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Innovation and Sustainability  
of Agri-Food System  
in the Mediterranean Area

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# Towards food systems transformation in the Mediterranean region: Unleashing the power of data, policy, investment and innovation

JOSÉ VALLS BEDEAU\*, MARYAM REZAEI\*, MASSIMO PERA\*, JAMIE MORRISON\*

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## Abstract

*There is an abundance of actions that could positively change the way food systems operate in the Mediterranean region. However, the uptake of these actions at local level has proven to be slow and often limited in their scope and impact. Considering the diverse nature of agri-food systems challenges in the region, trade-offs in interventions and the diversity of stakeholders, a radical shift from focusing on top-down, global solutions for sustainable food systems, to adapting demand driven, country-led actions is required. This review uses a food systems lens to identify four levers which are essential to “enable” and accelerate the adoption of game changing solutions to food systems challenges by local actors in the Mediterranean region. These are namely: 1) Multi-stakeholder collaboration; 2) Data and evidence; 3) Technological innovation; and 4) Coherent policies and investment. We recognize that each of these enablers is a powerful mean of change, but the evidence suggests that a sustainable and inclusive transformation is only possible when they are deployed together in an integrated and intentional way. Results of this review outline some of the barriers to unlocking the potential of enablers and provide insights on how to use their power to transform Mediterranean food systems.*

**Keywords:** Sustainable food systems, Mediterranean, Agenda 2030, Innovation, Digital technology, Investment, Multi-stakeholder collaboration.

## 1. Introduction

The world’s food systems have undergone notable transitions over the past century, from traditional to more industrial practices, with different degrees of vertical, horizontal and human development. Data and evidence paint a rather grim picture of today’s food systems in terms of their contribution to the Sustainable Development Goals (SDGs). Recent estimates (FAO *et al.*, SOFI 2020a) indicate that globally nearly

690 million people suffer from chronic hunger, further been exacerbated by the COVID-19 pandemic. At the same time, more than two billion people are overweight and obese, and more than three billion people cannot afford a healthy diet. A major contributor to greenhouse gas (GHG) emissions, the global food system is the primary driver of biodiversity loss, continues overuse of freshwater for agriculture, degrades soils and drives down the productive capacity of land (IPCC, 2019).

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The Mediterranean region is not an exception. Population growth, along with demographic changes, urbanization and globalization, are all driving increased food demand and influencing food choices. This has resulted in profound changes in food production and consumption patterns across the Mediterranean. At the same time, the region is affected by the adverse impacts of environmental degradation as a result of climate change, over-exploitation of land and water, desertification and drought, loss of biodiversity, marine pollution and depletion of fish stocks to name a few. Today, the main concern in the Mediterranean region is to provide enough food, in the quantity and quality required to meet the nutritional needs of a growing population, while conserving natural resources and to improve livelihoods. However, the region does have one key ingredient for using food to address these challenges and potentially make agri-food systems more sustainable – the Mediterranean diet. This common heritage shared by Mediterranean countries, despite their cultural and political differences, provides a powerful lever for bridging food sustainable consumption and production.

Acknowledging that “Business as usual” no longer responds to the complexity and challenges of food systems, the Global Sustainable Development Report (UNDESA, 2019) identified food systems transformation as one of the six entry points to radical change needed to achieve the 2030 Sustainable Development Agenda and its goals.

In the review, analysis of results and discussion of this article, we advocate for a food systems approach which adopts a holistic way of thinking and working. This approach looks beyond a specific focus area, to understand the broader system dynamics and objectives and aims to improve the performance of food systems to deliver on multiple sustainability dimensions.

## 2. Methodology

The methodology was developed to respond to three main questions: What are the most powerful levers for accelerating progress towards more sustainable food systems? What are the limiting

factors hindering their transformative potential at local level? How could they be leveraged to deliver impact at scale in the Mediterranean region?

