



PRIMA

PARTNERSHIP FOR RESEARCH AND INNOVATION
IN THE MEDITERRANEAN AREA



2019 AGRIFOODMED DELPHI

Trends, challenges and policy options
for Water Management, Farming Systems
and Agri-food Value Chains in 2020-2030





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Index

1	Introduction	1
2	Alternative Scenarios for the Future of Mediterranean Agri-food Sector	5
	2.1 The pessimistic scenario	5
	2.2 The optimistic scenario	9
	2.3 The sources of divergence	13
3	Policy interventions	15
4	Discussion and Conclusions	20
Appendices		
	Methodological Appendix	24
	Appendix A: Glossary	28
	Appendix B: Overview of the drivers in decreasing/increasing	30
	Appendix C	38

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Other Activities 3.2.2 Networking, engagement and communication to stakeholders

1

Introduction

The main challenge for the food and agricultural sector is providing enough food, in quantity and quality, to meet the nutritional needs of global populations while simultaneously conserving natural resources and ecosystems for present and future generations.

The Mediterranean region is currently facing a wide range of challenges arising from complex and intertwined trends and dynamics such as population pressure, poverty, structural inequalities in the production sector, inadequate food supplies, change in dietary habits, food and nutrition security, environmental degradation and climate change, and political stability (Box1).

The 17 Sustainable Development Goals of the 2030 Agenda for Sustainable Development of the United Nations provide an overarching agenda for mobilizing efforts and resources in the Mediterranean agri-food systems (Holden, 2015¹) but need immediate and transformative actions in order to be implemented.

The 17 Sustainable Development Goals of the 2030 Agenda for Sustainable Development of the United Nations
Source: UN, 2015 website



1 Holden P. (2015): "The Mediterranean and the Global Sustainable Development Goals", Mediterranean Politics.

In this context, this report outlines the results of a Delphi analysis that was conducted by the University of Siena between February and October 2018. The purpose of this exercise is threefold. First, to identify the main challenges, trends and driving forces of agri-food systems in the Mediterranean over the short (2020) and medium term (2030). Second, to assess the desirability and feasibility of alternative policy responses to the challenges that the region will face in terms of water resource management, farming systems and the agri-food value chains. Last, to provide informed, evidence-based recommendations that will serve as a guide for different stakeholders to take action in the region's food supply chain.

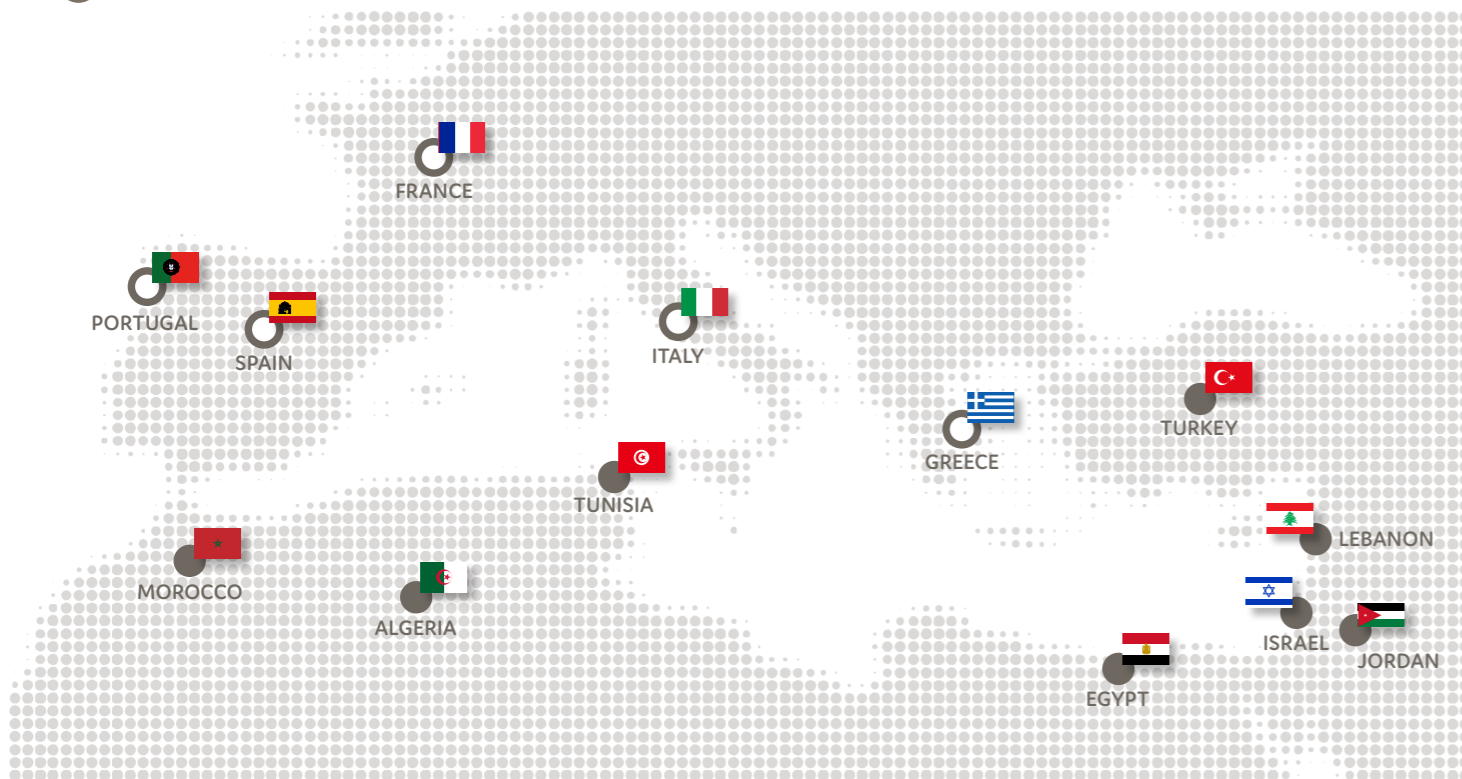
To achieve these goals, a group of practitioners, experts and academics from different countries and disciplines were invited to explore the main trends, future developments and possible policy solutions in the field of agri-food in the Mediterranean using the Delphi methodology. The **geographical area** covered by this study includes the following countries: Algeria, Egypt, Israel, Jordan, Lebanon, Morocco, Tunisia, Turkey (Southern Mediterranean), and France, Greece, Italy, Portugal, Spain (Northern Mediterranean).

The AGRIFOODMED Delphi exercise is part of the new Partnership on Research and Innovation in the Mediterranean Area (PRIMA) that, between 2018 and 2028, aims to develop smart and innovative solutions for more sustainable water management and agri-food systems in the Mediterranean region by fostering joint research and innovation².

This report is organized into three sections. The first section presents two alternative scenarios based on the analysis of the main trends. The second section discusses what policy options are considered feasible and/or desirable to address the challenges raised by these trends. The final section presents the main conclusions and recommendations. An appendix describes the Delphi methodology and the main characteristic of the AGRIFOODMED study.

Countries of Northern and Southern Mediterranean

- NORTH MED
- SOUTH MED



² To learn more about the PRIMA project, please consult the website: <http://ec.europa.eu/research/environment/index.cfm?pg=prima>

Box1: Overview of the Mediterranean Agri-food System Challenges



Water Management

Mediterranean water resources are limited and often low quality, fragile and unevenly distributed in space and time. Tourism, manufacturing and irrigated land have increased the competition for water and put increasing pressure on resources. Under the arid and semi-arid conditions of the Mediterranean basin, the various forms of land degradation, particularly erosion and salinization, are sharply felt.

Summary of present challenges:

Declining water resource availability and pollution; intensive agricultural use (accounting for 70% of total water withdrawals on average) and competition with other sectors; land degradation (erosion, salinization); climate change vulnerability.



Farming System

Agriculture is a major economic sector in terms of its capacity to generate employment and income for a large fraction of the Mediterranean population. In most Southern Mediterranean countries (Morocco, Egypt, Turkey and Tunisia), it already occupies 20 to 30% of the population. However, past increases in agricultural production have often been through intensification and heavy reliance on external inputs. In order to safeguard the environment and avoid exploitation of natural resources an economically sustainable agriculture practice is needed. GHG (greenhouse gas) emissions from the food system account for about one-third of emissions in EU countries.

Summary of present challenges:

Agriculture is a major economic sector (20-30% employment in the Southern Mediterranean); 40% of land is used for agriculture; biodiversity hotspot (18% species threatened with extinction); GHG emissions.





Agri-food Value Chains

Mediterranean agri-food value chains suffer from a weak logistical infrastructure and poor safety, quality and traceability standards. Overall, there is substantial food loss at the production level (especially in the Southern Mediterranean) and significant food waste at the consumer level (especially in the Northern Mediterranean). Supply irregularity, low rates of innovation and management, and poor marketing and communication skills make it difficult for businesses (especially Small and Medium Enterprises) to meet consumer requirements. As a result, imported products flood local markets making local products uncompetitive and creating a dependence on international markets. Improved food processing, such as innovative packaging, could make local products more competitive and create new trade opportunities. In many Mediterranean countries, current dietary trends are, in fact, deviating from the Mediterranean lifestyle and diet, while the rates of chronic diseases and micro-nutrient deficiencies are growing. Additionally, Mediterranean countries are also constrained by limited investments in Research and Development (R&D) for agri-food chains.

Summary of present challenges

Limited investments in R&D; food loss (at the post-harvest level, mainly in the Southern Mediterranean) and food waste (at consumer level, Northern Mediterranean); poor infrastructures; fragmentation of value chains; abandonment of Mediterranean diet.



overweight

74-86% women
69-77% men



Source: PRIMA Strategic Research and Innovation Agenda 2018/2028

2

Alternative Scenarios for the Future of Mediterranean Agri-food Sector

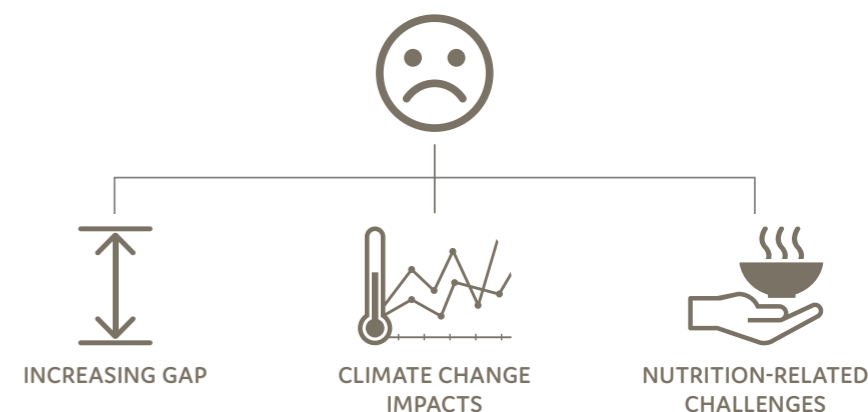
The AGRIFOODMED study focuses on trends that are expected to occur in the Mediterranean region over the short (2020) and medium term (2030). Additionally, the paper will delve into the policy interventions that are considered to be desirable and feasible to overcome current challenges of water management, farming systems and agri-food value chains. Based on the results of the experts' judgments, the report presents two alternative scenarios – one pessimistic; one optimistic – that focus on the main positive and negative trends that were highlighted by the panel of experts³.

2.1 The pessimistic scenario

According to experts, Mediterranean countries will most likely face three main challenges over the short and medium term:

- an increasing gap between the Northern and Southern Mediterranean countries in terms of water management, farming and the agri-food value chain;
- adverse, but different impacts from climate change throughout the entire Mediterranean region;
- nutritional-related challenges on Southern Mediterranean countries.

Experts converge on the sources of pessimism while they diverge on the sources of optimism, i.e. experts show a relatively higher consensus on the fact that current negative trends will worsen while they disagree on the potential sources of improvement. The main areas of disagreement are related to the nature and direction of trends in the Northern part of the Mediterranean.



³ For a definition of all indicators the reader is referred to Appendix A.

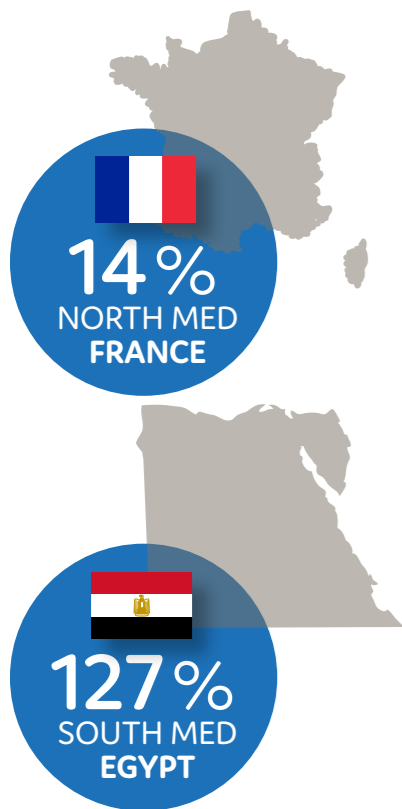


An Increasing Gap between the North and South of the Mediterranean

Experts disagree in their view that the Southern countries will face more severe challenges than the Northern countries in the region. The South is expected to experience an increase in the pressure on renewable water resources; in the annual freshwater withdrawal in agriculture (currently, 72% on average in the South and 58% in the North); in fertilizers and energy use in agriculture (currently on average, the fertilizer [kg/ha of arable land] is 252 in the South and 155 in the North, and the energy use [% of total energy use] is 6.2 in the South and 2.7 in the North); and in the ecological footprint of food consumption (global hectares per capita, 0.85 in the South versus 1.14 in the North). These pressures will be felt both in the short and medium term and, according to a majority of experts, will accelerate over the medium term (until 2030s). More positive trends are expected in the North in terms of increased crop water productivity by 2030 and relatively lower increase in climate change vulnerability. The pressure on renewable water resources, however, is also expected to increase in the North Mediterranean, both in the short and long term.

These trends are expected to impact countries within the region in different ways. Experts expect a greater variation in impact among the Southern Mediterranean countries than among the Northern ones. This heterogeneity of the impact accounts for the experts' disagreement on whether crop water productivity and the percentage of the rural population using improved drinking water sources will increase over the medium term.

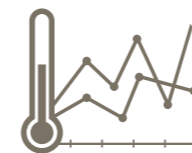
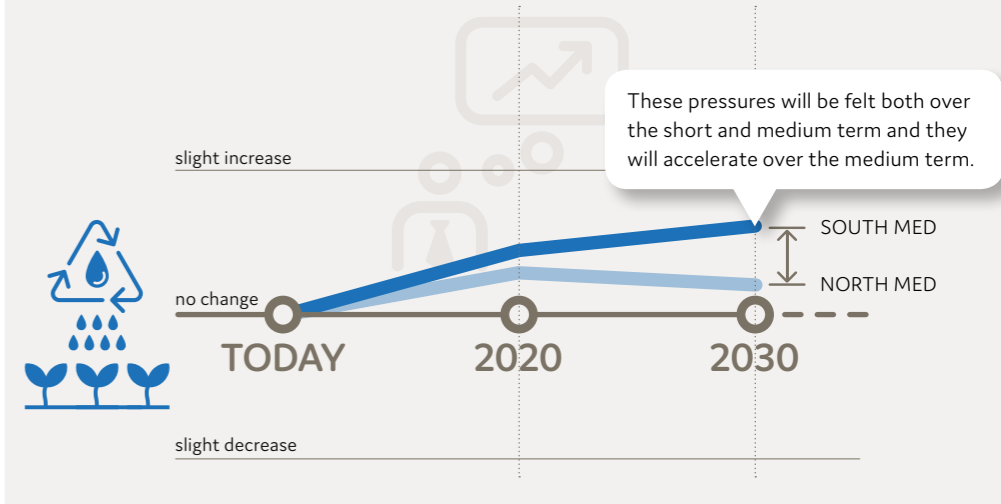
The pressure on renewable water resources ranges from



Glossary

Freshwater withdrawal as % of total renewable water resources (FAO-AQUASTAT): Water withdrawn for irrigation in a given year, expressed in percentage of the total renewable water resources. This parameter is an indication of the pressure on the renewable water resources caused by irrigation.

