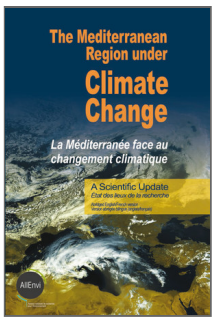

Stéphanie Thiébault and Jean-Paul Moatti (dir.)

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Chapter 2. Agricultural management, livestock and food security

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Chapter 2

Agricultural management, livestock and food security

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Abstract

Over the centuries, farmers from the countries bordering the Mediterranean have developed a variety of agricultural practices, providing a wide array of commodities that have made the Mediterranean diet world famous. However, climate change projections reveal that some of these practices are at risk because of the expected drier and hotter conditions coupled with soil and water constraints, as well as a higher fire frequency threat. Nevertheless, adapting to climate hazards has long been part of farming practice in this area. The growing of pulses or other drought-tolerant crops (olives, grapes, almonds, etc.), transhumance and the use of rangelands or tree fodder by livestock, as well as water harvesting techniques, are among some of the age-old solutions to erratic rainfall or hot summers. In this chapter, we highlight some of the challenges facing agriculture in the Mediterranean and provide a series of examples of how agricultural and livestock management can be better adapted to climate change.

Reliable metrics are necessary to enable the impact of climate change to be assessed and targeted agricultural policies to be designed. Long-term environmental observatories are essential to improve land management in the context of global change. Modelling the projected effects of current climatic trends shows that regional agricultural import dependence will increase as the impacts of climate change become more severe. Small ruminants (sheep, goats) have a good adaptation potential and can play a food security net role under climate change with a view to responding to the local food demand that emerges with new life styles. Local small ruminant breeds are adapted to harsh environments but this unique genetic heritage is now endangered. Perennial forage grasses are an alternative to cereals due to lower input requirement, year-round soil cover and optimal use of water. Mediterranean fruit trees, although well adapted, face increases in temperature and soil salinity as well as decreases in water availability. They will require improvements such as selection of early flowering varieties (olive), assessment of best pollinating conditions (figs) and salt tolerant rootstock (citrus).

Résumé

Depuis des siècles, les agriculteurs de la zone méditerranéenne ont mis au point une large gamme de pratiques agricoles à l'origine de productions qui ont rendu le régime alimentaire méditerranéen célèbre dans le monde entier. Les projections climatiques montrent cependant que des risques de sécheresse et de température élevée, associés à des contraintes concernant le sol, l'eau et les dangers d'incendie, menacent certaines de ces pratiques. L'adaptation à l'aléa climatique est néanmoins une habitude ancienne dans cette zone. La culture de légumes secs ou d'autres cultures tolérantes à la sécheresse (olives, raisin, amandes, etc.), la transhumance, l'utilisation des terrains de parcours et du fourrage arboré par le bétail, ou encore les techniques de capture de l'eau, font partie de ces solutions ancestrales au problème de la pluviométrie irrégulière ou des étés caniculaires. Dans ce chapitre, nous présentons certains des défis auxquels l'agriculture méditerranéenne est confrontée et nous proposons quelques exemples illustrant l'adaptation de l'agriculture et de l'élevage au changement climatique. Pour évaluer l'impact du changement climatique et concevoir des politiques agricoles appropriées, des mesures fiables sont nécessaires. Pour améliorer la gestion des terres dans un contexte de changement climatique, des observatoires environnementaux à long terme sont indispensables. La modélisation des effets attendus du changement climatique montre que la région deviendra progressivement plus dépendante des importations agricoles. Les petits ruminants (moutons, chèvres) ont un fort potentiel d'adaptation et peuvent jouer un rôle de filet de sécurité alimentaire en accord avec les nouvelles exigences alimentaires liées à de nouveaux styles de vie. Les races locales de petits ruminants sont adaptées à des

environnements contraignants mais ce patrimoine génétique est désormais menacé. Les graminées fourragères pérennes représentent une alternative aux céréales en raison de leurs exigences modestes en intrants, de leur capacité à couvrir le sol toute l'année et de leur utilisation optimale de l'eau. Bien qu'ils soient bien adaptés, les arbres fruitiers méditerranéens sont confrontés à l'augmentation de la température et de la salinité du sol ainsi qu'à une diminution des réserves en eau. Ils devront faire l'objet d'améliorations comme la sélection de variétés à floraison précoce (oliviers), la prise en compte des conditions de pollinisation (figuiers) ou le greffage sur des porte-greffes tolérants à la salinité (agrumes).