Throughout the review process, we highlight the importance of building the actions based on local contexts, interdependencies between different types of actions at different levels, and put the spotlight on the means for implementation, referred to as “enablers” in this article. The article looks at unpacking the concept of enablers for accelerating adoption of existing solutions to food systems challenges by national and local actors.

A three-step methodological approach included:

1) a brief desk review of existing literature to gather intelligence on barriers to change in food systems and enablers of transformation at global level. This included information which provided an overview of the Mediterranean context, considering the diversity of food systems stakeholders and challenges and opportunities which could affect transition to sustainability. Where possible, the narrative is supported by examples of actions and solutions from different parts of the food system, both at global and regional level and by different stakeholders.

2) an analysis of the information gathered during the desk review to identify the key enablers for system change. The review identified four major enablers which met the criteria of relevance for the region and a track record in driving systemic change – multi-stakeholder collaboration, data and evidence, science and technological innovation, policy and investment.

3) a synthesis of the results of the analysis, highlighting gaps and opportunities for enablers in improving sustainability of food systems, with a focus on the region.

We acknowledge that the list of enablers presented in this article is by no means exhaustive. Diverse factors that contribute to and accelerate progress towards sustainability are often specific to the challenges and contexts of each country and community. In particular, the role of indigenous and local knowledge and practices in sustainability, as well as the human rights approach to food, deserve more attention and specific research to explore their full transformational potential.

### 3. Theoretical background

From adopting nature-positive and regenerative food production practices, to reduction of food loss and waste, and accelerating the shift towards plant-based diets, there is an abundance of actions that could potentially change the way in which food systems operate. However, the uptake of these actions has proved to be slow, limited in scope and ineffective in generating lasting positive impact. The recent progress in identifying barriers to food systems transformation shows that even when solutions are available, there is a significant lack of means to implement them, which often hinders achievement of successful results at scale. In addition, trade-offs and synergies among intended impacts of different actions will also reflect the differences of interests, resources and power inherent to all societies. In this section we will explore the nature of the enablers, their interconnection and importance for accelerating the transformation towards sustainable food systems.

#### 3.1. Multi-stakeholder collaboration

Addressing trade-offs between competing economic, environmental and social objectives requires negotiation amongst different communities and actors with divergent perceptions, interests, resources and power. In many settings, the capacity to manage such trade-offs is limited by asymmetries of power and voice, social and gender inequalities in access to resources and decision-making. This is ever crucial as much of the increase in food production to meet the global food security targets will have to come from the 750 million smallholder farmers that will be operating in 2030, and who at present have little access to institutional, legal or financial support (UNDESA, 2019). Transitioning towards more sustainable food systems requires inclusive and participatory processes in which all stakeholders, in particular the most vulnerable (women, small-scale agricultural producers, Indigenous Peoples, people with disabilities, and poor consumers in urban areas, among others), have regular and informed dialogues to design and develop policies and actions for such a shift. In

recognition of this point, the High Level Panel of Experts on Food Security and Nutrition (HLPE) highlights the importance of agency in decision making, defined as the capacity of individuals or groups to make their own decisions about what foods they eat, what foods they produce, how that food is produced, processed and distributed within food systems, and their ability to engage in processes that shape food system policies and governance (HLPE, 2020).

Similarly, the role of multi-stakeholder partnerships in the promotion of sustainable food systems is widely recognized (HLPE, 2018; UNEP, 2019; HLPE, 2020). The literature illustrates multi-stakeholder collaboration as more than just bringing different stakeholders to the table and recognizes the process of interactive learning, empowerment, co-creation and participatory governance of food systems. These processes allow a more comprehensive analysis of the needs and the eventual impact of the actions, ensure that all stakeholders are committed, accountable and contribute effectively to implementing the agreed actions for moving towards sustainable food systems and achieving results at scale. This is the objective, for example, of the SFS-MED platform, a multi-stakeholder initiative that FAO, CIHEAM and the Union for the Mediterranean Secretariat are developing in the Mediterranean as part of the One Planet Network's Sustainable Food System Programme, and which is featured as a unique opportunity to pilot and validate a "change of route" in the region (Ridolfi *et al.*, 2020) by providing a space for policy, science and technical dialogue in shaping pathways towards more sustainable food systems by 2030.