Expected trends in annual freshwater withdrawals in the North and South Mediterranean



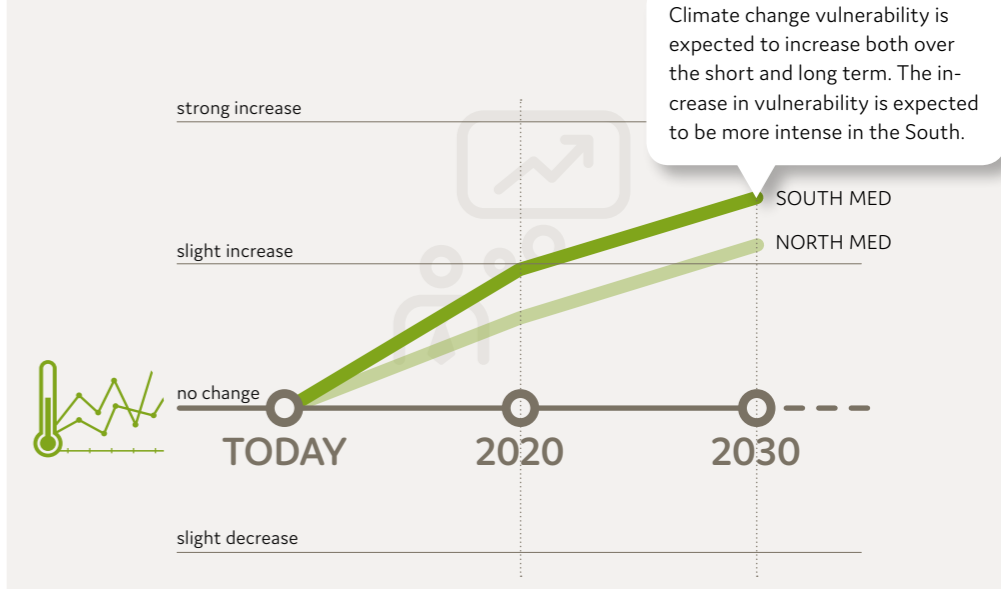
Climate change as the most important source of pessimism in the area

Climate change is by far the main reason for the experts' negative outlook in the expected agri-food trends in the Mediterranean region. Experts converge in their expectation that climate change is the most important source of social and economic vulnerability and its effects are expected to intensify their pressure on both the Northern and the Southern Mediterranean countries. Climate change vulnerability is expected to increase both over the short and long term. The increase in vulnerability is expected to be more intense in the South, especially over the long term: since the first round, 91% of the experts disagreed in their assessment that the climate change vulnerability index will increase over the 2030s and 63% of them agree it will increase significantly.

Glossary

Climate change vulnerability index (The Hague Centre for Strategic Studies): provides an assessment of a country relative to its vulnerability to climate change. It uses indicators for the three main impacts of climate change on social systems: 1) Increase in weather-related disasters; 2) Sea level rise, and 3) Loss of agricultural productivity.

Expected trends in climate change vulnerability in the North and South Mediterranean





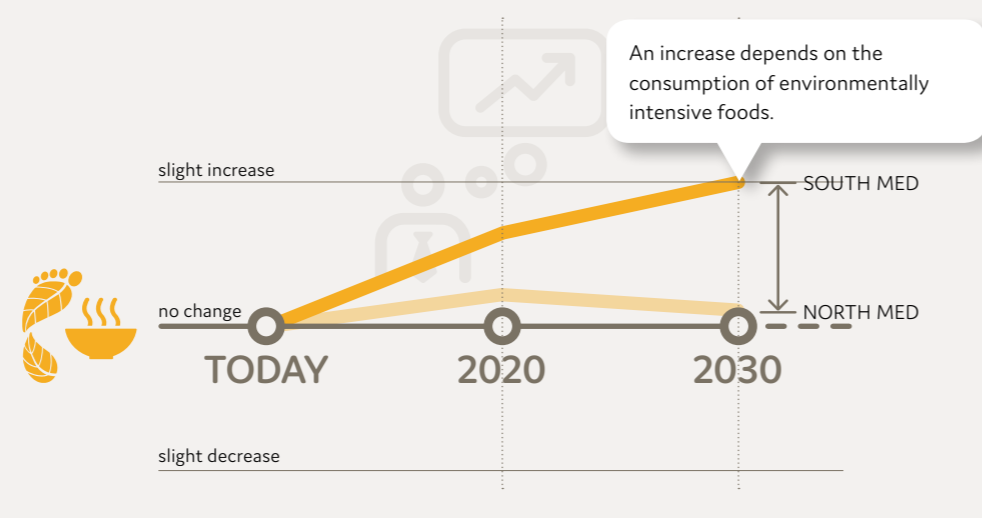
Growing nutritional challenges, especially in the South

Nutritional challenges are expected to intensify overall, with an increase in child and adolescent overweight in the year 2020 in both the North and South Mediterranean. Experts expect that this growing trend will continue in the South unabated through the 2030s, while it will come to a standstill in the North. These nutritional trends are correlated to an expected increase in the ecological footprint of food consumption, which largely depends on the consumption of environmentally intensive foods (such as meat-based products), especially in the South. 83% of our experts agree that it will increase (33% substantially) over the short and medium term. The implications of these processes for the long term social, environmental and economic sustainability of societies in the South is an area of research that deserves further attention.

Glossary

Ecological footprint of food consumption (UN): it is a measure of personal contribution to the human consumption of resources of the Earth. The ecological footprint measures the consumption of resources of a person, a state or mankind. It is measured as global hectares per capita.

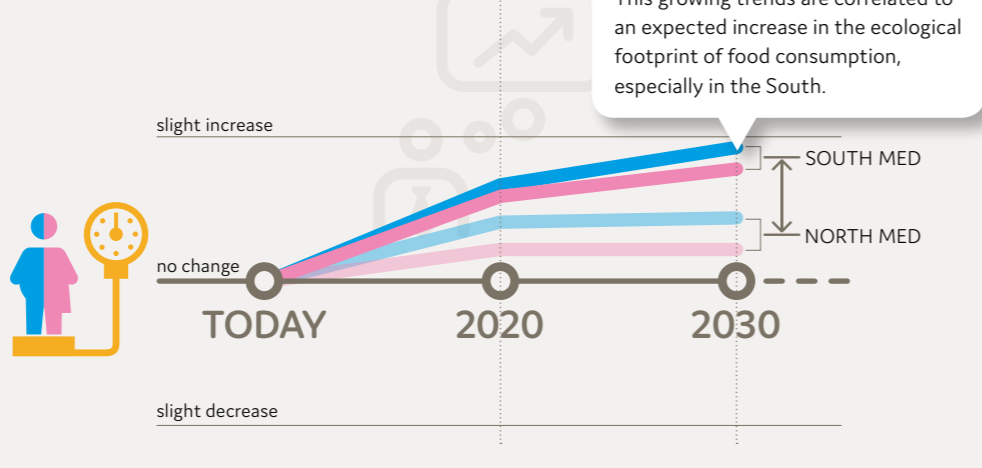
Expected trends in the Ecological Footprint of food consumption in the North and South Mediterranean



Glossary

Female/Male Prevalence of overweight among children and adolescents (WHO): % by gender, young people are asked to give their height (without shoes) and weight (without clothes) and their BMI is calculated from this information. The prevalence of overweight and obesity is calculated as the percentage of adolescents reported to be in the weight categories corresponding to adult BMI values of ≥ 25.0 and ≥ 30.0 kg/m², respectively.

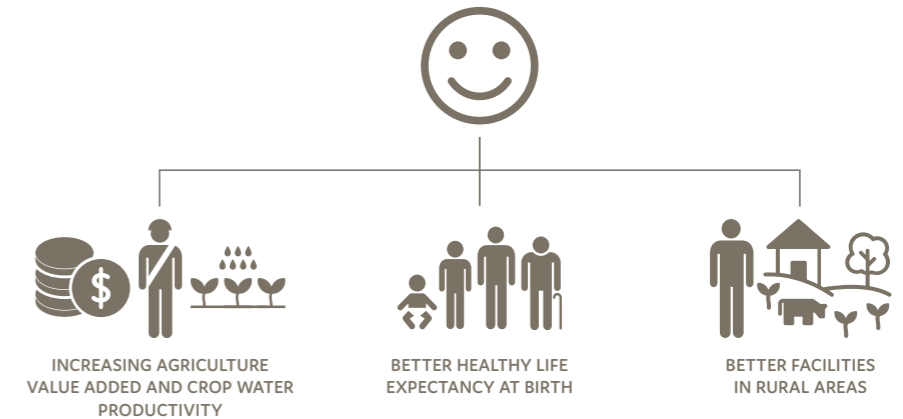
Expected trends in prevalence of overweight among children and adolescents in the North and South Mediterranean



2.2 The optimistic scenario

According to experts, the Mediterranean countries will experience three main positive trends over the short and medium term, namely:

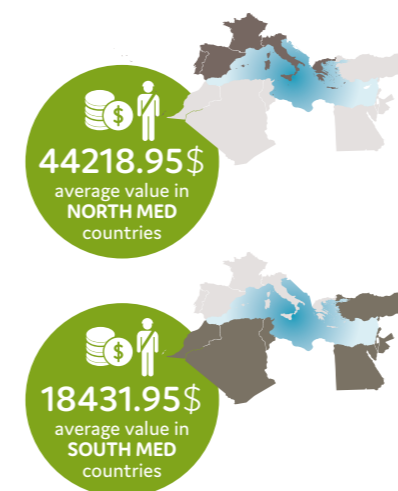
- increase in agriculture value added and crop water productivity;
- improvement in healthy life expectancy in the Southern Mediterranean;
- improvement in the facilities provided to rural areas.



Increasing agriculture value added and crop water productivity

Agriculture value added is expected to increase in the 2020s (in the South) and in the 2030s (in the North and South), currently ranging from \$5,017.63/worker in Morocco to \$88,578.25/worker in France with an average value of \$18,431.95/worker for the Southern Mediterranean countries and \$44,218.95/worker for the Northern Mediterranean countries. Crop water is an efficiency term to convey the amount of marketable products in relation to the amount of input needed to produce that output in regard to water resources. Producing more crop per drop of water is essential for achieving food security in the future while using water resources in a sustainable manner.

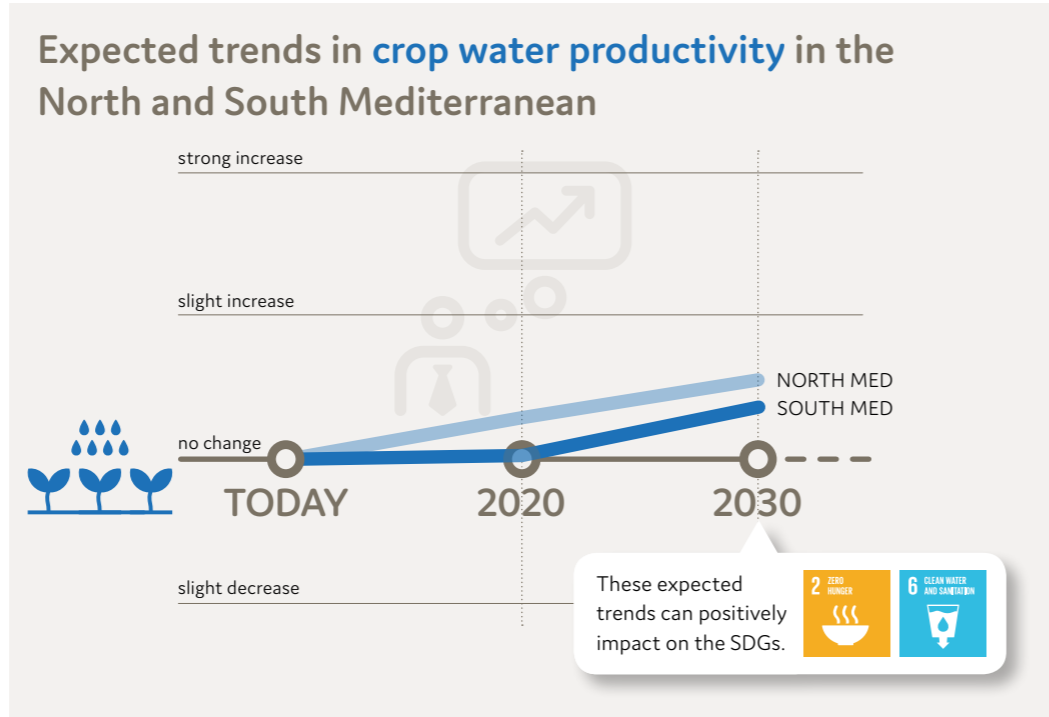
Average agriculture value added in North and South Med



According to this study's experts, crop water productivity will increase in the long term in both the North and the South sub-regions, and the increase is expected to be larger in the North than in the South. Currently, crop water productivity ranges from 0.51 kg/m³ in Jordan to 1.42 kg/m³ in France, with an average of 0.93 kg/m³ at the Mediterranean level. The situation is quite heterogeneous among North and South Mediterranean countries, with Israel and Egypt having a value of 1.01 kg/m³ and 1.22 kg/m³ respectively and Spain that has a value of 0.91 kg/m³. These expected trends can positively impact on the SDG 2 "Zero Hunger" and SDG6 "Clean Water and Sanitation".

Glossary

Crop water productivity (FAO): Crop water productivity expressed in kg/m³ is an efficiency term, expressing the amount of marketable product (e.g. kilograms of grain) in relation to the amount of input needed to produce that output (cubic meters of water). The water used for crop production is referred to as crop evapotranspiration. This is a combination of water lost by evaporation from the soil surface and transpiration by the plant, occurring simultaneously.



Better healthy life expectancy (HALE) at birth

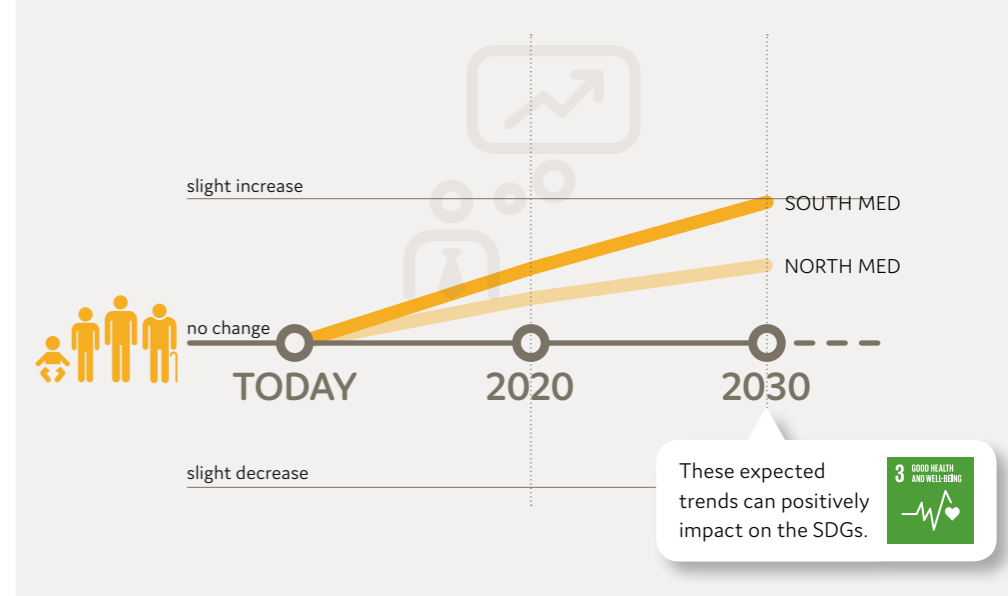
According to the World Health Organisation, healthy life expectancy is a form of health expectancy that applies "disability weights to health states to compute the equivalent number of years of good health that a new born can expect". In the Mediterranean countries, HALE ranges from 59.1 years in Egypt, to around 70 years in France, Israel, Spain and Italy. Since the year 2000, life expectancy has been steadily increasing in both the North and South Mediterranean, but is still lower in the South (62 years on average) than in the North (70 years on average). Overall, poor health can result in a loss of nearly 10 years of healthy life in the South and eight in the North.

