BRIEFING

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Climate change and its impact on food and nutrition security

KEY FINDINGS

There is increasing evidence for negative effects of climate change on food and nutrition security in the European Union (EU). Impacts on agriculture are mediated, for example, by changes in temperature, precipitation, extreme weather events and variation in patterns of pests and diseases. Among the impacts are reduced cereal yields in southern Europe, reduced yield and nutrient content of fruit and vegetables, changing fisheries, and expanding distribution of livestock infections. Certain geographical regions and population groups are particularly vulnerable. Options for adaptation include modifying farming practices, and breeding crops more resilient to biotic and abiotic stress.

In addition, agriculture itself, and food systems more generally, contribute substantially to greenhouse gas emissions. Mitigation options include reducing food loss and waste, improving farming practice, and modifying food intake patterns. Adjusting dietary consumption, particularly to reduce the excess consumption of calories and large amounts of food from animal sources, will bring health co-benefits alongside the reduction in greenhouse gas emissions and alleviation of pressures on other natural resources.

The consequences of COVID-19 on food and nutrition security may have been aggravated by the impacts of climate change decreasing food system resilience. In planning for the post-COVID-19 recovery, it is vital that the gradual resumption of economic and social activity is achieved together with accelerating progress towards a low-carbon economy in the EU. Pursuing food system mitigation activities to tackle climate change will help to support European Green Deal objectives and facilitate the low-carbon recovery after COVID-19.

Food and nutrition security in the EU

Combatting malnutrition in its various forms – undernutrition and micronutrient deficiencies as well as overweight and obesity – is a problem faced by all countries. The countries of the EU are not immune from these problems[1,2]. Half of low-income households in the newer Member States struggle with their access to food, there is clinical evidence of rising nutritional deficiencies across the EU, often associated with deteriorating mental health, chronic diseases and worsening child health. More than half of the EU adult population is overweight.

In addressing the issues for food and nutrition security, it is necessary to understand better the complexity of linkages between policies for agriculture, nutrition and health and their linkages with global environmental change. There is also increasing need to adopt the food systems approach to analysis, to encompass all steps in the value chain from growing, harvesting, processing, transporting, trading,

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purchasing, through to recycling, so as to bring production and consumption patterns together and to operate within the planetary boundaries.

Effects of climate change on food and nutrition security

There is mounting evidence for negative consequences of climate change on human health worldwide, from both direct and indirect effects, mediated by ecosystems and socioeconomic systems. The impacts are being experienced in the EU[3,4] and the effects of climate change on food systems are a critical part of the overall impacts on human and planetary health[5].

Comprehensive analysis by the European Environment Agency[6] documents how changes in temperature and precipitation, and weather extremes are already influencing crop yields and livestock productivity in the EU. As a generalisation[3], climate change is expected to increase the suitability of northern Europe for growing cereal crops, but to reduce crop productivity in large parts of southern Europe although the growing season there might shift into winter in partial compensation. Modelling future impacts, subject to the severity of climate change, indicates potentially large reductions in yields in central and southern Europe. Increasing atmospheric concentrations of CO_2 may have additional effects on crop quality and quantity[7].

Climate change also negatively affects yields of vegetables and fruit in the EU, with further nutritional and health consequences[3]. Although negative effects on fisheries in the European region may be less than elsewhere, in consequence of fish stocks moving from tropical to temperate latitudes, there will be uncertainty and local variation, and ocean acidification will reduce shellfish productivity.

Negative effects of climate change on agriculture may also be mediated by changing patterns of pathogens and modelling suggests that cereal and fruit crop yield loss to insects will continue to increase[3]. Problems are currently experienced and will continue for livestock as well as for arable farming. For example, outbreaks of Bluetongue, the vector-borne disease of sheep, are extending in northern Europe, associated with climate change[8]. Climate change is also bringing problems for food safety[9], e.g. because of increased food spoilage and food-borne pathogens and toxins, emphasising the importance of taking the food systems approach that considers implications for harvesting, processing and trading, as well as growing.

Furthermore, a large proportion of the EU's food imports comes from developing world areas that will be particularly vulnerable to climate change[2]. Recent assessment[10] indicates an increasing probability of weather hazards occurring at the same time in the world's major food-producing regions (Europe, North America and Asia) with the potential for world food system collapse. Supply chain issues and changing trade patterns will have consequences for quality, quantity and price of food products with greatest impacts on vulnerable groups in the EU. And, choices made by the EU will have implications for vulnerable groups in the rest of the world[1,2,3].

Climate change will affect everybody, but some population groups and settings are more vulnerable than others. In terms of food and nutrition security, certain regions in Europe may be particularly at risk, e.g. the Arctic and Mediterranean. In all countries, certain groups in the population may be more at risk, e.g. the elderly, children, migrants and those who are already ill[1,3].

Climate change adaptation

There is a range of options at regional, national and local level for adaptation to climate change in the agricultural sector[6], but they depend on raising stakeholder and policy-maker awareness. Options include: new infrastructure for irrigation and flood protection, initiatives to reduce pests and diseases, conservation of soil and other natural resources, changes in farming practice including diversification as well as, more generally, measures to decrease risks of extreme weather events. Options also need to be explored throughout the food system to ensure climate resilience, e.g. in food storage and transport, market transparency, siting of food processing facilities and other infrastructure[1,3].