The complexity of the challenges requires integration of actions and coordination by all stakeholders, across multiple sectors, and across different levels, from the local to the national, regional, and global levels. Local level coordination is closer to the action and specific stakeholders, while global level coordination and international cooperation remains key to addressing the transboundary effects that local or national policies can have on one or more countries or on a global public good (OECD, 2021). In the context of collaboration, the latter is cru-



cial, as countries have different interests, preferences, and policy-making approaches, which can create significant difficulties in achieving international cooperation.

There is no one single approach to establishing successful multi-stakeholder collaboration, as it will depend on each individual context, ongoing processes, moment in time and already existing sectoral and multi-actor coordination mechanisms or bodies. It is, however, important that the performance of multi-stakeholder partnerships is geared towards responding to three result-related qualities: effectiveness, impact and capacity to mobilize resources; and to five process-related qualities: inclusiveness, accountability, transparency, reflexivity and efficiency (HLPE, 2018). A thorough assessment of these processes and qualities can contribute to enhancing the contributions of multi-stakeholder collaboration mechanisms to food systems transformation.

### 3.2. Data and evidence

Sound data analysis can shape policies and investment plans and help identify leverage points in food systems where resource allocation could generate significant and more sustainable impact. However, the accuracy of decision making highly depends on the credibility and reliability of the data and information. In addition to quality data, stakeholders require tools and methods that enable objective analysis of interdependencies and trade-offs, to ensure that the desired transformations are happening at the necessary scale and speed towards sustainability.

What do we mean by “sustainability” in the context of food systems? There is indeed a potentially confusing and counterproductive diversity of views and language being used among countries and other stakeholders when debating what sustainable food systems are and how they can be achieved (SFS Programme, 2020). Whatever the perspective or the entry point applied, the capacity to establish and use relevant indicators to assess the transformation towards more sustainable food systems often depends on the soundness of the conceptual framework

supporting them, including the definition of sustainability dimensions, systems boundaries and methodologies for data collection.

Composite indicators and indices are commonly used as metrics for complex systems, since they can provide an overview of the overall state of all elements of a system instead of analysing individual elements separately. Individual indicators can also provide an overview of the system performance, e.g. through spider graph representations or indicator dashboards, but they present more limitations in illustrating correlations between different outcomes. For instance, there are key SDG indicators that provide measures of different food systems outcomes (SDG2 on hunger and malnutrition, SDG12 on food losses and waste, SDG15 on sustainable use of terrestrial ecosystems, etc.). However, they do not show the interconnection between such outcomes and how they affect each other. In addition, the scope of several SDG indicators goes beyond food systems, and therefore changes, for example, in land use, urban development or prevalence of non-communicable diseases will not necessarily indicate the contribution of changes in food systems.

Several initiatives have emerged in recent years attempting to address the challenge of measuring the sustainability of food systems. At the micro level, i.e., agri-food companies and/or value chains, for example, the “Food and Agriculture Benchmark” developed by the World Benchmarking Alliance (WBA, 2020) takes a holistic approach to assess the role and performance of companies and industries, through a broad set of indicators in four measurement areas: governance and strategy, environment, nutrition and social inclusion; and the FAO’s SFVC Guiding Principles and the VCA4D methodology both focusing on individual agri-food value chains, incorporate social, economic and environmental sustainability metrics to their analysis. At the macro level, i.e., national and global, the National Index on Agri-Food Performance that is being developed as a national sustainability benchmark for Canada’s agri-food sector (DMCI, 2021); Béné *et al.* (2019) developed a global score of food systems sustainability, which comprises 20 indicators for 97 coun-

tries, including a good number of Mediterranean countries, organized into four sustainability dimensions: environment, social, food security and nutrition and economic. Efforts to find an adequate set of indicators to measure progress in the transformation of food systems need to be adapted to the particular context. The Med Diet 4.0 framework (Dermeni *et al.*, 2017) provides a multidimensional and interdisciplinary framework to assess the sustainability of the Mediterranean diet. Going beyond the health-related aspects and benefits, it includes an initial list of potential indicators distributed into four broad thematic areas, i.e. nutrition and health, environment, economy, and society and culture, with country-specific variations.