According to the Delphi survey results, healthy life expectancy at birth will improve in the Southern Mediterranean, in the short and the long term. These positive trends can favourably impact on SDG3 "Good Health and Wellbeing".

Glossary

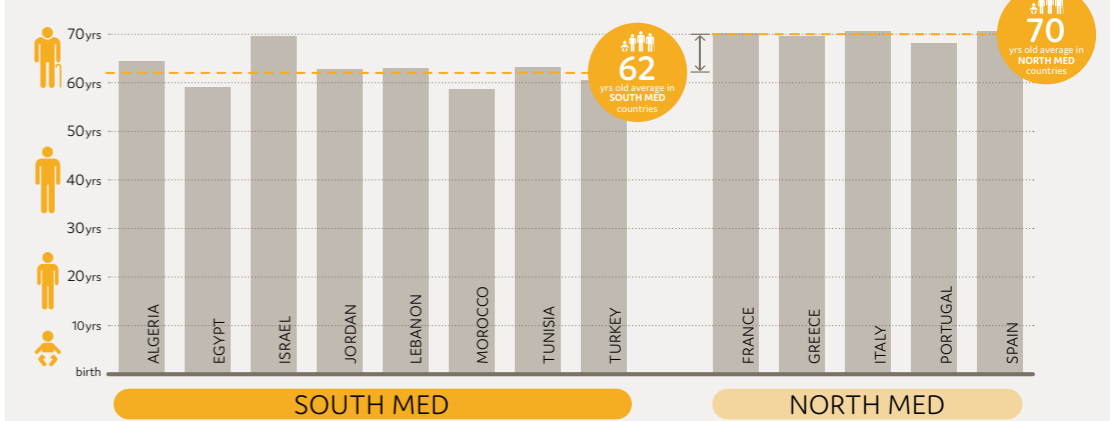
Healthy life expectancy at birth (WHO): number of years, healthy life expectancy (HALE) is a form of health expectancy that applies disability weights to health states to compute the equivalent number of years of good health that a newborn can expect.

Expected trends in healthy life expectancy at birth in the North and South Mediterranean

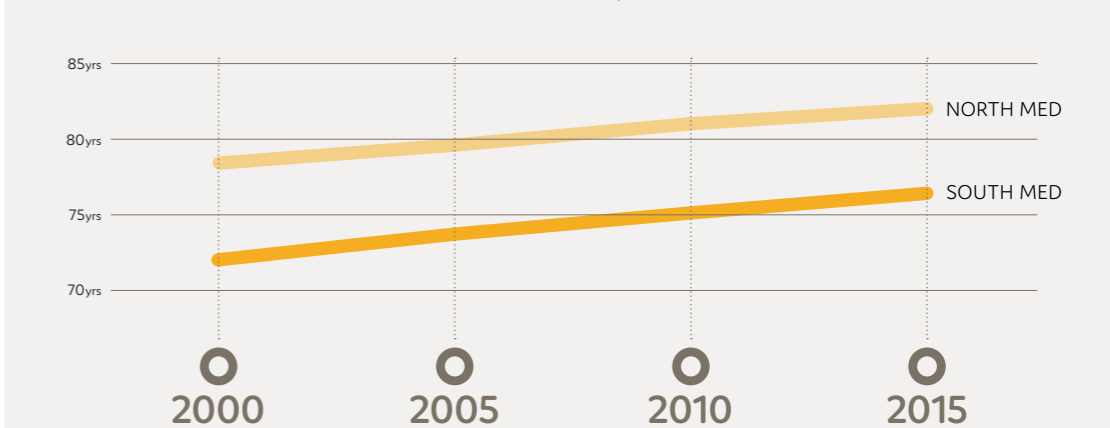


Source/ data based on World Development Indicators 2016*

Healthy life expectancy at birth in the Mediterranean countries (year 2000)



Trends in Healthy life expectancy at birth in the North and South Mediterranean (years 2000/2015)



* United Nations, Department of Economic and Social Affairs, Population Division (2017): World Population Prospects: The 2017 Revision, Volume I: Comprehensive Tables.



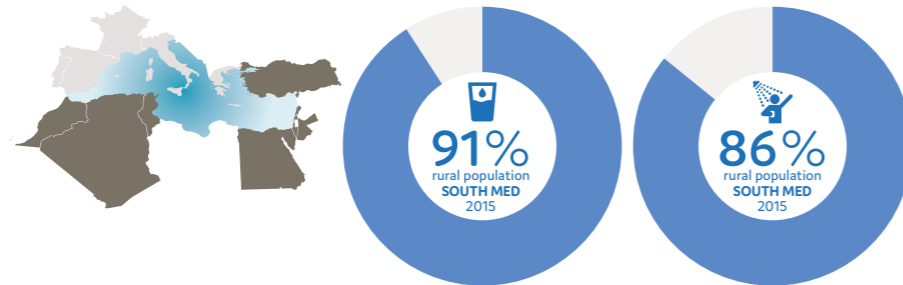
An improvement in the facilities provided in rural areas will be observed in the South. Three main trends are expected to improve in the rural areas over the short and the long term, namely, access to electricity, improved sanitation facilities, and improved drinking water sources. Figure below presents the past trends (years 1990-2015) in the usage of improved drinking water sources and sanitation facilities. In 2015, 91% of the rural population in the South used proper water services, and 86% had access to adequate sanitation facilities. These expected trends can positively impact on the implementation of, among others, the SDG3 "Good Health and Wellbeing"; SDG6 "Clean Water and Sanitation".

Glossary

Population using improved drinking-water sources, rural (World Bank/UNICEF):

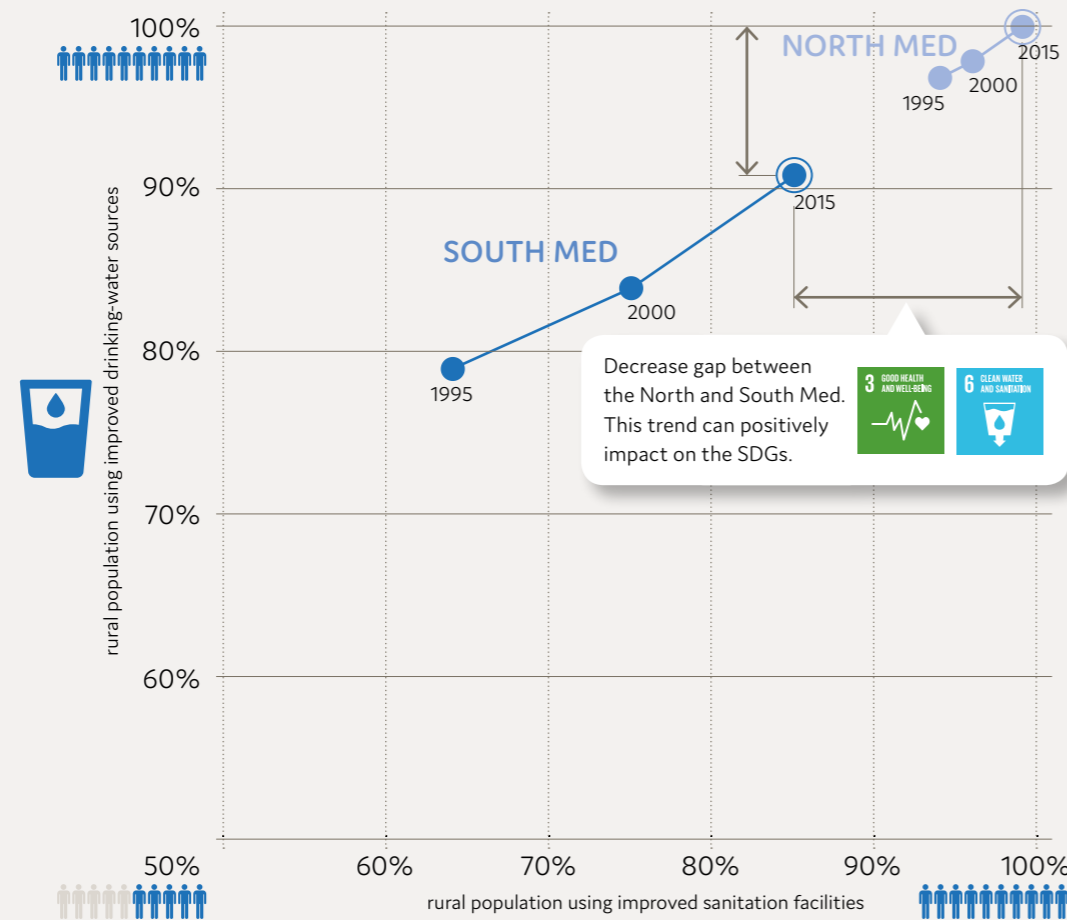
% of rural population with access to drinking-water sources.

Population using improved sanitation facilities, rural (WHO): % of rural population with access to improved sanitation facilities.



Source/ data based on World Development Indicators 2018*

Trends in rural population using improved drinking-water sources (%) and using improved sanitation facilities (%)



* WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply, Sanitation and Hygiene (washdata.org).

The reader is referred to the Appendix B for a detailed overview of the other drivers indicated by the panel of experts.

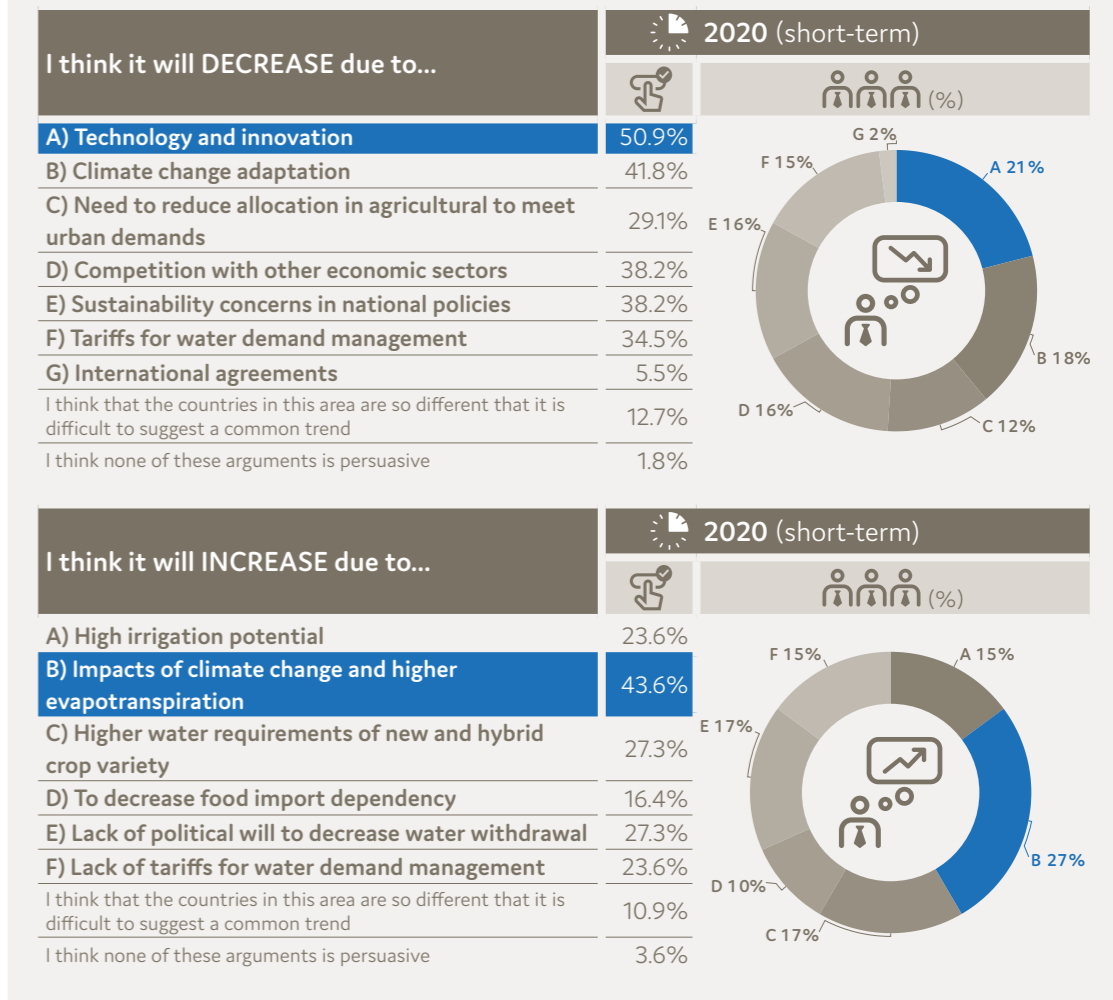
2.3 The sources of divergence

The study highlights some areas on which there is divergence among experts about the relative weight of different drivers in the current increasing and decreasing trends. They include the following:

Annual agricultural freshwater withdrawal for agriculture in the North (2030)

Some experts predict that freshwater will decrease due to technology and innovation (21%) and to climate change adaptation strategies (18%). Others stress that the impact of climate change and higher evapotranspiration conditions (27%) and higher water requirements for new and hybrid crop varieties (17%) are the main drivers of this increase in annual freshwater withdrawal for agricultural purposes.

Annual freshwater withdrawal for agriculture in the North Mediterranean - 2020 (short-term)



3

Policy interventions

Crop water productivity in the South (2020 and 2030)

Experts disagree on the relative weight of the main positive and negative drivers of crop water productivity in the South. Among the drivers expected to decrease crop water productivity, experts mention climate change (34% in 2020, 40% in 2030), as well as conflicts and political crisis (24% both in 2020 and 2030). Technological development and innovation are believed to be the main drivers of the increase in crop water productivity.

Cereal yield in the North (2020) and South (2020 and 2030)

By 2020, the North experts expect a decrease in cereal yield due to climate change impacts (30%), land degradation (21%), and water scarcity (20%). In the South, the drivers include new technology and innovation (21%); whereas a decrease can occur due to climate change impacts (27% and 26%, in 2020 and 2030 respectively), as well as land degradation and water scarcity.

Rural population using improved sanitation facilities in the South (2020)

The principal reasons for a decrease in the trend are drinking water scarcity and climate change; new technology (30%) and infrastructure in remote areas (29%) contribute to the increase in usage.

Ecological footprint of food consumption in the North (2020)

Experts disagree on the trends in the ecological footprint of food consumption. Among the reasons of a decrease, greater efficiency in food production and transformation (21%), increased flexitarian or climate-friendly food habits (19%), and improved waste management (14%) are all possibilities. There was no consensus among the experts in pinpointing the increase of food consumption.

Agricultural land use in the South (2020 and 2030) and in the North (2020)

The reasons for a short-term increase in agricultural land use in the North are urbanisation (30%) and soil degradation (24%). In the South, urbanisation, climate change, rural migration and soil fertility degradation are expected to decrease agricultural land use, both over the short and the long term. Increasing food demand is the principal factor behind the expected increase in agricultural land use in 2020 and 2030.