Introduction

The Mediterranean region is highly exposed to anthropogenic climate change. This will result in a hotter and drier climate, especially during the warm season (Lelieveld et al. 2016). Projected temperature changes in the region are often 50% higher than the global mean temperature increase and are combined with an increased frequency and intensity of droughts (Giorgi and Lionello, 2008).

Crop (wheat, maize and soybean) simulation models forced by climate change scenarios show projected yield impacts varying in the range of -22 to 0% and –27 to +5% for the Northern and Southern parts of the Mediterranean basin respectively (Porter et al. 2014). Adaptation through changes in sowing dates is likely to be difficult, since an early sowing of cereals could be restricted by the lack of adequate rainfall in autumn (Porter et al. 2014). Besides, recent studies have shown that more efficient irrigation systems are required if Mediterranean countries are to protect their water resources at the watershed level (Fader et al. 2016).

Several factors could potentially affect agriculture and livestock production in the Northern part of the Mediterranean basin (Kovats et al. 2014):

– Some of the non-climate trends, such as soil degradation – which is already intense in parts of the Mediterranean basin – may aggravate climate change impacts on agriculture;

– Regional projections show significant reductions in soil moisture, runoff and groundwater resources, which may limit irrigation options;

– Fire frequency and the extent of wildfire significantly increased after the 1970s compared with previous decades as a result of fuel accumulation, climate change, and extreme weather events in the Mediterranean basin, and were associated with strong winds during hot and dry periods. Nevertheless, in the Northern part of the Mediterranean region, the total burned area has decreased

since 1985 and the number of wildfires declined from 2000 to 2009, despite the broad interannual variability;

– The Mediterranean basin is expected to suffer multiple ecological stresses due to climate change, such as changes in plant species composition, increase of alien species, habitat losses and degradation, leading to agricultural and forest production losses due to increasing heat waves and droughts exacerbated by competition for water;

– A reduction of spring rainfall associated with higher temperatures is expected in some areas and an increase in groundwater use for irrigation may lead to further environmental concerns (Dono et al. 2016).

Although fewer data are available for the Southern part of the Mediterranean basin, the analysis and modelling of rainfall (Niang et al. 2014) points to a potential significant impact on agriculture. Over the last few decades, the northern regions of North Africa (north of the Atlas Mountains and along the Mediterranean coast of Algeria and Tunisia) have experienced a strong decrease in the amount of precipitation received in winter and early spring. The CMIP5 modelling ensemble projects very likely decreases in mean annual precipitation over the Mediterranean region of northern Africa in the mid- and late 21st century for RCP8.5.

High climatic variability and an inherently challenging climate are nevertheless nothing new for farmers in the Mediterranean. Traditional practices such as the growing of pulses or other drought-tolerant crops (olives, grapes, almonds, etc.), transhumance and the use of rangelands or tree fodder by livestock, and water harvesting techniques (e.g. spade irrigation) are widespread. They are often a response to erratic rainfall or hot summers. Food processing also constitutes a response to climate rigor, e.g. the drying of fruits such as apricots (Syria), figs or dates. The well-known Mediterranean diet (fruits, pulses, legumes, cereals, olive oil, combined with small quantities of meat and dairy products) has proven efficient in staying healthy and reducing risks such as cardio-vascular diseases. Therefore, although being vulnerable to climate change, the Mediterranean region can also be seen as a good example of a healthy food system well suited to the current climate.

In this chapter, we propose a series of examples of how agricultural and livestock management in the Mediterranean region can become better adapted to climate change. We first cover observatories and metrics which contribute to information for decision-making. We then provide a selection of adaptation options covering small ruminants, fodder grass and fruit trees. In a final section, the likely impact of climate change (coupled with demographic expansion and changes in eating habits) on agricultural trade and imports in the Middle East – North Africa region is analyzed. Despite multiple challenges, adaptation and transformation through technological, institutional and market innovations have strong potential in the region. The current knowledge base already provides important indications for the long-term adaptation to climate change of agriculture and food in the Mediterranean basin, but this major challenge is deserving of yet greater research efforts.

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