sup> [http://www.anpe.nat.tn/Fr/actualites\\_7\\_34\\_D37](http://www.anpe.nat.tn/Fr/actualites_7_34_D37)

<sup>27</sup> <https://unfccc.int/topics/adaptation-and-resilience/the-big-picture/introduction-to-loss-and-damage>

## Annex – Overall of economic relevance of the sector across countries assessed

Agriculture sector: GDP (2017) <sup>28</sup> and jobs <sup>29</sup>	Trend of Agriculture sector	Forecast <sup>30</sup>
Algeria (12.26% of GDP, 12.78% of total employment)	GDP from Agriculture in Algeria increased to 16.96 EUR Billion in 2017 from 15.91 EUR Billion in 2016, reaching an all time high of 16.96 EUR Billion in 2017	In the long-term, the Algeria GDP From Agriculture is projected to trend around 19.10 EUR Billion in 2020
Egypt (11.49% of GDP, 24.48% of total employment)	GDP from Agriculture in Egypt increased to 6502.8 EUR Million in the third quarter of 2018 from 5066 EUR Million in the second quarter of 2018. GDP from Agriculture in Egypt averaged 3208.4 EUR Million from 2007 until 2018, reaching an all time high of 6502.8 EUR EGP Million in the third quarter of 2018	In the long-term, the Egypt GDP From Agriculture is projected to trend around 5993.4 EUR Million in 2020
Israel (1.17% of GDP, 1.06 of total employment)	GDP From Agriculture in Israel increased to 970 EUR Million in the second quarter of 2018 from 961 EUR Million in the first quarter of 2018, reaching an all time high of 1124 EUR Million in 2011	In the long-term, the Israel GDP From Agriculture is projected to trend around 1076 EUR Million in 2020
Hashemite Kingdom of Jordan (4.01 of GDP, 3.68% of total employment)	GDP From Agriculture in Jordan increased to 439 EUR Million in the third quarter of 2018 from 379 EUR Million in the second quarter of 2018, reaching an all time high of 636 EUR Million in 2017	In the long-term, the Jordan GDP From Agriculture is projected to trend around 409 EUR Million in 2020
Lebanon (3.53% of GDP, 3.17% of total employment)	GDP From Agriculture in Lebanon decreased to 1518 EUR Million in the second quarter of 2016	No Data
Morocco (13.06% of GDP, 37.01% of total employment)	GDP From Agriculture in Morocco decreased to 2930 EUR Million in the third quarter of 2018 from 3004 EUR Million in the second quarter of 2018, reaching an all time high of 3004 EUR Million in 2018	In the long-term, the Morocco GDP From Agriculture is projected to trend around 3125 EUR Million in 2020
Palestine (3.16% of GDP, 9.67% of total employment)	GDP From Agriculture in Palestine decreased to 86 EUR Million in the third quarter of 2018 from 92 EUR Million in the second quarter of 2018, reaching an all time high of 111 EUR Million in 2011.	In the long-term, the Palestine GDP From Agriculture, Forestry and Fishing is projected to trend around 99.9 EUR Million in 2020
Tunisia (9.22% of GDP, 13.51% of total employment) <sup>31</sup>	GDP From Agriculture in Tunisia decreased to 466 EUR Million in the third quarter of 2018 from 475 EUR Million in the second quarter of 2018, reaching an all time high of 478.9 EUR Million in 2018.	In the long-term, the Tunisia GDP From Agriculture is projected to trend around 460 EUR Million in 2020

<sup>28</sup> <https://www.theglobaleconomy.com/>

<sup>29</sup> <https://data.worldbank.org/indicator/sl.agr.empl.zs>

<sup>30</sup> Based on forecasts from Trading Economics (<https://tradingeconomics.com/egypt/gdp-from-agriculture>)

<sup>31</sup> Note that for Palestine and Tunisia the GDP share of agriculture is for 2016 when for the rest of the countries is for 2017





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Palau de Pedralbes | Pere Duran Farell, 11 | 08034 Barcelona, Spain  
Phone: 00 34 93 521 4100 | Fax: 00 34 93 521 4102