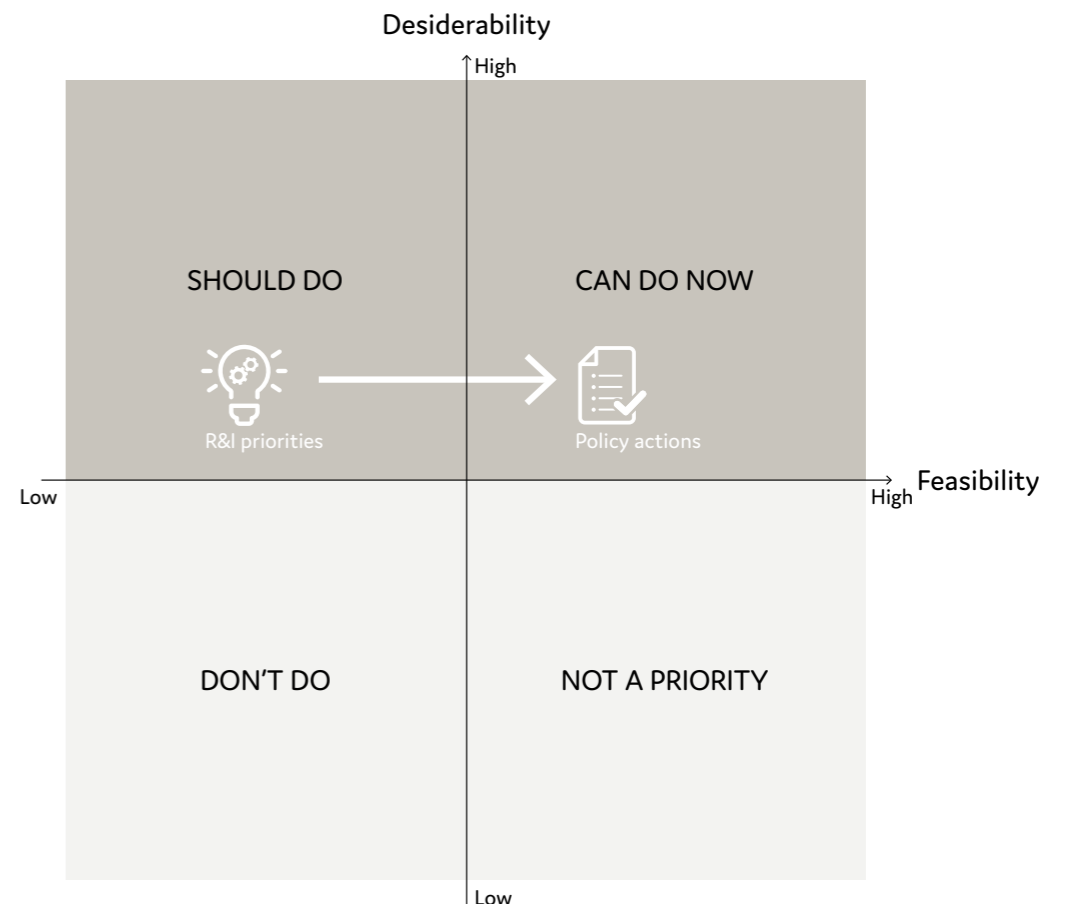
GHG emissions in agriculture in the North (2020) and in the South (2030)

In the North, the drivers of a decrease in GHG emissions in agriculture, include technology and innovation (24%) and more stringent policy measures and regulation (21%); whereas, the lack of effective policy measures and incentives are among the reasons for an increase.

Policy options are assessed on their desirability and feasibility. Based on these two dimensions, policy options are classified into four different groups:







- High desirability and high feasibility (CAN DO NOW options)
- High desirability and low feasibility (SHOULD DO options)
- Low desirability and high feasibility (NOT A PRIORITY options)
- Low desirability and low feasibility (DON'T DO options)

Here we focus on the first two categories of policy issues, as they can inform the agenda of researchers and policy makers, respectively¹. The "SHOULD DO" policy options includes those policy alternatives most in need of research and analyses in order to bridge the desirability-feasibility gap. The "CAN DO NOW" category assembles those actions that can be immediately implemented by decision-makers, being both highly desirable and highly feasible. Both groups of policy options are also those most relevant for an assessment of Research & Innovation (R&I) priorities in the Mediterranean, in order to understand how to improve the feasibility of such measures (the "Should do" policies), as well as how prioritize policy actions (the "Can do now" options) in the Mediterranean region.



¹ Appendix C provides an overview of the different policy options for each of the areas of analysis.

The policy options belonging to the **SHOULD DO category**, that represent areas in need of research and analyses in order to bridge the feasibility gap, can be summarised as follows:

- 
Value chains: increase public spending in R&D to close the technological and managerial gap of food value chains; increase investments in rural development and efficient value chains to mitigate migration waves. Results show that sustainable and innovative food value chains help achieve rural development and migration flow stabilization in the Mediterranean region.⁴
- 
Agriculture, land & water resources: develop dual-purpose crops (high yields and soil fertility); manage water resources with an integrated approach in recognition of the water-food-energy nexus; develop a Mediterranean water policy à la EU Water Framework Directive. Given the negative scenarios expected in terms of water management (i.e. the increase in the pressure on renewable water resources), the policy measures described here should be given high priority in the Mediterranean countries, especially in the South where the impacts of climate change are expected to be higher.
- 
Food safety: adopt a common framework for food safety and risk assessment in the Mediterranean countries; build a common strategy across plant-animal-human health.
- 
Climate change: establish urban food policies and actions to mitigate climate change; develop binding targets for companies aimed at carbon neutrality by the year 2050; establish more stringent reporting requirements for companies. Climate change networks, such as the Cities Climate Leadership Group (C40) comprising of 96 cities in the world (25% of GDP), have the potential to facilitate dialogue amongst city officials aiming at advancing climate action to reduce GHG as well as adapting and improving their resilience to climate hazards.
- 
Nutrition & public health: establish policy and actions at the city level to improve nutritional patterns and public health. Engaging with city officials and policy makers is crucial also for improving nutrition and public health, as the world continues to urbanise very fast. By the year 2050, over 65% of the world's population will live in cities⁵ and urbanisation can be associated with shifting food consumption patterns.
- 
Food loss & waste: establishing compulsory targets at the Mediterranean level; adopt a common standard for accounting and reporting in cities. A number of cities have established ambitious targets for the reduction of food loss and waste, for instance, the City of Milan has committed to halve food waste by the year 2030 and is a member of the EU Platform for Food Losses and Waste. Created in 2016 by the European Commission (DG SANTE), it brings together the 27 Member States and the 37 European organisations active against food waste⁶.

4 Antonelli, M., Cupertino, S., Riccaboni A., (2018): "Promoting sustainable and innovative food value chains to achieve rural development and migration flow stabilization in the Mediterranean region", in AL-Salmi (ed.) Corporate Social Responsibility: Best practices in Oman and the World, Independent Thought.

5 UCCRN (2018): "The Future We Don't Want - How Climate Change Could Impact the World's Greatest Cities", UCCRN Technical Report



6 Barilla Center for Food & Nutrition Foundation and Milan Urban Food Policy Pact (2018): Food & Cities. The Role of Cities for Achieving the Sustainable Development Goals.

Mayors Eric Garcetti, Anne Hidalgo, Michael Bloomberg, Ada Colau and Giuseppe Sala pose together during a two-day summit of the C40 Cities initiative for Climate Change in Paris 2017
REUTERS, Charles Platiau



- 
International cooperation, agreements & targets: prioritise policy coherence across sectors (e.g. nutrition, agriculture, rural development, health); monitor agri-food systems against the targets of the SDGs; strengthen cooperation between Northern (European) and Southern Mediterranean countries to boost resilience of agri-food value chains; establish an Intergovernmental Panel on Food Safety, Nutrition and Food Security. All these efforts are pivotal for advancing the 2030 Agenda for Sustainable Development and the 17 SDGs.

The policy options belonging to the **CAN DO NOW category**, representing actions immediately actionable by decision-makers, are mainly:

- 
Value chains: strengthen collaboration with research to close the technological and managerial gap.
- 
Agriculture, land & water resources: increase organic farming; provide incentives to farmers to shift to conservation agriculture; provide youth employment opportunities and training to boost innovation; invest in Information and Communication Technologies (ICTs) and provide incentives for the modernization of agricultural holdings; strengthen the role of women in agriculture; prioritise integrated water resources and demand management in all Mediterranean countries; improve water distribution networks at the local level; adopt a common standard for water resources assessment; meet agricultural demands through unconventional water sources.
- 
Food safety: foster education and training for farmers and households to improve food safety; improve coordination of standards across the Mediterranean; ban routine use of antibiotics in healthy animals (as recommended by the WHO).
- 
Nutrition & public health: provide routine health education at school to address the widespread diet-related problems affecting the Mediterranean countries.
- 
Food loss & waste: ban food waste at the retailer level and promote food donations; make compulsory organic waste recycling for food business; adopt a common standard for business accounting and reporting.

Of all policy options discussed, only one policy has been judged as fully undesirable by an overwhelming majority of experts: the increase in the use of biotechnology and GMOs in Mediterranean countries (average score 3,92 on a 0 to 10 scale, with 80% of the experts assigning a score in the bottom end range 1-4).

There are also a few policy options that are comparatively less desirable than others, namely:

- the use irrigation water charging in Mediterranean countries as a tool for demand management (76% of the respondents assigned a score within 1 and 6) or as a tool for cost recovery (87% of the respondents assigned a score within 1 and 6) respectively;
- the inclusion of agriculture in carbon markets (65% of the respondents assigned a score within 1 and 6);
- the control of crop pests and disease through genetic improvement technologies (71% of the respondents assigned a score within 1 and 6);
- to further restrict the importation and movement of plants and plant-based products to control plant pests and disease (63% of the respondents assigned a score within 1 and 6);
- to address food safety concerns by creating a Mediterranean Food and Drug Authority (81% of the respondents assigned a score within 1 and 6).

Greta Thunberg, Swedish student and activist speaks at the 2019 World Economic Forum (WEF) annual meeting in Davos
REUTERS/Arnd Wiegmann



SHOULD DO Research & Innovation priorities

CAN DO NOW Policy actions

Value Chains

- ✓ Increase public spending in R&D to close technological and managerial gap
- ✓ Invest in rural development and efficient value chains to mitigate migration waves



- ✓ Strengthen collaboration with research to close the technological and managerial gap

Agriculture, land & water resources

- ✓ Develop dual-purpose crops (high yields and soil fertility)
- ✓ Manage water resources with an integrated approach in recognition of the water-food-energy nexus
- ✓ Develop a Mediterranean water policy à la EU Water Framework Directive



- ✓ Increase organic farming
- ✓ Provide incentives to farmers for shifting to conservation agriculture
- ✓ Provide youth employment opportunities and training to boost innovation
- ✓ Invest in ICTs and incentives for the modernization of agricultural holdings
- ✓ Strengthen the role of women in agriculture
- ✓ Prioritise integrated water resources and demand management
- ✓ Improve water distribution networks at the local level
- ✓ Adopt a common standard for water resources assessment
- ✓ Meet agricultural demands through use of non-conventional water sources

Food safety

- ✓ Establishing compulsory targets at the Mediterranean level
- ✓ Adopt a common standard for accounting and reporting in cities



- ✓ Ban food waste at the retailer level and promote food donations
- ✓ Make compulsory organic waste recycling for food business
- ✓ Adopt a common standard for business accounting and reporting

Nutrition & public health

- ✓ Adopt a common framework for food safety and risk assessments
- ✓ Build a common strategy across plant-animal-human health



- ✓ Foster education and training at farmer and household level to improve food safety
- ✓ Improve coordination of standards across the Mediterranean standards
- ✓ Ban routine use of antibiotics in healthy animals

Climate change

- ✓ Establish urban food policies and actions to mitigate climate change
- ✓ Develop binding targets for companies aimed at carbon neutrality year 2050
- ✓ Increase investments in rural development
- ✓ Establish more stringent reporting requirements for companies



Food loss & waste

- ✓ Establish policy at city level to improve nutrition patterns and public health



- ✓ Provide routine health education at school

International cooperation, agreements & targets

- ✓ Prioritise policy coherence across sectors
- ✓ Monitor agri-food systems against the targets of the SDGs
- ✓ Strengthen cooperation between North and South Mediterranean to boost resilience agri-food value chains
- ✓ Establish Intergovernmental Panel on Food Safety, Nutrition and Food Security



Discussion and Conclusions

The AGRIFOODMED Delphi explored trends, challenges and policy options in the agri-food sector in the Mediterranean region over the short (2020) and the long term (2030).

As to trends and challenges, three are the main findings from the Delphi analysis.

First, **the gap between the countries in the South and the North of the Mediterranean in terms of the challenges posed in water management, farming systems and the agri-food value chain will grow.** More specifically, experts converge on the fact that the South will experience, both over the short and long term, an increase in the pressure on renewable water resources, in fertilizers and energy use in agriculture, as well as in the ecological footprint of food consumption. The pressure on renewable water resources is expected to increase also in the North Mediterranean, both in the short and long term.

Secondly, **climate change will play a key role in the future of both sides of the Mediterranean, with a differential impact in the sub-two regions.** Climate change vulnerability is expected to increase both over the short and long term and particularly in the South over the medium term. In the Mediterranean, climate change exacerbates environmental pressures exerted by land-use change (urbanisation, agricultural intensification), pollution and declining biodiversity, therefore acting as a threat multiplier. The various changes in the Mediterranean area are likely to dramatically impact the livelihoods of people in the entire basin, not only in terms of environmental security but also socioeconomically, due to famines, migrations and conflicts⁷.

Lastly, **nutrition-related challenges will exert a growing pressure in both Southern and Northern Mediterranean countries by 2020, and over the long term in the South Mediterranean.** The Mediterranean diet has been recognised as a healthy and environmentally friendly model⁸, but the abandonment of the diet - one based on the consumption of high amounts of olive oil and olives, fruits, vegetables, cereals (mostly unrefined), legumes, and nuts, moderate amounts of fish and dairy products, and low quantities of meat and meat products - in favour of a diet richer in meats, starches, refined carbohydrates, sugars, and other processed and refined foods instead, has profound implications for the health prospects of the Mediterranean populations. It has been reported that adherence to the Mediterranean diet model is decreasing for multifactorial influences including life styles changes, food globalization, as well as socio-cultural factors, which need to be analysed in a multidisciplinary way⁹.

Interestingly, **experts converge on the sources of pessimism while they diverge on the sources of optimism.** Disagreement, for instance, is reported in the stabilisation of the ecological footprint of food consumption in the Northern part of the Mediterranean. Much less disagreement is instead found among experts on what trends will characterize the Southern part of the area. They converge in agreeing that the situation will become more challenging and difficult in the South of the Mediterranean, but they diverge on whether the sources of improvement in the South will materialize over the short and medium term. As an example, experts are divided in assessing whether crop water productivity in the South will increase over the short term (50% of them think there will be no change) while the situation will slightly improve over the medium term.

As to the spectrum of available **policy options**, the study focuses on two sets of policy options, those that are the most relevant for an assessment of the PRIMA Research & Innovation (R&I) priorities: those policy options that the group of experts consider highly desirable but not highly feasible (the "Should do" policies) and the ones that are assessed as highly desirable and highly feasible (the "Can do now" options). Looking at the most desirable and feasible policy options, five are the top priorities, according to the experts consulted for this study. First, improving public health by providing routine health education at school. This is key to tackle the growing overweight and obesity rates that are widespread in the region. Secondly, stopping routine use of antibiotics in healthy animals to promote growth and prevent infectious diseases, as prescribed by the WHO. Thirdly, creating employment opportunities for rural youth in Mediterranean countries. Fourth, involving farmers in the use of new technology to improve the efficiency agricultural practices. Fifth, addressing technological and managerial innovation gap through increased collaboration with the research community. For this purpose, also cooperation, multi-stakeholder initiatives, platforms, as well as city-to-city networks for sharing lessons learned and best practices have an important role to play. All of these actions are needed to spur sustainable development in the Mediterranean region and realise the 2030 Agenda for Sustainable Development.

