## **AGRICULTURE**

This sector encompasses diverse activities, ranging from livestock to arable farming and from open to covered horticulture in glasshouses. Some of these activities will benefit from climate change impacts, while others will experience considerable disadvantages. In addition, a changing climate will have a strong share in the diktat of global market prices and related demands<sup>1</sup>, which will ultimately reflect local costs and constraints on production.

Climate change clearly affects agriculture, and so does the effect of agriculture activities on our climate. This industry is a significant emitter of greenhouse gases into the atmosphere, which is set to increase due to an ever-expanding global population and bigger markets.

Yet, the agriculture industry is strongly entrenched in innovation and adaptation as a response to an ever-changing physical and economic environment. Yet, the importance of at least being aware of the consequences of climate change<sup>2</sup> and perhaps even anticipating it becomes a pre-requisite in order to seize new opportunities<sup>3</sup>.

One of the most pronounced effects of climate change on agriculture is the projected increased in heavy rainfall, which can potentially delay autumn and winter harvesting. It can also lead to field flooding during the growing season resulting in crop losses due to low oxygen levels in the soil, increased susceptibility to root diseases and increased soil compaction due to the use of farm equipment on wet soils. Another impact of heavy downpours and associated storms is the effect of strong wind gusts on crop surfaces, which can cause significant damage.

Another significant impact are extended local droughts, which are projected to increase in the future, particularly under higher emissions scenarios. Given that water deficits are detrimental for all crops, increased drought will be occurring at a time when crop water requirements also are increasing due to rising temperatures.

Higher temperatures, increased drought, and longer growing seasons will lead to increased agricultural water use in some areas. In addition, crops will be subject to more aggressive and invasive weeds, insects<sup>4</sup> and pathogens giving rise to a greater

<sup>&</sup>lt;sup>1</sup> Agriculture not only depends on natural conditions but also on the choices made by farmers (such as choice of crop variety and management decisions) and the economics of particular sectors (such as costs, subsidies, price, etc). The European Common Agricultural Policy and national planning/development also determine the magnitude of the economic effects.

<sup>&</sup>lt;sup>2</sup> The projected temperature increase will lead to early budding/germination, leading to a longer growing season. In Europe, the growing season is expected to lengthen still further in the next forty years or so. However, the growing season is also dependent on other factors including sufficient moisture, which will be exceedingly lacking in the southern European region.

<sup>&</sup>lt;sup>5</sup> Climate change can have both beneficial and detrimental impacts on plants. Crop responses in a changing climate reflect the interplay among rising temperatures, changing water resources, and increasing carbon dioxide concentrations. Some crops are particularly sensitive to high nighttime temperatures, which are projected to continue to increase during the 21<sup>st</sup> century.

<sup>&</sup>lt;sup>4</sup> Many insect pests thrive due to warming, leading to increased loss of crops and thus greater use of pesticide. Warming assist insects in several ways: higher winter temperatures allow more insects to survive over the cold seasons. Certain insects are also carriers of diseases that harm crops, and are expected to increase as warmer seasons allow proliferation and higher survival rates of disease-carrying pathogens and parasites (see impacts on ecosystems).

application of herbicides, insecticides and fungicides<sup>5</sup>. At the same time, higher temperatures are known to reduce the effectiveness of certain classes of pesticides.

Impacts on livestock include thermal stress<sup>6</sup> caused by the projected temperature and humidity increase. The higher the heat and humidity, the greater the stress and discomfort on livestock.

Research shows that an increase in the carbon dioxide concentration in the atmosphere can lead to an increase in agricultural production. Such an increase in yield is crop type-dependent, as it will only happen under optimal cultivation conditions<sup>7</sup>.

## Salient impacts:

- 1. Increased heat, disease, and weather extremes are likely to reduce agriculture productivity.
- 2. Climate change will have both positive and negative effects on agricultural production and the economics of the various agricultural sectors. The negative effects are greater if extreme climate conditions occur more frequently or persist for longer periods.
- 3. Increased drought conditions will increase soil salinization.
- 4. Projected increase in crop development difficulties due to pollination by insects no longer being synchronous due to early germination/budding and a longer growing season
- 5. Diseases and insect pests benefit from warming, increasing stress on crop plants and requiring more attention to pest control. Selection of climate-resistant crops will be applied.
- 6. Extreme events such as heavy downpours and droughts are likely to reduce crop yields because excesses or deficits of water have negative impacts on plant growth.
- 7. Projected increase of heavy rainfall (also with hail) will increase sowing and harvesting problems, including damage to crops and infrastructure

<sup>&</sup>lt;sup>5</sup> Where increases in water and chemical inputs become necessary, they will increase costs for the farmer, together with society-wide impacts by depleting water supply, increasing nitrogen and pesticide loads to the environment, and increasing risks to food safety and human exposure to pesticides.