In addition, scientific advances are bringing new opportunities within range for developing crops that are more resistant to biotic (e.g. pests and diseases) and abiotic (e.g. drought, water-logging) stresses[2,3]. There is more to be done to capitalise on these advances. For example, the decline in climate resilience of European wheat must receive more attention by plant breeders, wheat traders and farmers[11]. However, although the science has advanced rapidly, there is still considerable debate on how new gene technology-based plant-breeding techniques should be regulated and implemented[12,13]. The EPRS recently published a thorough assessment of the current state of the controversy, preparatory to the European Commission's proposed clarification of the situation in 2021.

Effects of agriculture on climate change

When considering the complex interactions between climate change and food and nutrition security, it is also important to recognise that agriculture itself contributes very substantially to climate change. Currently, agri-food systems worldwide account for about 30% of greenhouse gas emissions (GHGs) and a major part of this contribution is from livestock. If current trends continue, food production alone will exceed global targets for total GHGs. A combination of measures is needed to mitigate the projected increase in the contribution of agriculture to climate change and decrease pressure on other environmental resources, such as water[14]. Mitigation measures include reducing food loss and waste, improving agronomic practice and modifying dietary consumption: it is, of course, vital to choose measures that do not themselves adversely affect food and nutrition security.

In addition to contributing to climate change mitigation and helping to reconcile current priorities with the interests of future generations, adjusting dietary consumption patterns would bring public health co-benefits in those populations that already consume excess calories and large amounts of food from animal sources. Systematic review of the literature[15], on what is achievable by shifting current Western dietary intakes to environmentally sustainable patterns, demonstrates that reduction in environmental footprints were generally proportional to the magnitude of animal-based food restriction and associated with benefits in all-cause mortality risk. However, there must be more attention given to understanding what constitutes a sustainable, healthy diet[14], how to inform consumer choice, how to protect vulnerable groups with lowest income who may already be suffering micronutrient deficiencies that would be exacerbated by taxing animal products, and how to manage the consequences of changes in food production and consumption on agricultural communities and rural development. Although food product labelling can provide one route to encouraging sustainable and healthy food choices, there is risk of consumer confusion and exploitation by vested interests[16].

Implications of COVID-19

The COVID-19 pandemic threatens global food and nutrition security[17,18]. Some have suggested[19] that "*The COVID-19 pandemic has shown the resilience of the EU food supply*" and that food security is no longer an issue in the EU. However, although food systems in many Member States seem to have coped relatively well so

far during the coronavirus pandemic, there is evidence of multiple consequences for food and nutrition security[20] that may worsen. Again, the most vulnerable in the population may be affected most, directly and indirectly through loss of purchasing power because of unemployment. Food system challenges in the EU in consequence of COVID-19 include the availability of seasonal labour for crop harvesting, disruption of food processing and of retail supply chains, and increase in food wastage (partly as a result of shutdown of restaurants, schools and other community facilities)[21,22,23]. In some cases, the consequences of COVID-19 may have been aggravated by the continuing impact of climate change to decrease food system resilience and by extreme weather events adding to societal disruption.

In planning for the post-COVID-19 recovery, much depends on successfully combining the desired medical outcomes with a gradual resumption of economic activity and social activity while the EU is also facing a climate change emergency[13]. Flagship policies for transformational change such as the European Green Deal assume even greater importance, not only in accelerating progress towards a low-carbon economy and addressing the climate emergency in a fair way, but also in strengthening society's resilience to future disruptions. The European Green Deal and associated activities to facilitate economic recovery after COVID-19 have the potential to achieve significant health improvements in the near term while reducing health risks from climate change[24], and the food system mitigation activities described previously can make a major contribution. Achieving health co-benefits requires careful design, evaluation and coordination of policies across sectors.

Conclusions for the science-policy interface

Improving human and planetary health, through tackling the challenges for food and nutrition security, must be seen as key priorities in implementing Farm to Fork policies, reforming the Common Agricultural Policy, updating the Climate Adaptation strategy, and in cross-cutting initiatives for the circular economy and bioeconomy. The EU should also show global leadership, urging ambitious action based on a verifiable scientific evidence base[13], e.g. in the United Nations Framework Convention on Climate Change and in pursuit of the Sustainable Development Goals[14].

There is an increasing political interest in these issues, but developing informed options for policy-making requires better awareness and use of the evidence base. Many commentators offer advice on what is necessary, but some of their comments are driven by vested interests. Academies of science have important roles to show where the available scientific evidence is relevant, transparent and robust and where there are knowledge gaps that need to be filled by new research. The European Academies' Science Advisory Council (EASAC), formed by the national science academies of the EU Member States to enable them to collaborate with each other in giving advice to European policy-makers, recognises its continuing responsibility to collect and interpret evidence, and foster interaction between disciplines, sectors and countries. The EASAC report on climate change and health[3], on which this briefing draws, provides detail on the manifold priorities for linking research outputs and policy development for climate change adaptation and mitigation, on the core importance of "health in all policies", and on ways to fill knowledge gaps and integrate data sets. An additional, shared priority for the science and policy communities is also emphasised – to raise public awareness of the current and potential deleterious effects of climate change and of the solutions available. In doing this, it is imperative to counter misinformation and denial of scientific knowledge by vested interests, and so reduce polarisation in public and policy debates.

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