7 Cramer W., Guiot J., Fader M., Garrabou J., Gattuso JP, Iglesias A., Lange M.A., Lionello P, Llasat M.C., Paz S., Peñuelas J., Snoussi M., Toreti A., Tsimplis M.N., Xoplaki E., (2018): "Climate change and interconnected risks to sustainable development in the Mediterranean." *Nature Climate Change*.

8 Serra-Majem L., Ortiz-Andreucchi A. (2018): "The Mediterranean diet as an example of food and nutrition sustainability: a multidisciplinary approach", *Nutrición Hospitalaria* 35(4)

9 Dernini S., Berry E.M. (2015): "Mediterranean Diet: From a Healthy Diet to a Sustainable Dietary Pattern", *Frontiers in Nutrition*, 2(15).

A stylized graphic in the bottom right corner of the page. It features a plant with several leaves and a central stem, positioned in front of a large, light-colored semi-circle that resembles a sun or moon. The plant and sun are rendered in a light gray color against a white background.

Appendices

Methodological Appendix

The Delphi method: an iterative expert survey to produce informed knowledge

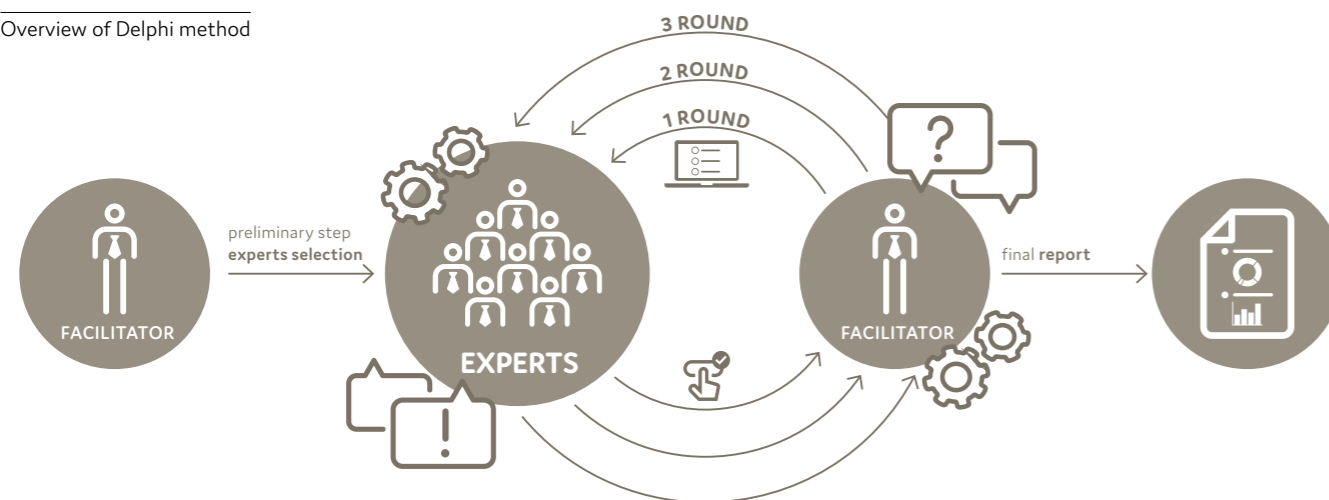
The Delphi is a method to conduct a detailed examination and discussion on relevant topics by assessing whether experts in a certain field converge or polarize on a number of issues. The Delphi relies on group communication as instrument to build informed knowledge on a specific domain.

Although based on structured interviews, **the Delphi is not an opinion survey**. First, the group of respondents is explicitly **non-representative**. Accordingly, in the AGRIFOODMED Delphi, we drew our group of respondents from a small and highly distinguished panel of experts, coming from different countries and selected for their expertise in the field of agri-food. Second, the Delphi follows an **iterative approach**, in which experts are asked to respond to **at least** two survey questionnaires, called "rounds", over a period of time. In the second and later rounds, for those items in which the panel did not reach a convergence in the previous round, respondents are provided with the summary results of the group's answers and they are then required to revise or confirm their previous answers in the light of the group's evaluation. In this way, experts have the opportunity to learn from their colleagues and share their views – although indirectly and in a moderated way. Participants' anonymity is preserved, in order to guarantee a balanced exchange of opinions, without any undue influence from prevailing or charismatic personalities.

In the AGRIFOODMED Delphi, we invited our panel of respondents to three rounds of questionnaires over eight months. The first round was designed to explore the main issues related to our topic. In the second round, we presented respondents with the panel's answers, expressed both in terms of averages and standard deviations, for those items in which a consensus had not been reached in the first round. Experts were then given the opportunity to revise or confirm their views, in light of the answers provided by their colleagues. Finally, in the third round, experts were required to revise or confirm their evaluations on issues on which there was still disagreement, based on the feedback of previous round and they were invited to select those arguments in support of either position that they considered as more convincing.

In all three rounds, experts were strongly encouraged to include any relevant comment, to provide the rationale of their answers, and better contextualise the issues addressed in the survey.

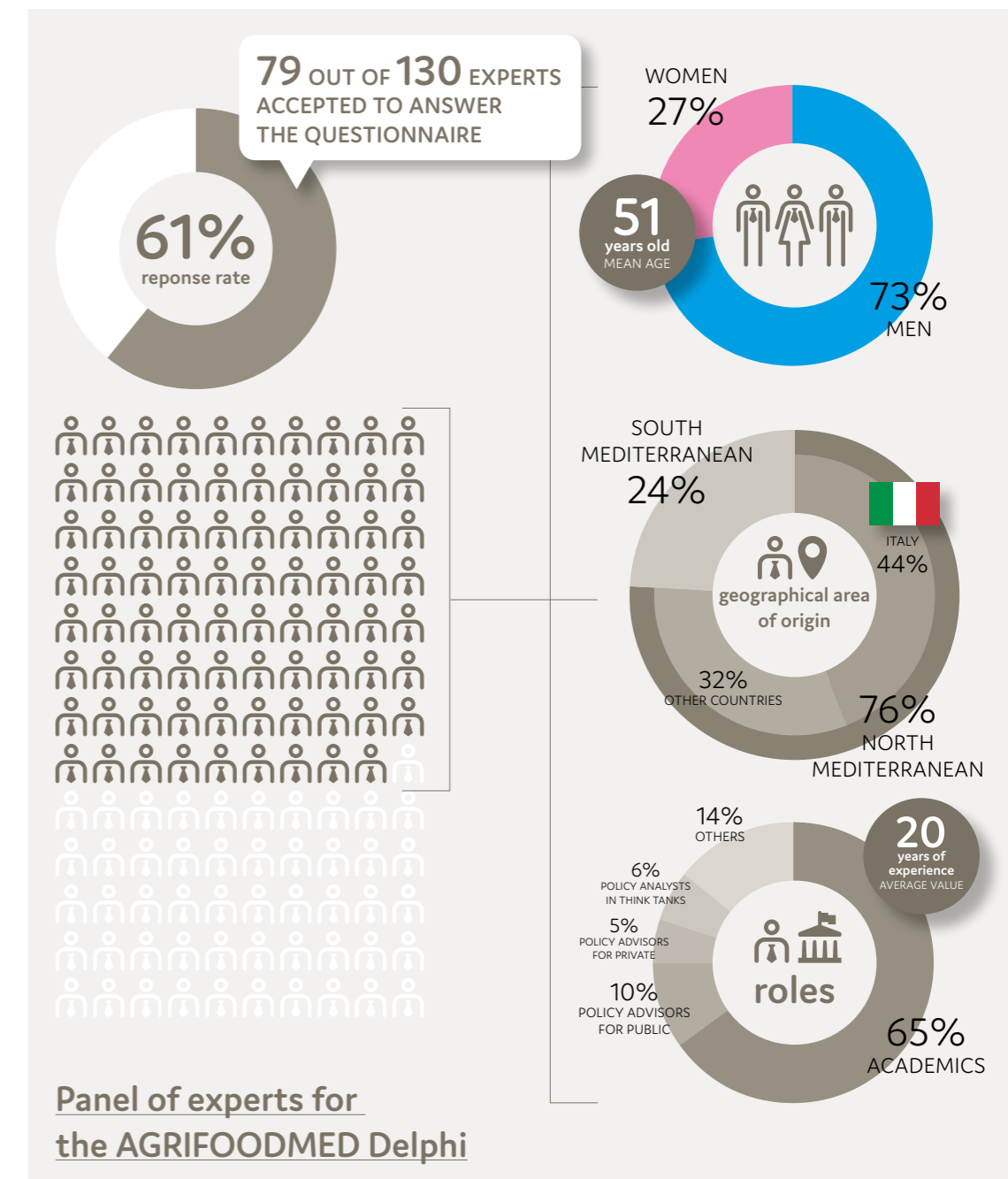
Overview of Delphi method



The AGRIFOODMED Delphi: the activity

The AGRIFOODMED Delphi was implemented from September 2017 to October 2018. In the preliminary step (September-December 2017), experts were selected, based on a list created according to the following ranking criteria:

- scope of their expertise (national/comparative or focus on the Mediterranean area/ single country – preference was given to experts covering the broader issue area);
- seniority (preference was given to senior experts, where 'senior' is defined as experience exceeding 10 years and experience that begins with their first post-graduate or post-doctoral job);
- qualitative assessment of publications and institution of affiliation. Experts were further classified according to their role, which could be: academic, think tank, policy maker, practitioner, businessmen and/or women. Experts' lists tried to ensure adequate representativeness to each of these roles.

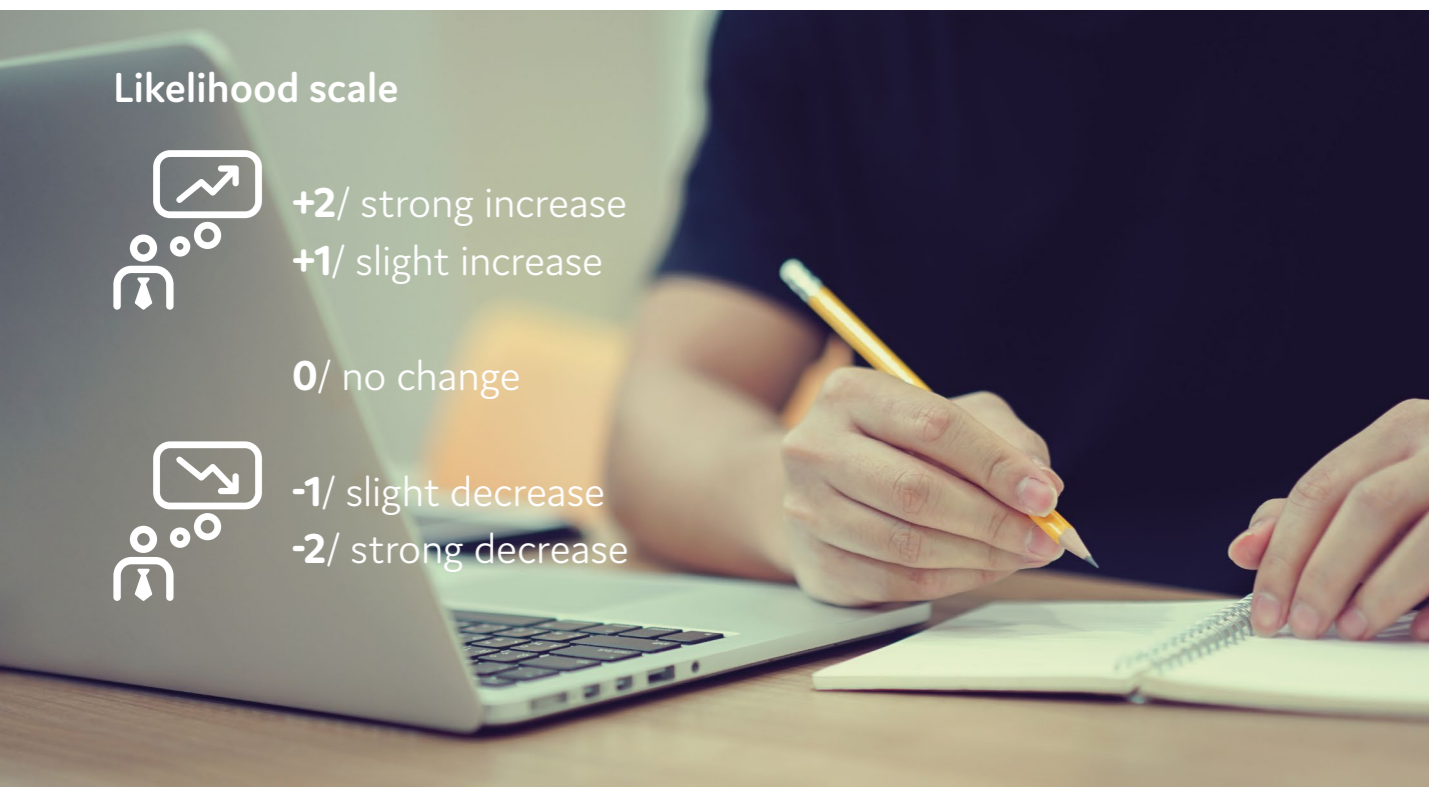


Out of the 130 shortlisted experts invited to join the AGRIFOODMED exercise, 79 agreed to answer the questionnaire (response rate: 61%). All Rounds were administered in Computer Assisted Web Interview (CAWI) mode, with each expert receiving a unique, personal link to the survey.

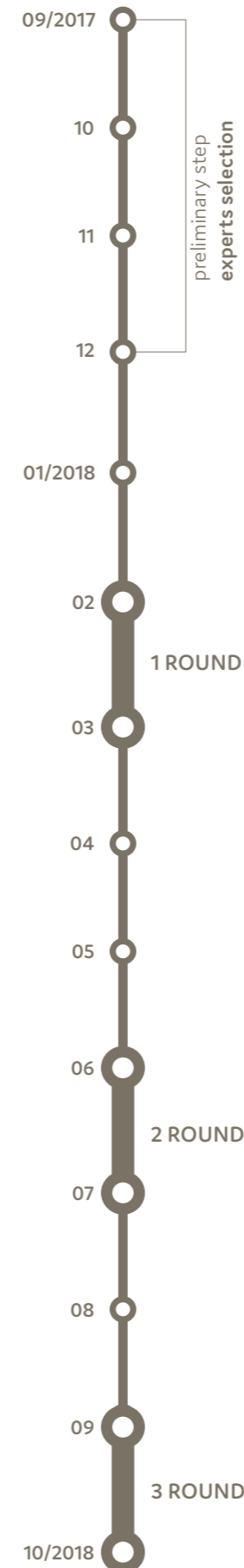
Overall, 76% of respondents come from North Mediterranean countries - besides Italy (44%), in decreasing order of numbers of experts, Spain, France, Germany, Greece, the Netherlands, Norway, Portugal, Croatia, Sweden, and the UK. The remaining 24% of Southern panellists come from Morocco, Lebanon, Egypt, Iran, Israel, Jordan, Tunisia, and Turkey. 46% of the respondents have an expertise only on the North Med area, 16% only on the South Med area and 38% in both the North and South Med areas.

The panel featured a higher presence of men (73%) over women (27%). The mean age of respondents was 51 years old, ranging from 28 to 77 years old. The panel was mainly composed by academics (65% respondents), followed by policy advisors for public (10%) or private (5%) institutions, policy analysts in think tanks (6%), while the remaining 14% defines her/himself as consultant, project coordinator, or expert. It also featured an overall remarkable seniority of expertise in the field, with 20 years of experience in the field on average (SD 11.42), ranging from 3 to 42 years of reported experience. Among the respondents, the majority (56%) had previously heard about Delphi. Nearly 20% of them had already taken part in a Delphi exercise before the AGRIFOODMED and 11% had been an active researcher in one of them.