Indicators – simple or composite –, dashboards and indices can help in providing an accurate view of the status of the performance of a food system or its components, at different levels and different points in time. This is critical to understand the underperformance and key priority areas and leverage points for intervention within the food systems, as well as to monitor the progress in improving them. However, understanding the interlinkages between outcomes, e.g. how a change in one indicator would affect the other indicators of the system, and the causal pathways between specific interventions and sustainability outcomes is still a challenge.

Making informed and evidence-based management decisions to deliver sustainable food systems therefore requires, not only measuring the status of the food system outcomes, but also integrating foresight and trade-off analyses to identify the most appropriate pathways to address the three sustainability dimensions. There is a range of quantitative and qualitative tools and modelling approaches developed to conduct trade-off analysis of agricultural systems (Antle and Valdivia, 2020), including simulation modelling, mathematical programming, econometric models, qualitative approaches and Integrated Assessment Models, Life Cycle Assessment methodologies, although they often present technical limitations in addition to the challenges related to cost and timeliness of data to feed them.

### 3.3. *Technology and innovation*

Much of the literature points to science and technological innovation as a key enabler in accelerating food systems transition towards resilience, inclusiveness and sustainability. The impact of these innovations, however, has not been always positive across multiple actors, in particular in developing countries, and has sometimes resulted in widening the socio-economic gap and gender inequality. Without a holistic approach in identifying appropriate types of innovation, analysing the context for deploying innovations and managing distribution of impacts and outcomes among different stakeholders, innovation could lead to unintentional negative consequences.

Our review mainly focused on technological and digital innovations with the potential of generating equitable economic and social benefits for the communities while having positive impact on natural resource and climate change. This is notwithstanding the vast spectrum of innovations in institutional reform and governance, social innovation, and finance, which could be complementary to and increase effectiveness of technological solutions. Each of these innovations could be a powerful driver of change, but true transformation is only possible through recognition of the interdependencies between various innovation systems.

Historically, farmers and food supply chain actors, inspired by continuous processes of learning and adaptation, have been driving the bulk of innovation in agri-food systems. For many years, the main objective of innovation in the agri-food sector was productivity growth and to increase availability and access to food for communities. The peak of this trend was during the green revolution (1950s to the late 1960s), when large public investment in crop genetic improvement for the major staple crops – wheat, rice, and maize – led to significant increase in yields in developing countries, rising by 208 percent for wheat, 109 percent for rice, 157 percent for maize (Pingali, 2012; FAO, 2004). As a result, the global price of staple crop decreased, and availability of energy dense food lowered the number of hungry peo-

ple in the world. However, as evidence shows, this progress often came at the cost of degraded land and natural resources, loss of biodiversity, deforestation, malnutrition and increasing inequality in food systems. This has defined a new paradigm of “innovation for sustainability”.

In the Mediterranean region, the emergence of digital technology has revolutionized production and the delivery of services in many sectors. However, when compared to other sectors, food and agriculture have been slow to harness the power of these technologies, attracting significantly lower levels of investment and inspiring fewer technology start-ups than other sectors (WEF, 2018). This is in part due to the lack of an enabling policy environment and infrastructure, effective public-private partnership and sustainable investment to tailor innovation to local actors’ needs and challenges. Another major barrier is the limited capacity of farmers and small-scale food producers, who make up the majority of the work force in agri-food systems in southern Mediterranean region, to use and adapt digital technologies in their practices. This is closely linked to the argument made in this article, for moving away from a “top-down” approach and to experiment with collective approaches that recognize farmers and agri-food actors as active innovators (as opposed to passive receivers of innovation). To this end, there are many examples of local initiatives in the Mediterranean region, operating under the tags of “living labs”, “innovation hubs” and “centres of excellence”, which aim at providing an ecosystem for sharing experience among various actors and to facilitate equitable access to technology. These platforms could link the knowledge and insights of farmers to innovator companies and support identifying opportunities for behavioural change, deployment of new technology and for sustainably scaling actions.