<sup>&</sup>lt;sup>6</sup> Heat stress reduces animals' ability to cope with other stresses, such as diseases and parasites

<sup>&</sup>lt;sup>7</sup> A doubling of the carbon dioxide concentration can lead to a 15-20% increase in yield.

Phenomenon	Agricultural yield and quality	Quality of agricultural land	Infrastructure	Pests and diseases	Livestock
Increased air temperature	Decreased functioning and vigour of vineyards <sup>8</sup> .	Increased land-use at high elevation or close to coastlines in order to adapt vineyards to the warming trend.		Pests which normally occur to the south of Malta spreading wider <sup>9</sup> .  Decreased potato <sup>10</sup> blight infections.	Increased thermal stress on animals <sup>11</sup> , leading to losses in productivity.
Increased frequency of heat-waves	Decreased productivity.	Projected increase in soil erosion and nutrient loss.			Increased thermal stress on animals.
Prolonged drought periods	Decreased productivity of local fodder <sup>12</sup> .	Projected increase in soil erosion and nutrient loss.	Lack of water management infrastructure (such as large reservoirs using second class water) will lead to water shortages for irrigation. This will worsen the current problem of illegal groundwater extraction from boreholes.		
Milder and damper winters	Projected difficulties in pollination due to early germination/budding and a longer growing			Increased risk of crop diseases.	Increased risk of livestock diseases.
Increased torrential rains, flooding and severe storms	Increased loss of harvest and quality of produce.  Spring-sown crops are expected to have lower yields (such as legumes).  Potato crops will require more water.  Autumn-sown crops expected to have lower yields.	Increased erosion affecting quality produce.  Increased maintenance of rubble walls against breaches that allow soil erosion.  Reduced soil fertility because of the impact of large raindrops on soils, resulting in shattering of soil particles.	Increased damage to crops and greenhouses; not covered by private insurers.  Exiting small wells and reservoirs will not be able to hold larger harvest of rainwater. Remaining rain will be lost as surface run-off, collected in aquifers or lost through evaporation.	Increased conditions favouring viral disease vectors.	Increased conditions favouring viral disease vectors.

<sup>&</sup>lt;sup>8</sup> These modification lead to (a) reduced photosynthesis, (b) partial or total inhibition of berry development and biosynthesis of its principal components, notably during growth of the berry, (c) inhibition of ripening, (d) loss of fruit volume with resulting consequences for yields and harvest concentration, and (e) possible increase in alcohol content of wines produced by a warmer climate. High temperatures, especially if associated with drought, can inhibit certain biochemical pathways or physiological processes essential for the production of quality grapes.

<sup>9</sup> So far, no studies on the local interactions between pests, crop diseases and climate are available. High temperatures, especially if associated with drought, can inhibit certain biochemical pathways or physiological processes essential for the production of quality grapes.

10 There are no specific local case-studies. Research in southern Europe shows that this cash crop is likely to be negatively affected by climate change.

<sup>11</sup> Maltese farms are susceptible to high ambient temperature changes as most are not equipped with cooling devices. Maltese livestock units are typically small, land-based units that have given rise to the evolution of highly intensive livestock production system.

<sup>12</sup> These changes are expected to affect Maltese livestock directly as Malta imports much of its animal feed ingredients from overseas. Livestock farmers lack adequate land base to produce their own feed and/or fodder.

	Decreased functioning and vigour of vineyards.	Periodical water logging of soils, especially in soils and low-lying areas render agricultural land useless.  Increased leaching of nutrients from sandy soils.  Additional fertilizer would be needed in this case, risking further pollution of the aquifers.
Increase in atmospheric carbon dioxide	Increased photosynthetic rates with an increased yield. This is crop type-dependent.	
Sea level rise	Loss of quality due to salinization of irrigated water.  Increased damage to the fruit-growing sector due to salinization	