ROUND 1 was conducted between February and March 2018 and explored the main trends and policy solutions. The questionnaire was organized in three thematic areas: Water Management, Farming System and Agri-food Value Chain. For each thematic area, experts were first asked to assess the likelihood and direction of change for a number of trends affecting the South and North Mediterranean, both in the near (2020) and long-term (2030) future, on a scale from -2 (decrease) to +2 (increase), through 0 (no change). They were then asked to rate, on a 1 to 10 scale, the desirability and feasibility of a number of policy solutions to address the main challenges in each of the three thematic areas. Finally, experts were invited to express their agreement or disagreement with a number of general issues in agri-food system. The questionnaire concluded with some final questions to explore respondents' previous experience in Delphi exercise, to collect comments on the first rounds, as well as with socio-demographic questions.



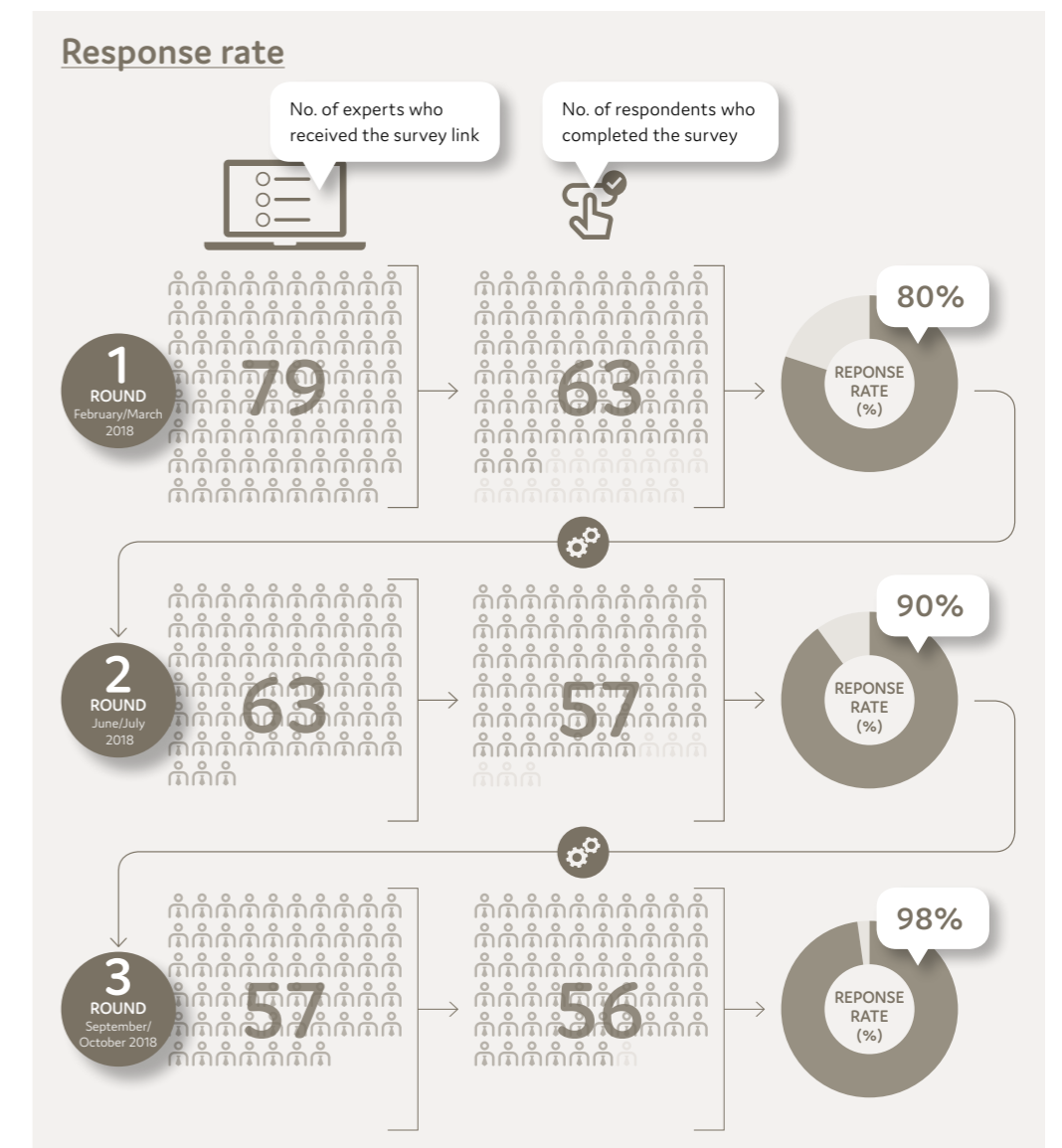
Timeline of AGRIFOODMED Delphi



ROUND 2 was conducted between June and July 2018, those items where experts did not achieve a consensus were selected as well as additional issues that experts in the previous round had determined as relevant to address. Experts were relayed the information on the group's responses of the first round for those items where the panel did not reach consensus, expressed with average values and standard deviations. Then, they were presented with the responses they provided in the first round and asked to either revise or confirm them. In the section on trends, a question was asked to evaluate whether experts' estimates have been affected by the heterogeneity of the countries included in the South and North Mediterranean.

Finally, **ROUND 3** (September-October 2018) explored what arguments underlay experts' estimates for those items where disagreement persisted after two rounds. Accordingly, for each thematic area respondents were asked to select those arguments that better reflected their own position concerning both the likelihood of change of trends and the feasibility of certain policy issues. The arguments presented in the questionnaire were based upon the comments provided by panellists in previous rounds, as well as on the assessment of the scientific board of advisors. Then, respondents, were presented with the average of the responses given by the group in the second round and asked, once again, to either revise or confirm their assessment.

The response rate was exceptionally high for all three rounds and they are presented in table below.



Appendix A: Glossary



Water management



Crop water productivity (FAO)

Crop water productivity expressed in kg/m^3 is an efficiency term, expressing the amount of marketable product (e.g. kilograms of grain) in relation to the amount of input needed to produce that output (cubic meters of water). The water used for crop production is referred to as crop evapotranspiration. This is a combination of water lost by evaporation from the soil surface and transpiration by the plant, occurring simultaneously.



Population using improved drinking-water sources, rural (World Bank/UNICEF)

% of rural population with access to drinking-water sources.



Population using improved sanitation facilities, rural (WHO)

% of rural population with access to improved sanitation facilities.



Annual freshwater withdrawal for agriculture (FAO-AQUASTAT)

% of total freshwater withdrawal used for agricultural purposes. Water withdrawal refers to water that has been removed from its source for agricultural purposes. Percentage of the annual quantity of self-supplied water withdrawn for irrigation, livestock and aquaculture purposes. It can include water from primary renewable and secondary freshwater resources, as well as water from over-abstraction of renewable groundwater or withdrawal from fossil groundwater, direct use of agricultural drainage water, direct use of (treated) wastewater, and desalinated water.

Freshwater withdrawal as % of total renewable water resources (FAO-AQUASTAT)

Water withdrawn for irrigation in a given year, expressed in percentage of the total renewable water resources. This parameter is an indication of the pressure on the renewable water resources caused by irrigation.



Farming system



Percentage of agricultural land (World Bank)

Agricultural land refers to the share of land area that is arable, under permanent crops, and under permanent pastures. Arable land includes land defined by the FAO as land under temporary crops (double-cropped areas are counted once), temporary meadows for mowing or for pasture, land under market or kitchen gardens, and land temporarily fallow. Land abandoned as a result of shifting cultivation is excluded. Land under permanent crops is land cultivated with crops that occupy the land for long periods and need not be replanted after each harvest, such as cocoa, coffee, and rubber. This category includes land under flowering shrubs, fruit trees, nut trees, and vines, but excludes land under trees grown for wood or timber. Permanent pasture is land used for five or more years for forage, including natural and cultivated crops.



Climate change vulnerability index (The Hague Centre for Strategic Studies)

Provides an assessment of a country relative to its vulnerability to climate change. It uses indicators for the three main impacts of climate change on social systems: 1) Increase in weather-related disasters; 2) Sea level rise, and 3) Loss of agricultural productivity.

Energy in agriculture (FAO)

Agriculture and forestry energy used as a % of total energy use, measured as Agr. Energy use/Total Energy Use.



Agriculture value added (World Bank)

Measured as \$ per worker, value added per worker is a measure of labor productivity-value added per unit of input. Value added denotes the net output of a sector after adding up all outputs and subtracting intermediate inputs.



Cereal yield (World Bank)

Measure of the yield of cereal per unit area of land cultivation (kg/ha).

Fertilizer consumption (FAO, World Bank)

measured as kg/ha of arable land.



GHG emissions in agriculture (UNFCCC)

Greenhouse gas emissions from agriculture measured as tCO_2eq .



Agri-food value chain



Ecological footprint of food consumption (UN)

It is a measure of personal contribution to the human consumption of resources of the Earth. The ecological footprint measures the consumption of resources of a person, a state or mankind. It is measured as global hectares per capita.



Healthy life expectancy at birth (WHO)

Number of years, healthy life expectancy (HALE) is a form of health expectancy that applies disability weights to health states to compute the equivalent number of years of good health that a newborn can expect.

Prevalence of wasting, under-5s (UNICEF)

Prevalence of wasting, weight for height (% of children under 5), wasting refers to a child who is too thin for his or her height. Wasting is the result of recent rapid weight loss or the failure to gain weight. A child who is moderately or severely wasted has an increased risk of death, but treatment is possible.

Access to electricity, rural (World Bank)

Measured as % of rural population.

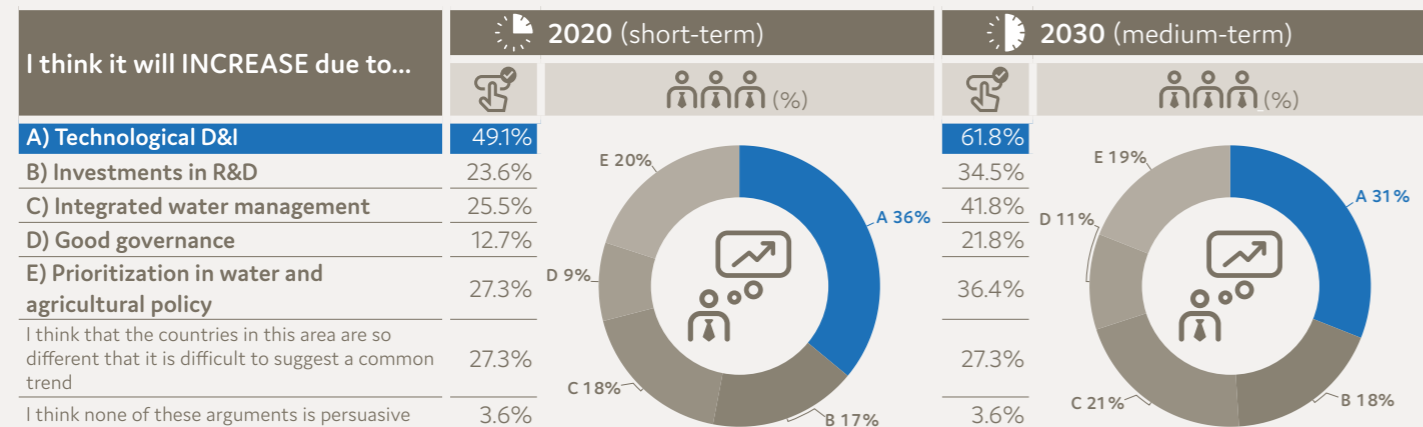
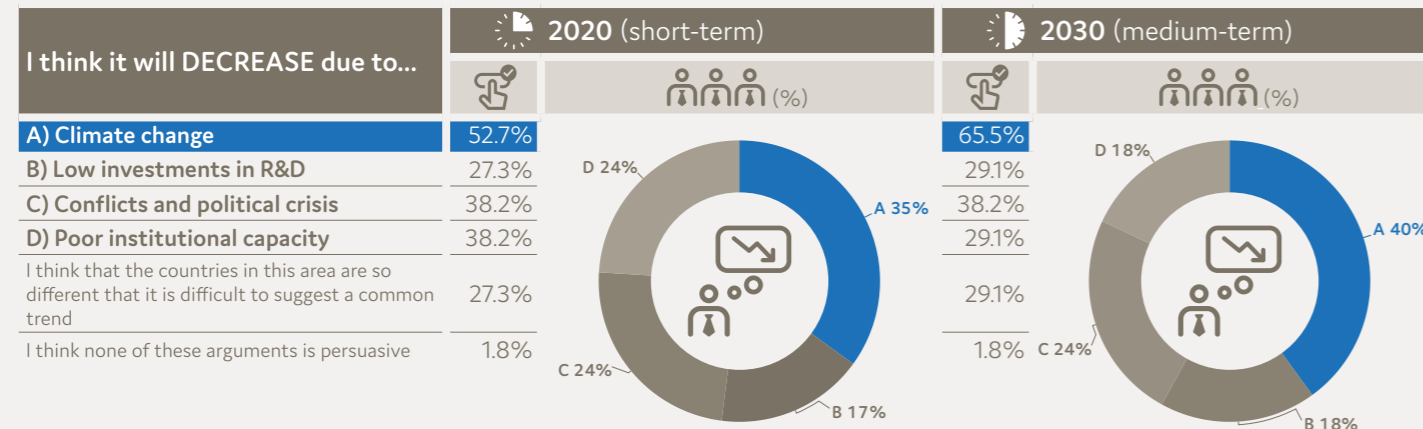


Female/Male Prevalence of overweight among children and adolescents (WHO)

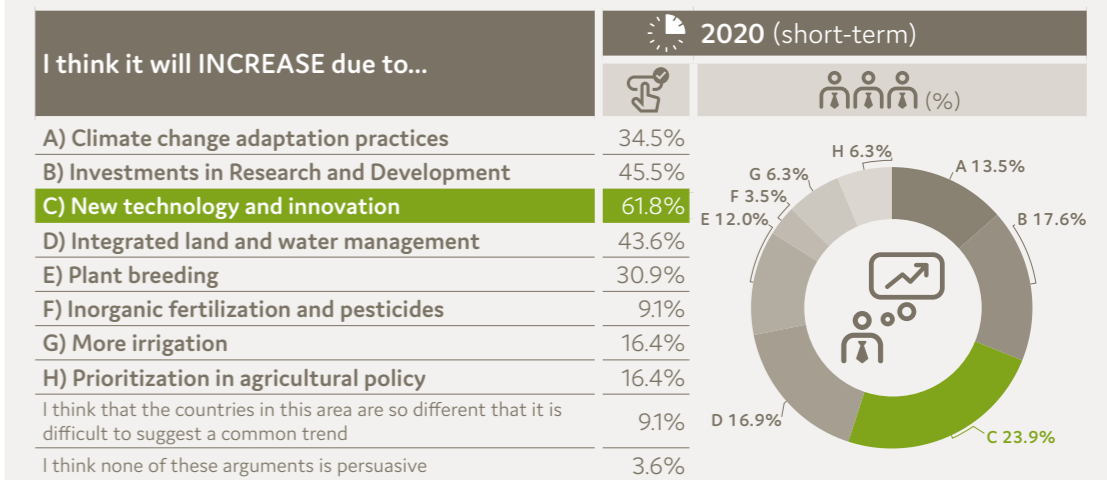
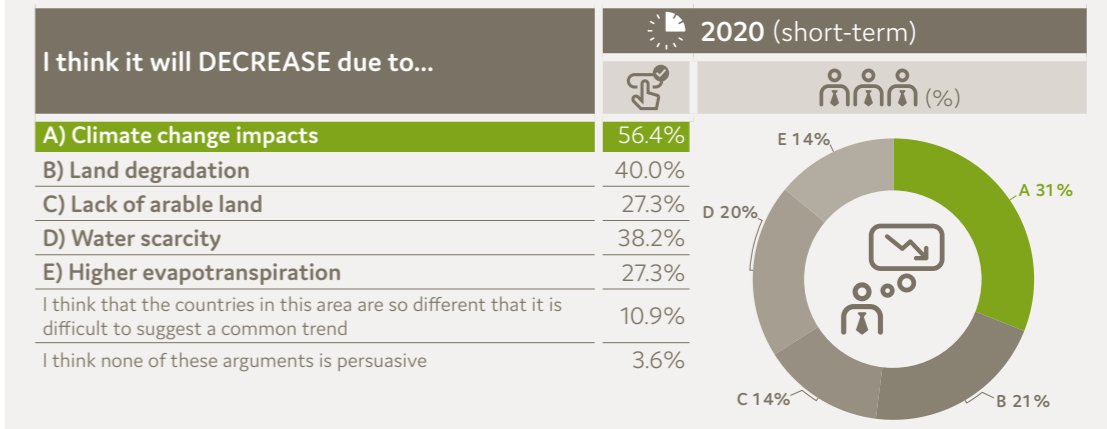
% by gender, young people are asked to give their height (without shoes) and weight (without clothes) and their BMI is calculated from this information. The prevalence of overweight and obesity is calculated as the percentage of adolescents reported to be in the weight categories corresponding to adult BMI values of ≥ 25.0 and $\geq 30.0 \text{ kg}/\text{m}^2$, respectively.