The contribution of technology in the sustainability of food systems cuts across all stages and actors. Digital technology could significantly reduce transaction costs – and especially resolve the information asymmetry problem in food systems (FAO, 2020). Artificial Intelligence (AI), big data analytics and cloud computing have resulted in new ways of delivering extension

services. As it becomes possible to tailor services to a specific field and farmer, the incentives for farmers to pay for such services also increases – thus leading to a transition from publicly offered, low-efficient and outdated services towards highly efficient private for-profit services (FAO, 2020).

Our review provides a brief snapshot on many ways in which technological innovation could lead to greener, more profitable and equitable food systems:

1) *Profitability and income (economic sustainability) through improved production* in agriculture, livestock and fisheries. This includes increased yields by optimizing the use of inputs, precision agriculture, reducing losses at pre- and post-harvest stages (through *AgBiotechnology* for pest and disease control), animal health, *Novel farming systems* for predictive and preventive use of artificial intelligence for fish behaviour recognition in aquaculture and open sea fisheries. Value chain optimization by reducing production costs through higher input efficiency, *midstream technologies* for enhanced food safety through better traceability, *agribusiness marketplace* for increasing producer prices, smart contracts and e-commerce; food demand optimization and customized nutrition through big data analysis, improving small producers’ access to suitable financial and insurance products, improved processing and smart packaging, improved logistics of food value chains through *farm management software, remote sensing and IoT*.

2) *Environmental sustainability, climate change adaptation through* reducing impact on natural resources – reduced use of water through vertical farming and smart irrigation systems, desalination, reduction of fertilizers and chemical pesticides, and food loss reduction. Reduction of GHGs – use of renewable energy for food production, digital apps for consumers’ sensitization and *in-store retail and restaurant tech* for food waste reduction, *innovative foods* – new food product development, such as alternative proteins.

3) *Social sustainability through:* use of blockchain for fair trade, producers’ empowerment for negotiation through dissemination of knowledge, digital extension services and peer to peer

exchange to improve information asymmetries through data sharing platforms; job creation and employment for youth and women, through AgTech start-ups incubation/acceleration and digital agriculture; and growth of small and medium sized agribusinesses.

Considering the complexity of challenges facing agri-food systems in the region, technology and digital innovations should be deployed in combination with appropriate policies, social safety nets, inclusive finance mechanisms and capacity building in use and adaptation to deliver the maximum impact.

### **3.4. Policies and investment**

Several policies are in place across the Mediterranean to tackle different food system challenges. They include policies and strategies on domestic production, food subsidies and social protection, sustainable intensification, micronutrient fortification of staple foods and micronutrient supplements, water and sanitation interventions, school feeding programmes, and promotion of healthy diets, among others. However, there are some examples of policy incoherence across the food system in the region, including agricultural policies that crowd out horticultural crops with potentially higher returns and export opportunities than cereals; subsidies for infant formula that inhibit efforts to promote exclusive breastfeeding; and consumer subsidies that promote cheap bread, vegetable oil and sugar, all linked to obesity (FAO *et al.*, 2020b).

A systems approach that leads to considering the broader implications of sectoral policies on several sustainability outcomes may address instances of policy incoherence. For example, self-sufficiency policies subsidizing cereal production through a combination of producer price-support and input subsidies may have negative effects on water use and availability, on the cost of healthy diets (by lowering the prices of energy-dense foods relative to nutrient-rich foods, such as fruits and vegetables), on malnutrition and on food waste. At the same time, increasing the production of nutrient-rich foods may have implications in terms of innovation and investment needed to ensure food safety and

adequate storage, processing and transportation while keeping them affordable for all consumers. Assessing the possible impact of a particular agriculture policy on other dimensions and how it would affect different stakeholders across the food system appears to be key, as well as having all relevant sectors (health, energy, environment, etc.) involved in the policy making process, so that all actions proceed in concert across the entire food system.