Appendix B: Overview of the drivers in decreasing/increasing

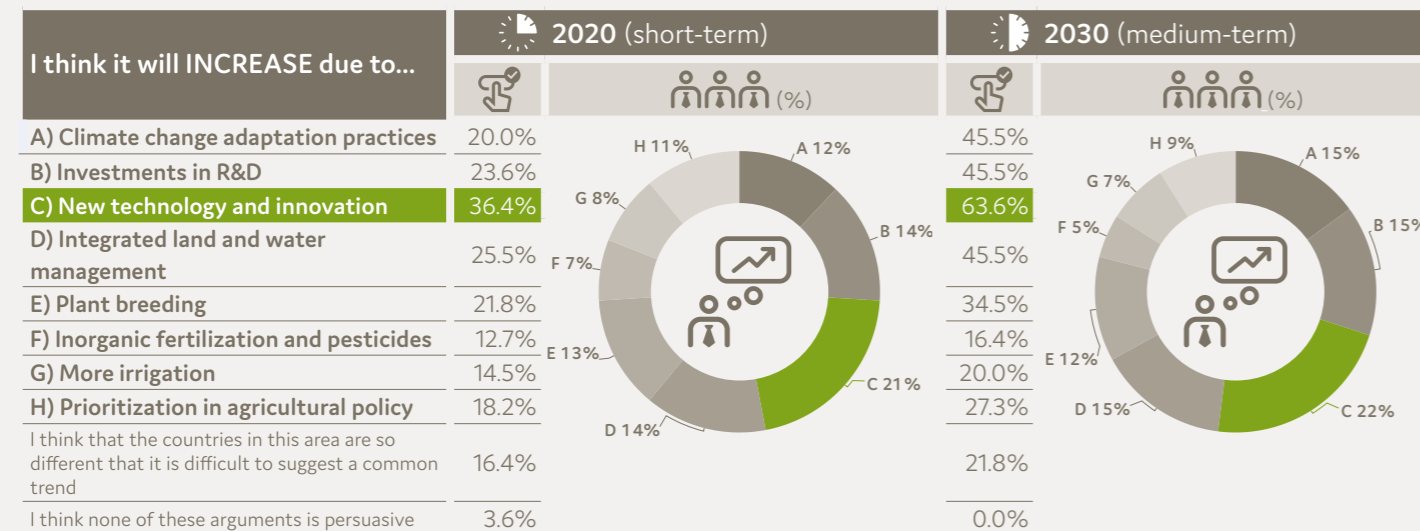
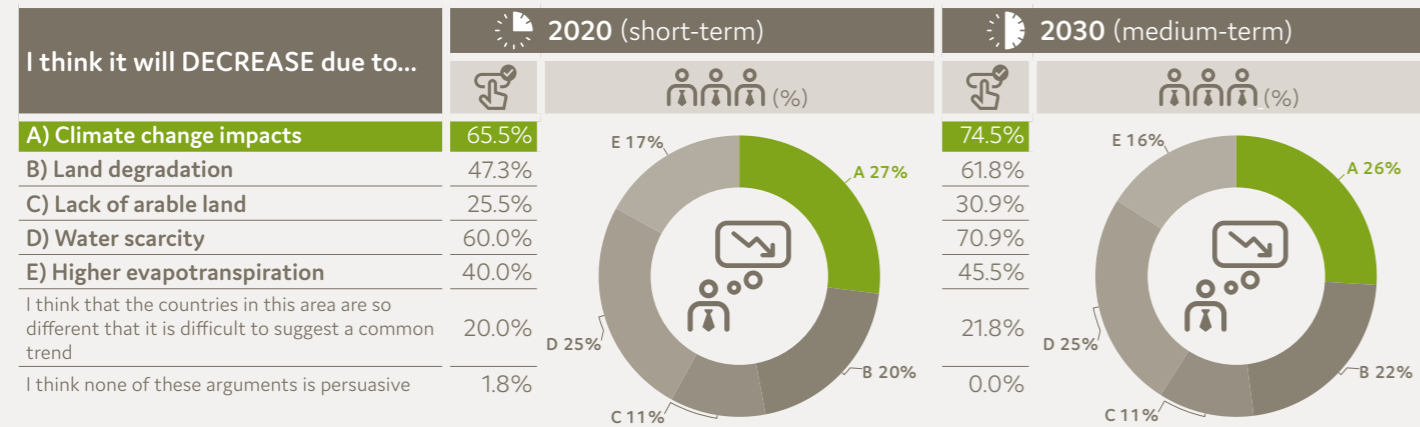
Crop water productivity in the South Mediterranean 2020 (short-term) and 2030 (medium-term)



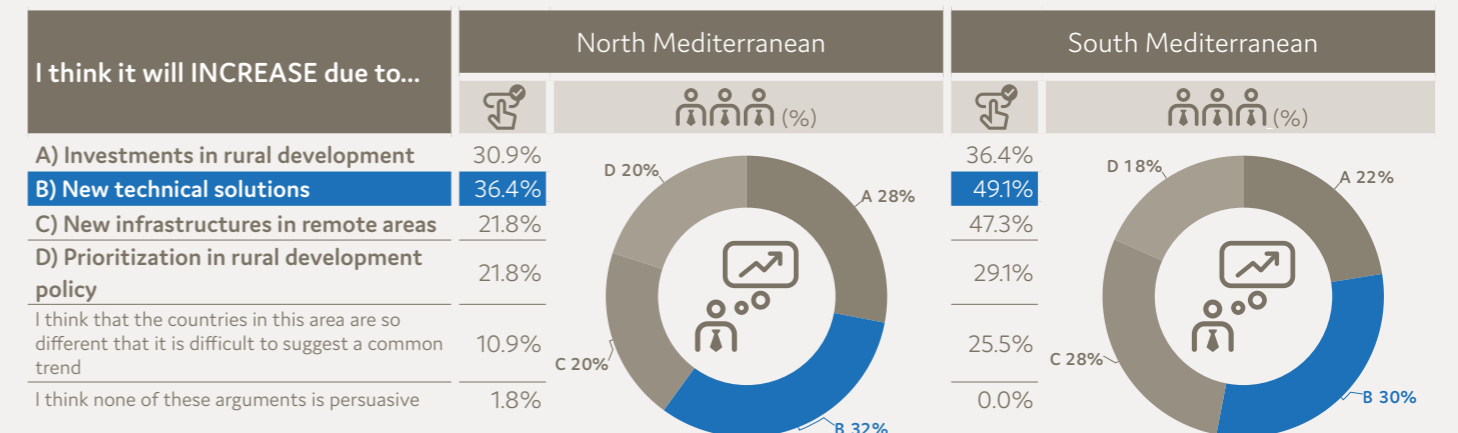
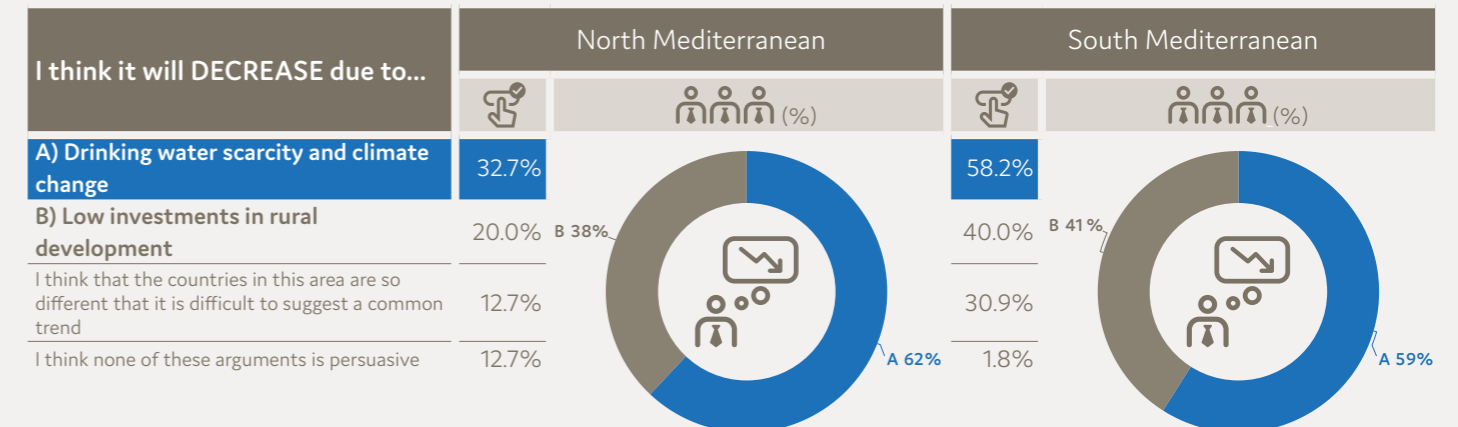
Cereal yield in the North Mediterranean 2020 (short-term)



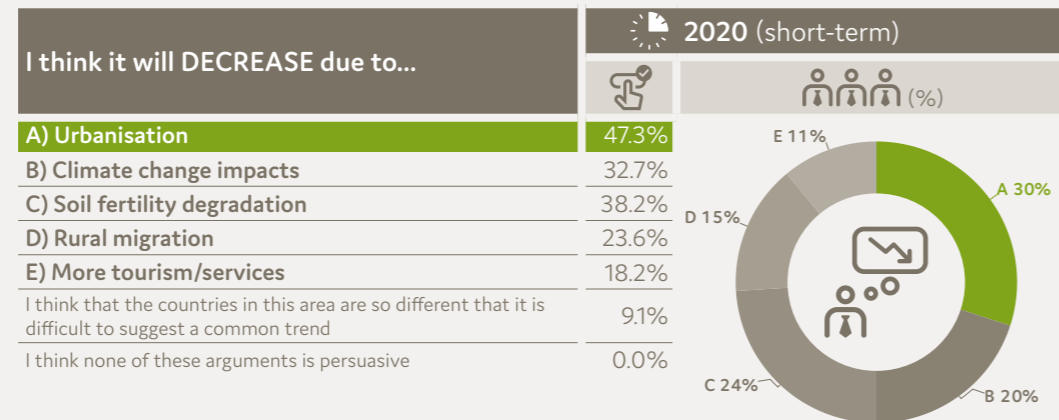
Cereal yield in the South Mediterranean 2020 (short-term) and 2030 (medium-term)



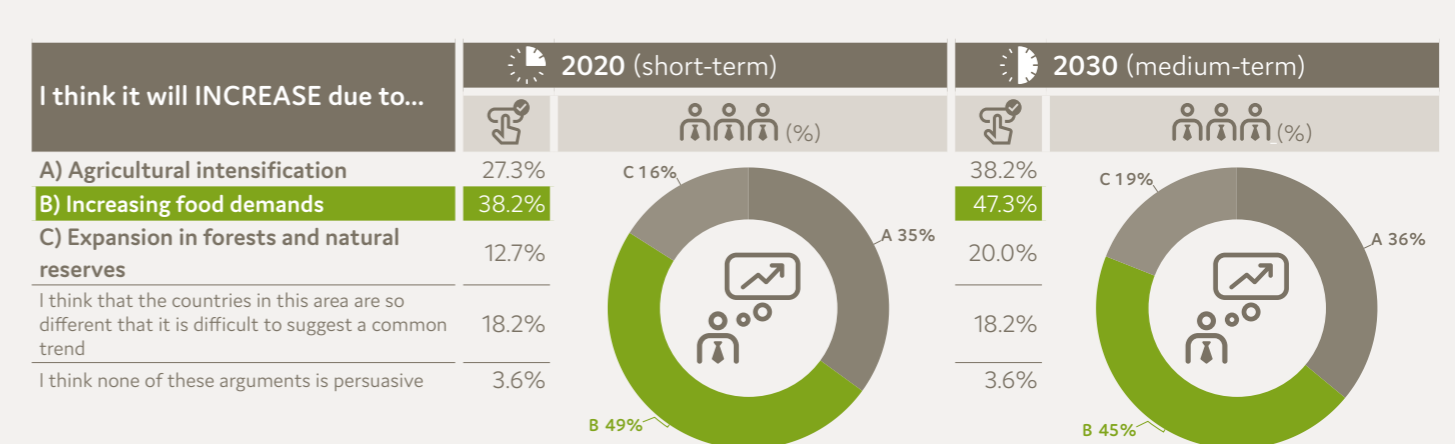
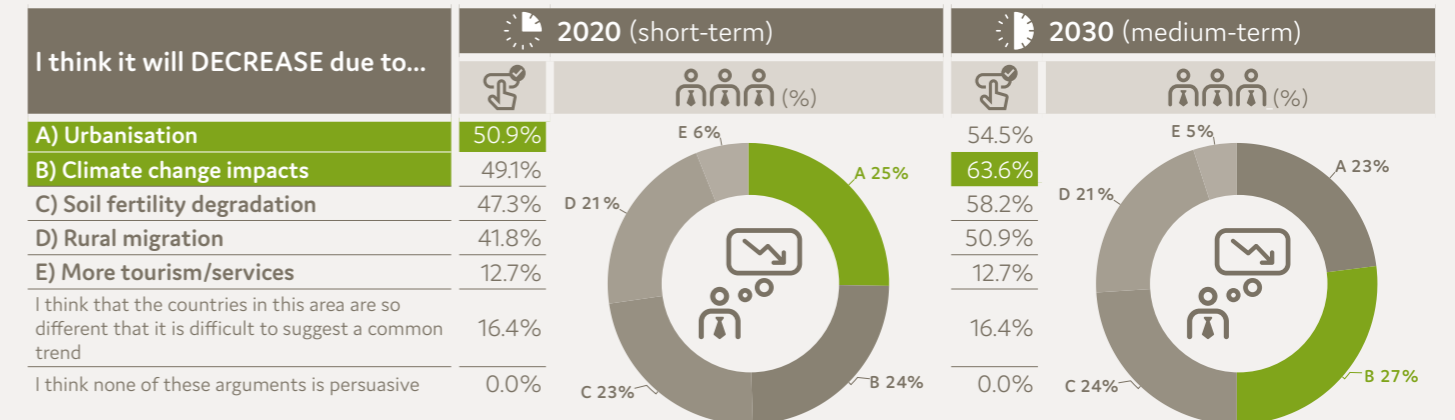
Rural population using improved drinking-water sources in the year 2020 - North and South Mediterranean



Agricultural land in the North Mediterranean 2020 (short-term)