The Global Panel on Agriculture and Food Systems for Nutrition distils four distinct objectives that need significant policy shifts to support the transition towards sustainable food systems (GLOPAN, 2020): 1) Making sufficient nutrient-rich and staple foods available to all and produced sustainably, through rebalancing public sector subsidies and agriculture research and development, focusing on both quantity and quality, applying innovative approaches; 2) Ensuring that foods move along value chains more efficiently, improving accessibility for all, through refocusing trade policies, supporting investments in value chains, generating jobs across the food systems and reducing food losses and waste; 3) Making healthy diets affordable to all, by promoting pro-poor growth, refocusing safety nets, adjusting consumer taxes and subsidies, reducing costs through innovation; and 4) Empowering consumers to make more informed food choices, through improving food environments, labelling and advertising, upgrading food based dietary guidelines.

Countries across the Mediterranean are starting to take a more integrated approach towards food systems. One example is the Farm to Fork Strategy, launched in 2020 by the European Union as part of the European Green Deal (European Commission, 2020). The Strategy comprehensively addresses the challenges of sustainable food systems and recognizes the inextricable links between healthy people, healthy societies and a healthy planet, with targeted actions covering every step in the food supply chain, from primary production to consumption and disposal. At the same time, since the EU is the biggest importer and exporter of agri-food products and the largest seafood market in the world, the Strategy is expected to produce significant im-

pacts on third countries, driving change beyond the EU borders.

Sustainable food systems policy coherence calls for systematically considering the pursuit of multiple policy goals in a coordinated way, minimizing trade-offs and contradictions, and maximizing synergies. However, in the real world, developing a coherent policy may force a choice between two or more desirable but competing outcomes. At the same time, coordinating across a large number of policy areas, and potentially across several levels of government, creates transaction costs that need to be balanced with the degree of coherence needed to ensure the desired impact sustainably.

With coherent policies in place, countries need to translate plans into concrete investments. In this respect, the public sector has a crucial role in promoting and enabling sustainable private sector investments.

There is an increasing awareness that to achieve the SDGs and, more specifically, to facilitate the transition to more sustainable food systems, the financing provided through Official Development Assistance (ODA) are below what is needed. According to the Initiative for Smallholder Finance (ISF, 2019), an estimated 270 million households require around USD 240 billion in agriculture and non-agriculture finance. The latest data suggests that financial service providers are currently supplying USD 70 billion to smallholder households, leaving a gap of around USD 170 billion. It is also estimated that there is an annual lending gap of USD 100 billion to agricultural small and medium enterprises (SMEs) in sub-Saharan Africa alone. This gap cuts across all sizes of agricultural enterprises, but is especially prevalent for micro-SMEs as well as mezzanine and equity investments to SMEs. Moreover, the shocking effects of the COVID-19 pandemic on food systems will likely disrupt the demand and the supply of food, both cash and staple crops, in the medium term, and may potentially turn investors away from investments in food production, processing and marketing. Developing countries will have to address a range of challenges, including higher borrowing, threatening inflationary spikes; international investors fleeing to the safety of de-

veloped government assets; and their traditional sources of foreign income (such as commodity exports, remittances and tourism) likely declining, limiting their access to hard currency while the dollar strengthens, which makes debt servicing more challenging. Overall, these obstacles constrain the fiscal space that developing economies need to manage the pandemic.

To bridge this financial gap, public ODA funding is being used more widely to leverage and catalyse private investments towards sustainable food systems, which are generally considered particularly risky as an investment asset – especially at the primary production level – and are unattractive to private lenders and investors. Investments may originate from a range of sources that aim to achieving non-financial outcomes, such as environmental and social impact, and financial outcomes.