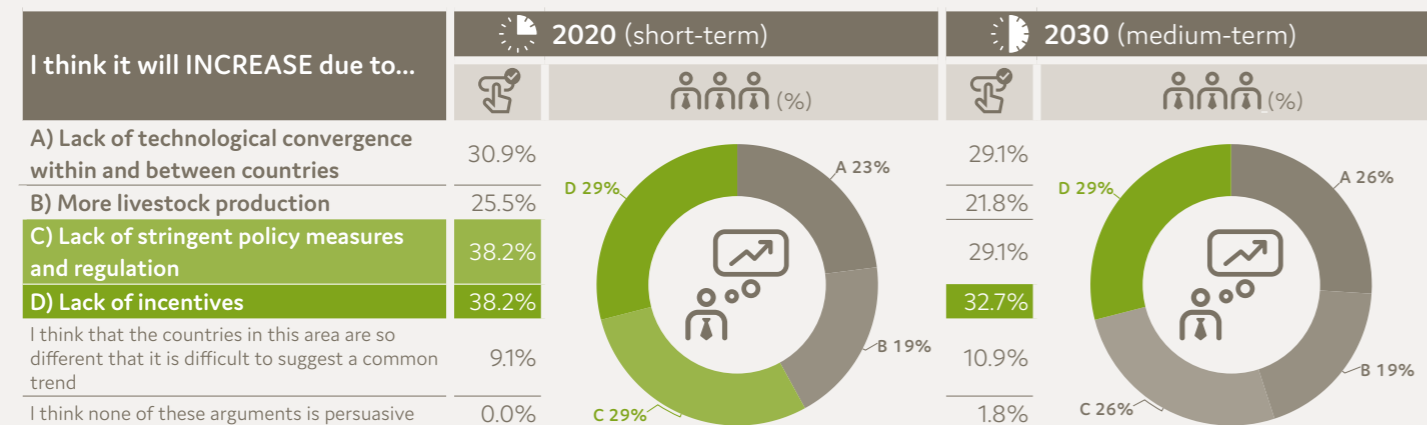
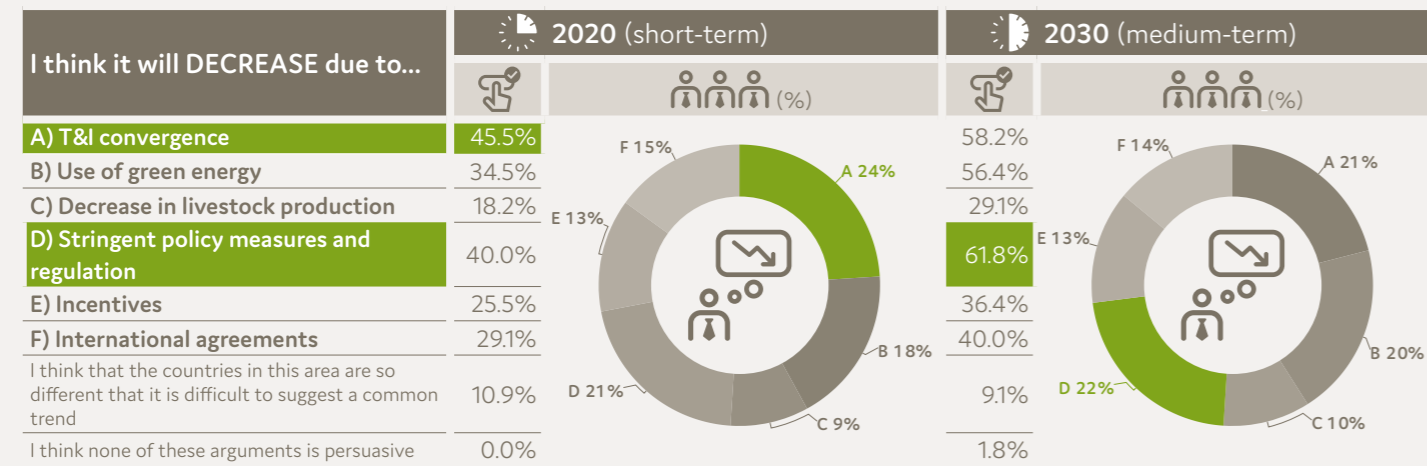


Agricultural land in the South Mediterranean 2020 (short-term) and 2030 (medium-term)



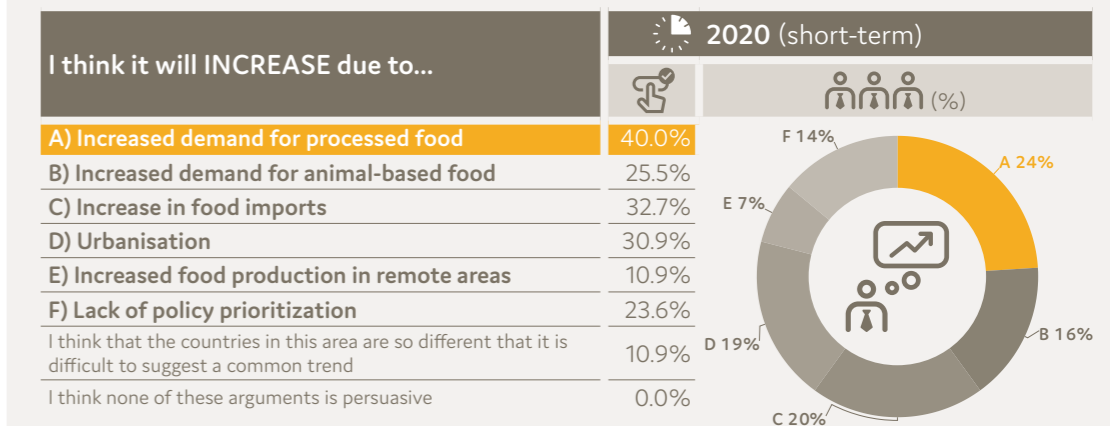
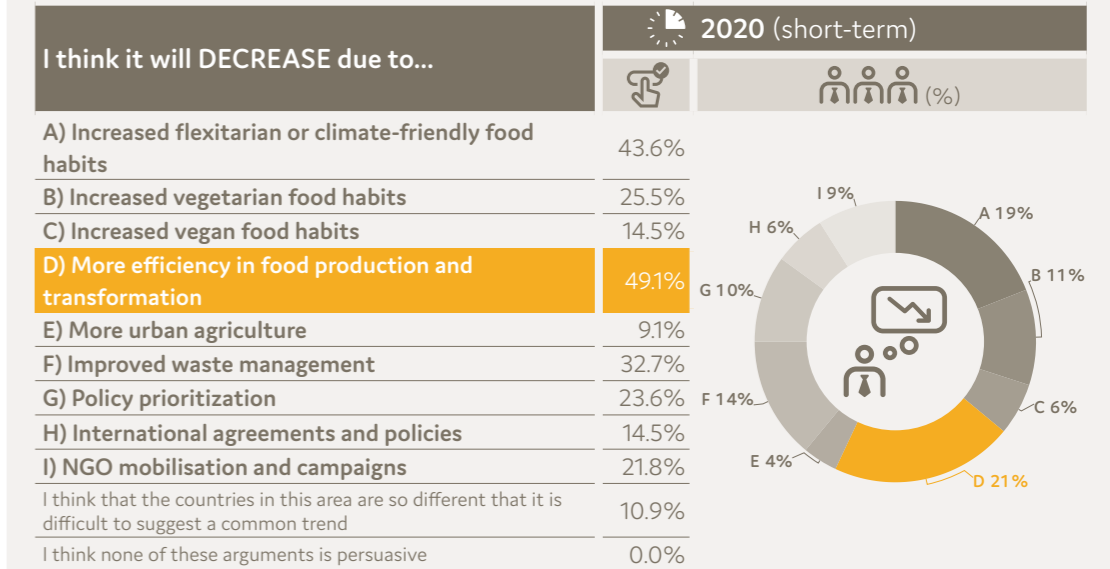
GhG emissions in agriculture in the North Mediterranean

2020 (short-term) and 2030 (medium-term)



Ecological footprint of food consumption

in the North Mediterranean - 2020 (short-term)



Policy options for Water Management areas



SHOULD DO

Manage water resources in Mediterranean countries in an integrated way, that is going beyond the sectorial approach, in recognition of the water-food-energy nexus

Develop binding policies such as the EU Water Framework Directive, at the Mediterranean level



CAN DO NOW

Involve farmers in the use of new technology, e.g. for soil moisture monitoring in Mediterranean countries

Pursue water use efficiency through improvements in distribution networks at the local level

Implement adaptive water management against climate change through effective measures and economic means in National planning in Mediterranean countries

Create integrated water resources and demand management a priority in all Mediterranean countries

Adopt common criteria for the assessment of water resources at the Mediterranean level

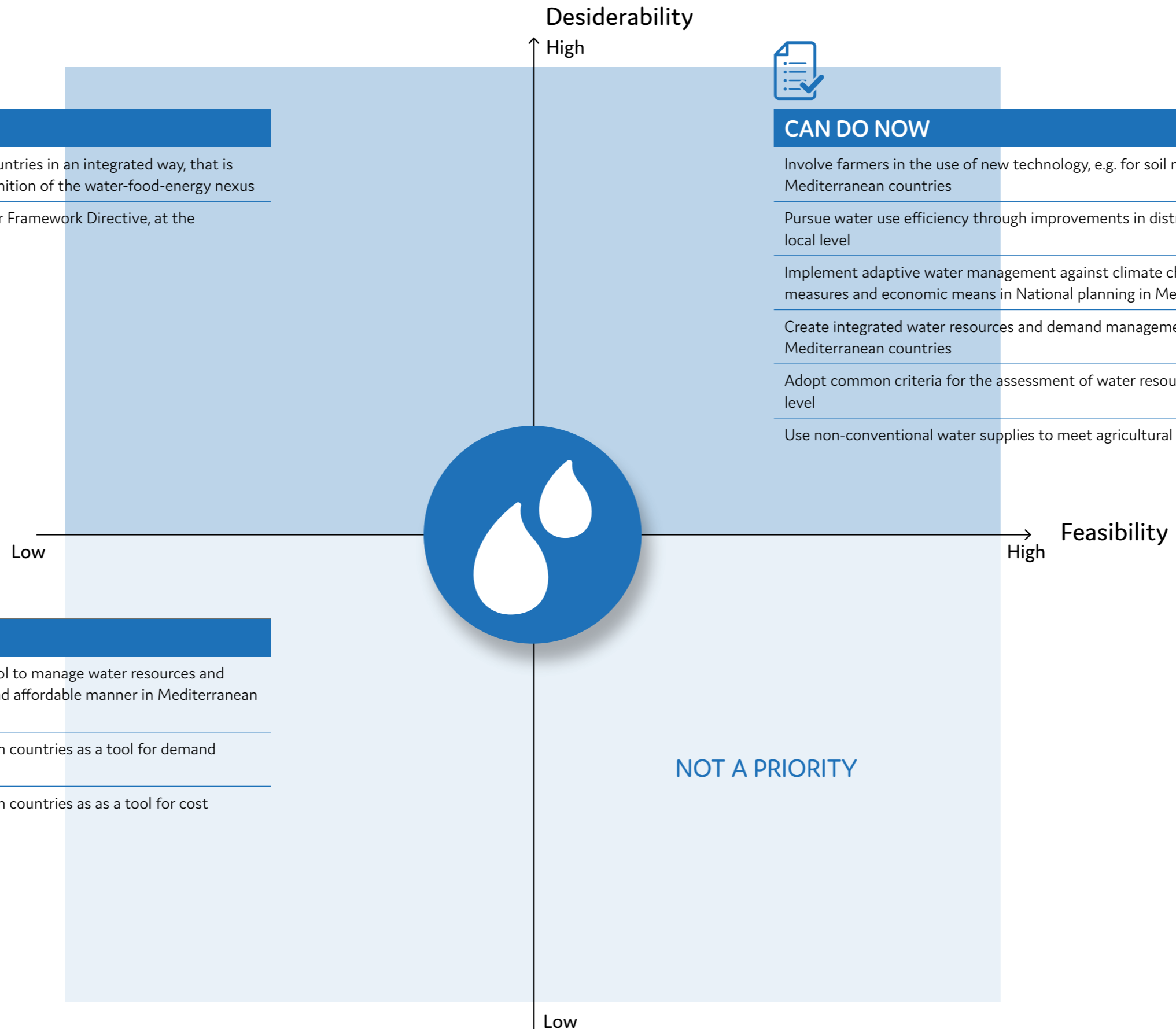
Use non-conventional water supplies to meet agricultural water demands

DON'T DO

Use Public-private partnerships (PPPs) as a tool to manage water resources and finance services in an effective, sustainable and affordable manner in Mediterranean countries

Use irrigation water charging in Mediterranean countries as a tool for demand management

Use irrigation water charging in Mediterranean countries as a tool for cost recovery



Policy options for Farming System areas



SHOULD DO

- Elaborate dual-purpose crops for achieving high yields while maintaining or possibly increasing soil fertility in the long term
- Develop legally binding documents and agreements at the Mediterranean level to make food production carbon neutral by 2050
- Generate value in the agricultural sector in the Mediterranean by means of greater integration and cooperation between Arab/South Mediterranean and the European Union
- Build a unique strategy at the Mediterranean level across plant–animal–human health
- Apply more stringent reporting requirements for food companies

DON'T DO

- Develop a common legal and institutional framework targeting the agricultural sector with a systemic approach at the Mediterranean level
- Include agriculture in carbon markets
- Further restrict the import and movement of plants and plant products to control plant pests and disease
- Control crop pests and diseases through genetic improvement technologies
- Increase the use of biotechnology and GMOs in Mediterranean countries

Desiderability

High



CAN DO NOW

- Stop routine use of antibiotics in healthy animals to promote growth and prevent infectious diseases, as recommended by the World Health Organisation
- Create employment opportunities for rural youth in Mediterranean countries
- Provide incentives for shifting to conservation agriculture to improve soil organic matter and soil quality
- Prioritise investments for sustainable intensification in national agricultural planning and policies
- Increase the proportion of organic farming in Mediterranean countries
- Fostering education on food safety at the household and farmer level
- Improve rural livelihoods by introducing policies that strengthen the role of women in agricultural development (e.g. facilitating lending procedures)

NOT A PRIORITY

- Use social media as a new tool for monitoring plant pests and disease

Low

High Feasibility

Low



Policy options for Agri-food Value Chain areas



SHOULD DO

- Address the technological and managerial innovation gap through increased public spending in research & development
- Establish compulsory targets at the Mediterranean level to reduce food loss and waste
- Develop a legal framework for food safety and risk assessment at the Mediterranean level
- Adopt a common standard at the Mediterranean level to enable cities to quantify and report on food loss and waste
- Increase adoption of primary production technologies (e.g. aquaculture) to increase productivity

DON'T DO

- Adopt a common standard at the Mediterranean level to enable countries to quantify and report on food loss and waste
- Introduce progressive taxes initially on sugary drinks and then on all foods and drinks with added sugar
- Address food supply chain fragmentation in the Mediterranean countries to reduce food safety concerns.
- Address food safety concerns by creating a Mediterranean Food and Drug Authority
- Adopt the same standards to control the safety of locally produced and imported food in Mediterranean countries



Desiderability

High

Low

High Feasibility

Low

NOT A PRIORITY



CAN DO NOW

- Improve public health by providing routine health education at school
- Address the technological and managerial innovation gap through increased collaboration with academia and research
- Strengthen innovation in the agri-food sector through vocational training and engagement of young farmers
- Develop a Mediterranean Protocol to assess the nutritional value of diets in the different Mediterranean countries
- Prevent food waste by banning food retailers from throwing away unsold products by signing donation contracts with non-for-profit organisations
- Prevent food waste by making it compulsory for the private sector to recycle organic waste
- Tackle food waste by means of national legislation
- Strengthen innovation in the agri-food sector through investments in ICTs
- Adopt a common standard at the Mediterranean level to enable companies to quantify and report on food loss and waste
- Strengthen innovation in the agri-food sector through public incentives for the modernization of equipment in agricultural holdings
- Address the technological and managerial innovation gap through increased public spending in R&D



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2019 AGRIFOODMED DELPHI

Trends, challenges and policy options
for Water Management, Farming Systems
and Agri-food Value Chains in 2020-2030



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