In this context, blended finance schemes (blending concessionary loans and grants to incentivize private non-developmental investments) become more and more crucial in de-risking the agricultural sector (by creating public risk buffering mechanisms and thus distributing the risks among different actors) and by providing incentives to invest at a lower cost. Such investments can be based on a variety of instruments: grants, equity, loans, debt and risk mitigation products (guarantees and insurance products, including hedging), all of which can include a “blended” (concessionary) component. The concessionary element within agricultural blended finance transactions can be used to address different challenges. These may include the use of public funds to ensure adequate training through technical assistance, creating market facilitating infrastructure (e.g. collateral registries, warehouses), establishing public grant funds to match private investments (such as the challenge funds), and setting up subsidized guarantee programs and insurance schemes. This was the case of an investment programme developed by the European Bank for Reconstruction and Development (EBRD), FAO and the Tunisian National Oil Office (ONH) to support the olive oil sector in Tunisia. The programme brought all stakeholders working in the sector together around a dialogue platform, as well as

boosted local financial institutions to incentivize an increase of flow of finance to agri-food value chains. This contributed to strengthening the competitiveness of the olive oil value chain actors by introducing best practices and granting producers' access to higher value markets through on-the-job training, mentoring and support for the food safety certifications.

Such blended financing schemes and mechanisms ultimately represent one of the key instruments to keep investments flowing into food systems and enabling the transformation into more sustainable and efficient value chains. To this end, addressing food systems bottlenecks and constraints will be hugely catalytic in getting abundant private sector capital back into circulation.

#### **4. Results and discussion: Towards unlocking the power of enablers**

The review of the logic and nature of different enablers and their dynamics, when viewed through a food systems perspective, reveals many interdependencies between the four enablers. Broadly, redefining policy agendas and approaches to capacity building, governance, monitoring, evaluation and accountability as well as funding, could lead to increasing synergies among desired outcomes to ensure that the function of the enablers is geared towards improving the performance of the system, as opposed to delivering a single benefit. Our analysis highlights some of the barriers to unleashing the potential of enablers, which provides insights on how to use their power to make sustainable and positive change in Mediterranean food system.

Co-designing solutions and bringing about tangible and positive changes cannot happen easily when there is no common understanding of the problem and of the trade-offs emerging between possible alternative actions for food system transformation. A context-specific framework for sustainable food systems in the Mediterranean, supported with relevant data and metrics, could provide a basis for steering collective action and inclusive decision-making. Similarly, multi-stakeholder collaboration across the Mediterranean would require defin-

ing incentives for the participation of all actors, and at all levels (regional, national and local), in policy design, implementation, monitoring and evaluation of outcomes. Ownership and mutual accountability are key in ensuring the effective contribution of all stakeholders, including the most vulnerable. In addition, collaboration may not always take the form of national or local decision-making mechanisms – it can also take the form of innovative engagement modalities to link stakeholders across the food systems, such as participatory guarantee systems and certification schemes that bring together producers, retailers, consumers and other local actors.

Science-based data and evidence is critical in establishing a clear and shared vision on sustainable food systems in the region, and in translating it to effective policies and investments. However, there are quantitative and qualitative data gaps on food systems performance at country level, including on use of water and energy, affordability of diets, household food consumption, food distribution channels and retail, among others. Besides data availability issues and given that different stakeholders often have their own priorities and agendas, the results of data analysis will vary depending on the entry points and objectives considered, which may range from improving nutrition to enhancing economic profitability or reducing GHG. Improving stakeholders' consultation processes and transdisciplinary research can provide holistic sustainability assessments that analyse the correlation between different dimensions in order to identify trade-offs and synergies to be considered in the development of integrated solutions. Furthermore, making the evidence usable by decision-makers will determine its power to ensure sustainable impact at scale.

Evidence can also help in developing and deploying new technologies and food systems innovations, ensuring that they are fit for purpose and respond to the market demand and stakeholders needs. Currently the bulk of technological innovation in the Mediterranean region is being developed and deployed by for-profit entities, including private sector companies. This has led to concentration of these solutions in the hands of medium and large-scale commer-

cial farmers with high financial turn-over and established access to markets, who could guarantee the return for investment for the private sector innovation developers. Public interventions may establish a conducive ecosystem on both supply and demand of digital technologies for agriculture and food systems in the region to drive responsible investment for inclusive access to technology. Multi-stakeholder collaboration has a key role in addressing issues of digital divide and of concentration of market power in the hands of one segment of stakeholders which could lead to imperfect competition, information asymmetries, high transaction cost in particular in case of sudden disruption of services as well as externalities. Such interventions should be coupled with capacity building at different levels to increase literacy on the impact of technological innovation, for example, through improved extension services in rural areas and partnership with academia in particular targeting women and youth for the adoption of technological solutions. Capacity may also be built for relevant public authorities to understand the implications on national regulations of digitalization in the agri-food sector to enable appropriate and timely response to market needs.

This review indicates that smallholder farmers and producers, in particular youth and women and other marginalized groups, are also less attractive counterparts for financial institutions and investors, as they could entail higher risks for their capital. More inclusive and equitable business models, and the establishment of facilities and pools of funds may improve the operations and profitability of small and medium agribusinesses, contributing to increased investor returns, trust and incentivizing potential future investments. In several countries of the Mediterranean region, public funds and technical assistance are used to ensure that investors and policymakers have access to smart subsidies, such as lines of credit, matching grants, guarantee schemes and technical assistance facilities, to make inclusive sustainable investments succeed. In many cases, technical assistance facilities can strengthen the commercial viability and development impact of agribusinesses that source

from smallholders, to increase attractiveness and impact of their supply chains. Recent literature illustrates that de-risking investments often involves the promotion of solution-oriented and evidence-based dialogue between private and public value chain players, as well as supporting an enabling policy and regulatory environment for investment across the food system. Establishing linkages between food systems stakeholders and financial institutions, both public and private, in the Mediterranean region, is indeed considered an effective vehicle to facilitate the emergence of concrete investment projects that can support the shift towards more sustainable food systems.

## 5. Conclusions

Resilient, inclusive and sustainable food systems have been identified as a key entry point for accelerating progress towards the achievement of the Sustainable Development Goals, but for this an innovative vision and clear change pathways need to be in place. It is the interactions between the actions of all actors across the food system, shaped by the characteristics of the unique policy, institutional and agro-ecological settings in which they operate, that determine the extent to which a food system will deliver accessible, affordable, safe and nutritious food, generate and equitably share wealth, and sustainably use the natural resource environment.

The engagement of actors and their commitment to implement a set of transformative actions is essential to achieve food systems transformation in the Mediterranean region. However, a number of factors such as science-based data, multi-stakeholder collaboration, innovation, policies and investment, are needed to enable a meaningful impact at the local level. When adequately combined and adapted to each specific context, these enablers have the power of shifting the way different stakeholders think and work together in translating policies into effective actions. To optimise their impact at scale and ensure a long-term transformative effect, enablers should be considered as inter-dependent elements to be incorporated into the plans and strategies in a balanced and targeted way.

Further analysis is needed to improve the collective understanding of how food systems operate in the Mediterranean, in particular regarding all three dimensions of sustainability, and to identify key entry points for boosting progress towards achieving the SDGs. Indeed, although many initiatives of different stakeholders have been emerging in support of more sustainable food systems, they often lack a common framing of the complex interactions, dependencies and trade-offs intrinsic to these systems. Capacities need to be developed across all stakeholders on what a sustainable food systems approach is, and what it entails in their own context. At the same time, further dialogue and cooperation is required among Mediterranean countries and stakeholders to build a shared vision on sustainable food systems and on how to best use policies, science, innovation and investments to accomplish it.

*Disclaimer:* The views expressed in this article are those of the authors and do not necessarily reflect the views of the Food and Agriculture Organization of the United Nations.

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